

INVITATION FOR BIDS (IFB)

No. PCCD-21-PCW2Upgrade-03

September 2, 2021

**UPGRADE
of
Plum Creek Watershed
Floodwater Retarding Structure Site 2
Hays County, Texas**

**Contracting Local Organization
Plum Creek Conservation District
Lockhart, Texas**

**Sponsors
Caldwell-Travis Soil and Water Conservation District
Hays County Soil and Water Conservation District
Plum Creek Conservation District**

In cooperation with:

Texas State Soil and Water Conservation Board

PLAN HOLDER REGISTRATION FORM / TERMS & CONDITIONS

Invitation for Bids (IFB) No. PCCD-21-PCW2Upgrade-03

Plum Creek Watershed, Floodwater Retarding Structure Site 2 – UPGRADE

It is the responsibility of all persons who download bid documents to REGISTER as a Plan Holder with the Plum Creek Conservation District (PCCD). Registered Plan Holders will be advised via email or other means of all IFB Amendments that are issued, and all Amendments will be available for downloading at the Plum Creek Conservation District website: <http://pccd.org> (**Job Bids tab**). A bidder's failure to acknowledge receipt of an IFB Amendment (see IFB PART I, Subpart B, Instructions to Bidders) may result in rejection of the sealed bid.

TO REGISTER, please fill out information below (all fields are mandatory) and submit form via:

FAX to 512-398-7776 (Attention: Daniel Meyer, PCCD Executive Manager)

-- or --

Scan and EMAIL completed form to **both** of the following email addresses:

daniel.meyer@pccd.org

jamaynard1@msn.com

SIGNATURE (Contact Person listed below): _____

Company Name: _____

Contact Person/Title: _____

Mailing Address: _____

Physical Address: _____

Office Phone: _____ Mobile: _____ FAX: _____

Email Address: _____

Bid documents for this project may be downloaded from this site, for bidding purposes only, if the User agrees, without exception, to the following terms and conditions:

The User agrees that electronic media documents downloaded from this site are for their use in preparation of their bid and are offered as a convenience to the User. Use of these materials for any other purpose shall be without liability to Plum Creek Conservation District and their consultants. The User acknowledges and agrees that Plum Creek Conservation District's instruments of service are the printed hard copy (as amended) of the Invitation for Bids issued for the respective project as available for viewing at the Plum Creek Conservation District office. In the event of a conflict in their contents, the printed hard copy shall take precedence over the electronic media. Plum Creek Conservation District's electronic media are furnished without guarantee of compatibility with the bidder's software or hardware. It is the User's responsibility to determine/evaluate the capability of their equipment to provide documents that are accurate for size, scale, and content.

If the User elects to only download partial information (selected sheets of the drawings or pages of the specifications), they shall be responsible to obtain all pertinent bidding information to adequately and accurately prepare their bid proposal. The User is responsible to include in their proposal all of the Required Bid Information as specified in IFB PART I, Subpart B, Instruction to Bidders #3.

The User agrees to indemnify, defend and hold harmless the Plum Creek Conservation District, their consultants and the officers and employees and any of them from and against any and all claims, suits, losses, damages or costs, including attorney's fees, arising from or by reason of the User's use of these electronic media documents.

TABLE OF CONTENTS**IFB NO. PCCD-21-PCW2Upgrade-03**

	<u>PAGE NO.</u>
<u>PART I – GENERAL PROVISIONS</u>	
Subpart A Notice to Bidders	GP-1
Subpart B Instructions to Bidders	GP-2
Subpart C BID FORMS (Exhibits A-E)	GP-7
Subpart D Sample Contract Agreement	GP-17
<u>PART II – GENERAL CONDITIONS</u>	GC 1-17
<u>PART III – SUPPLEMENTAL CONDITIONS</u>	SC 1-9
<u>PART IV – SPECIFICATIONS</u>	
Construction and Material Specifications	
<u>PART V – DRAWINGS</u>	
COVER + Sheets 1 through 71	
<u>PART VI – PREVAILING WAGE RATES DETERMINATION</u>	
Wage rates listing: 1 Page	

PART I – GENERAL PROVISIONS
SUBPART A

NOTICE TO BIDDERS

Sealed bids for furnishing all labor, material and equipment and performing all work required for UPGRADE of Plum Creek Watershed, Floodwater-Retarding Structure Site 2 will be received until **10:00 a.m. local time, Thursday, September 30, 2021**, at Plum Creek Conservation District (PCCD) office, 1101 West San Antonio Street, Lockhart, TX 78644, or may be mailed to this address. Promptly after 10:00 a.m. all bids received will be publicly opened.

Bids must be addressed to the attention of Daniel Meyer, PCCD Executive Manager, and mailed (or hand carried) to the above address in a sealed envelope (placed inside the mailing envelope, if any) labeled as follows:

- (1) IFB No. PCCD-21-PCW2Upgrade-03
- (2) Bid Opening Date / Time: September 30, 2021 – 10:00 A.M.
- (3) Name and Address of Bidder

There will be a **pre-bid conference** beginning at 9:30 a.m., Tuesday, September 14, 2021, to be held at PCCD office, 1101 West San Antonio Street, Lockhart, Texas. The conference will be followed by a site showing of the project site. Attendance is not mandatory. However, prospective bidders are HIGHLY ENCOURAGED to attend the conference and site showing.

All bids require a bid guarantee in the amount of not less than five percent (5%) of the total bid. Requirements are outlined in PART I, Subpart B, Instructions to Bidders. The successful bidder will be required to submit payment and performance bonds within 5 (five) workdays after receipt of Notice of Award per PART III, Supplemental Conditions, Article 13.

ESTIMATED PRICE RANGE: Between \$5,000,000 and \$7,000,000

Plum Creek Conservation District reserves the right to reject any and all bids. Bids providing less than 30 calendar days for acceptance will not be considered and will be rejected. Telegraphic or facsimile (Fax) bids, modifications, or withdrawals are not authorized.

Plum Creek Conservation District is the Contracting Local Organization (CLO) responsible for soliciting and awarding a local contract for this project. The contract is receiving State funding from the Texas State Soil and Water Conservation Board.

COVID-19 Alert: Anyone entering the PCCD office building is encouraged to follow guidelines of the CDC. By entering those attending will represent to PCCD that they are aware of CDC recommendations to avoid the spread of the Virus and, to the extent possible, are compliant with the recommendations; that they are not having symptoms of the Virus as described by the CDC and/or the Texas Department of State Health Services; and have not knowingly been in contact with others who have such symptoms.

PLUM CREEK CONSERVATION DISTRICT

**PART I – GENERAL PROVISIONS
SUBPART B**

INSTRUCTIONS TO BIDDERS

1. **Submission of Bids / Bid Opening:** Bids in response to this Invitation for Bids (IFB) must be sealed, marked and addressed as directed in the Notice to Bidders. Failure to do so may result in a premature opening of, or a failure to open, such bid. Bids will be publicly opened at the time set for opening in the Notice to Bidders. Their content will be made public for the information of bidders and others interested, who may be present either in person or by representative.
2. **Conditions Affecting the Work:** Bidders should visit the site and take such other steps as may be reasonably necessary to ascertain the nature and location of the work, and the general and local conditions which can affect the work or the cost thereof. Failure to do so will not relieve bidders from responsibility for estimating properly the difficulty or cost of successfully performing the work. The Contracting Local Organization will assume no responsibility for any understanding or representations concerning conditions made by any of its officers or agents prior to execution of the contract, unless included in the invitation for bids, the specifications, or related documents.

NO digging or taking of core samples will be allowed. Persons visiting the site are asked to take due care to ensure the existing site conditions are not disturbed.

Appointment Required to Visit the Project Site: Please contact Daniel Meyer, PCCD Executive Manager (phone 512-398-2383) to make an appointment for an authorized person to accompany you to the project site. No unescorted visits to the site are allowed.

3. **Required Bid Information:** Forms which must be included in a bid are:
 - (a) Exhibit A: Offer with appropriate 5% BID GUARANTEE.
 - (b) Exhibit B: Bid Schedule.
 - (c) Exhibit C: References.
 - (d) Exhibit D: Bid Bond form.
If a bid bond is submitted as the required bid guarantee, it must be executed on this form and in conformance with other requirements in these Instructions to Bidders.
 - (e) Exhibit E: Bidder Certifications.
Bidder must complete all applicable certifications and include in his/her bid.
4. **Preparation of Bid:** The bidder must submit his/her offer IN DUPLICATE (original plus one copy) on the forms furnished in this IFB, and the bid must be manually signed by a person or persons with authority to legally bind the individual, firm or corporation. If erasures or other changes appear on the forms, each erasure or change must be initialed by the person signing the bid. Facsimile (Fax) and telegraphic bids, modifications, or withdrawals will not be considered.

No bid will be considered unless all items in the bid schedule are priced. In case of error in the extension of price, the unit price shall govern. For other than bid items with a lump-sum "unit," the quantities listed in the bid schedule on which unit prices are requested are estimates only. Unless called for, alternate bids will not be considered.

Estimated Price Range: Between \$5,000,000 and \$7,000,000

Exemption from State, County, and Municipal Sales and Use Taxes. See Part II – General Conditions, Article 29 (Federal, State, and Local Taxes), paragraph (b). ***Bidders are entitled to EXCLUDE exempt taxes in their bid prices.*** Bidder is solely responsible to determine what tangible personal property and taxable services are eligible for exemption from these taxes.

Electronic Invitation for Bid (IFB) Documents. The IFB documents and IFB Amendments are available to interested parties electronically only, and no printed copies will be distributed. The Plum Creek Conservation District's instruments of service are the printed hard copy of the IFB (as amended) available for viewing at the Plum Creek Conservation District office. In the event of a conflict in their contents, the printed hard copy (as amended) shall take precedence over the electronic media. Plum Creek Conservation District's electronic media are furnished without guarantee of compatibility with the bidder's software or hardware. It is the user's responsibility to determine/evaluate the capability of their equipment to provide documents that are accurate for size, scale, and content. If an alteration of any kind to the CLO's printed hard copy IFB (as amended) is only discovered after the contract is executed and is or is not being performed, the contract is subject to immediate cancellation. Website to obtain documents (Adobe PDF format) is:

www.pccd.org

Click on Job Bids tab; then on IFB No. PCCD-21-PCW2Upgrade-03,
Plum Creek Site 2 – UPGRADE

5. **Submission of Offer in English Language/U.S. Currency:** Offers shall be in the English language and in terms of U. S. dollars or will be rejected.
6. **Explanation to Bidders / Inquiries:** Any explanation desired by a bidder regarding the meaning or interpretation of the invitation for bids, drawings, specifications, etc., must be requested in writing and with sufficient time allowed (**by noon on September 21, 2021**) for a reply to reach bidders before the submission of their bids. Any interpretation made will be in the form of an amendment to the invitation for bids, drawings, specifications, etc., and each Amendment will be available electronically. The CLO will make a reasonable attempt to advise (via email or other method) all prospective bidders who have registered as a bid documents holder or that may otherwise be known to have received a copy of the bid documents when an IFB Amendment is available electronically. However, it is the bidder's responsibility to check the electronic bid documents website for any changes or additions to the documents originally posted. Receipt of all amendments must be acknowledged by the bidder in the space provided on the bid forms (PART I, Subpart C, Exhibit A, Offer) or by letter received before the time set for opening of bids (electronic, Fax, and telegraphic acknowledgements will not be accepted). All amendments will be bound with and made a part of the contract documents. Oral explanations or instructions given before the award of the contract will not be binding. Written requests shall be mailed, hand delivered, or sent via facsimile machine or email (telegraphic inquiries will not be accepted) to :

Daniel Meyer, Executive Manager, Plum Creek Conservation
District, 1101 West San Antonio Street, Lockhart, TX 78644
FAX #: 512-398-7776 EMAIL: **daniel.meyer@pccd.org**

"Facsimile," as used in this section means a written inquiry or request for explanation that is transmitted to and received by the Contracting Local Organization (CLO) via electronic equipment that communicates and reproduces both printed and handwritten material. Facsimile receiving data and compatibility characteristics are as follows: (a) Telephone number of receiving facsimile equipment: **512-398-7776**. (b) If you choose to transmit a facsimile inquiry, the CLO will not be responsible for any failure attributable to the transmission or receipt of the facsimile inquiry including, but not limited to, the following: (1) Receipt of garbled or incomplete inquiry. (2) Availability or condition of the receiving facsimile equipment. (3) Incompatibility between the sending and receiving equipment. (4) Delay in transmission or receipt of the inquiry. (5) Failure of the sender to properly identify the inquiry. (6) Illegibility of the inquiry.

7. **Bid Guarantee:** As a good faith deposit to ensure execution of a contract, each offer must be accompanied by a bid guarantee in the form of a certified or cashier's check (on a responsible bank in Texas) or bid bond, in the amount of not less than five percent (5%) of the total bid. Bid guarantee is to be made payable to: PLUM CREEK CONSERVATION DISTRICT. Bid guarantees, other than bid bonds, will be returned (a) to all bidders (except the three most qualified) within 3 days of the bid opening, and (b) to the three most qualified bidders upon execution by the most qualified bidder of such further contractual documents and bonds as may be required by the bid as accepted. When a bid guarantee is

required, failure to furnish a bid guarantee in the proper form and amount, by the time set for opening of bids, may be cause for rejection of the bid.

Should the bidder to whom the contract is awarded fail or refuse to enter into a proper contract with the CLO, or fail or refuse to furnish the payment and performance bonds required by PART III, Article 13, or fail or refuse to provide additional Post-Award Information required by PART III, Article 4, within the time specified, the bidder forfeits the bid guarantee, and/or the CLO may pursue any other action allowed by law.

8. **Bid Bond Requirements:** Bond must be executed on the form provided (PART I, Subpart C. Exhibit D) by a corporate surety authorized and admitted to write surety bonds in the State of Texas. The surety must (i) hold a certificate of authority from the United States Secretary of the Treasury to qualify as a surety on obligations permitted or required under federal law; or (ii) have obtained reinsurance for any liability in excess of \$1,000,000 from a reinsurer that is an authorized reinsurer in the State of Texas or is a holder of a certificate of authority from the United States Secretary of the Treasury to qualify as a surety or reinsurer on obligations permitted or required under federal law. U.S. Treasury Department Circular 570 is published in the *Federal Register* and lists Treasury approved surety companies and their underwriting limitations. All bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act. The original and one copy of bid bond shall be submitted with the bid.
9. **Late Submissions, Modifications, and Withdrawals of Bids:**
 - (a) Any bid received at the office designated in the solicitation after the exact time specified for receipt will not be considered and will be returned to the bidder unopened.
 - (b) Any modification or withdrawal of a bid is subject to the same conditions as in paragraph (a) of this provision.
 - (c) The only acceptable evidence to establish the time of receipt at the Contracting Local Organization installation is the time/date stamp of that installation on the bid wrapper or other documentary evidence of receipt maintained by the installation.
 - (d) Notwithstanding paragraph (a) of this provision, a late modification of an otherwise successful bid that makes its terms more favorable to the Contracting Local Organization will be considered at any time it is received and may be accepted.
 - (e) Bids may be withdrawn by written notice received at any time before the exact time set for receipt of bids. A bid may be withdrawn in person by a bidder or its authorized representative if, before the exact time set for receipt of bids, the identity of the person requesting withdrawal is established and the person signs a receipt for the bid.
 - (f) If an emergency or unanticipated event interrupts normal Contracting Local Organization processes so as to cause postponement of the scheduled bid opening, and urgent Contracting Local Organization requirements preclude amendment of the solicitation or other notice of an extension of the opening date, the time specified for receipt of bids will be deemed to be extended to the same time of day specified in the solicitation on the first work day on which normal Contracting Local Organization processes resume.
10. **Tie Bid:** In the event of receipt of two or more bids from responsible bidders that are identical, in nature and amount, as the lowest and best bids, the Contracting Local Organization shall enter into a contract with only one of those bidders and must reject all other bids. The bidder shall be selected by the casting of lots in a manner prescribed by the Contracting Local Organization. All qualified bidders or their legal representatives may be present at the casting of lots. This provision does not prohibit the Contracting Local Organization from rejecting all bids.
11. **Qualification of Low Bidder:**
 - (a) After the low bidder has been determined, the next step is to consider the bidder's qualifications to perform the proposed contract. The award of a contract to a bidder solely on the basis of the lowest price is not the policy of the Contracting Local Organization. The ability to obtain bonds does not necessarily qualify a bidder for award.

- (b) A contract may be awarded only after it has been determined that the bidder is qualified to perform the contract. Qualification reviews will be made of all pertinent factors including: financial resources or ability to obtain them; present or impending work commitments; record of past performance on comparable projects; business ethics and integrity; eligibility to receive an award under applicable laws and regulations; the necessary organization, experience, operational controls and technical skills or the ability to obtain them; and the necessary equipment or ability to obtain it, as may be needed to prosecute the work in an expeditious, safe and satisfactory manner.
 - (c) If the bidder does not have adequate equipment but plans to obtain it after contract award, a firm commitment in writing from the suppliers must be furnished to the Contracting Local Organization. Also, if the bidder proposes to subcontract part of the work, they must provide information needed for the Contracting Local Organization's evaluation of the subcontractor's capability.
 - (d) Before disqualifying the low bidder, the Contracting Local Organization will inform the bidder of the reason for the proposed disqualification.
12. **Disqualification of Bidders:** Listed are some of the causes which may be considered as sufficient for the disqualification of a bidder and the rejection of his/her offer:
- (a) Failure to conform to the essential requirements of the invitation for bids (e.g., incomplete offer) will result in rejection of the bid.
 - (b) Bids from parties who are presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency, or from party presently on the State of Texas debarred vendor list maintained by the Texas Comptroller of Public Accounts, will be rejected. [See certification in PART I, Subpart C, Exhibit E, Section G.]
 - (c) More than one offer for the same work from the same individual, firm, partnership or corporation.
 - (d) Qualifying statements or accompanying qualifying letters that modify requirements or limit the bidder's liability will be cause for rejection of bid.
 - (e) Evidence of collusion among bidders.
 - (f) Poor performance in the execution of work under previous contracts, as determined by the Contracting Local Organization.
 - (g) Being in arrears on existing contracts, in litigation with the Contracting Local Organization, or having defaulted on a previous contract.
 - (h) Lack of comparable project experience.
 - (i) The bid is materially unbalanced. I.e., a bid based on prices significantly less than cost for some work and prices which are significantly overstated in relation to cost for other work, and there is reasonable doubt that the bid will result in the lowest overall cost to the Contracting Local Organization even though it may be the low evaluated bid.
13. **Submission of Post-award Information:** Within five (5) workdays after receipt of Notice of Award, Contractor will be required to submit post-award information as specified in PART III, Supplemental Conditions, Article 4.
14. **Award of Contract:** Award of contract will be made to that responsible bidder whose bid, conforming to the invitation for bids (IFB), is most advantageous to the Contracting Local Organization, price and other factors considered. The Contracting Local Organization may, when in its interest, reject any or all bids or waive informalities or minor irregularities in bids received. Only one contract will be awarded and the award will be based on the total bid, corrected if necessary, for errors in price extensions and/or addition.
- A response to an IFB is an offer to contract with the Contracting Local Organization based upon the terms, conditions and specifications contained in the IFB. Bids do not become contracts until a signed Notice of Award (NOA) is issued by the Contracting Local Organization.
- Award of Contract to Nonresident Bidder.** In accordance with Texas Government Code 2252.002, PCCD may not award a contract to a nonresident bidder unless the nonresident underbids the lowest bid

submitted by a responsible resident bidder by an amount that is not less than the amount by which a resident bidder would be required to underbid the nonresident bidder to obtain a comparable contract in the state in which the nonresident's principal place of business is located.

15. **Officials Not to Benefit:** Any contract to be awarded as a result of this solicitation will not be awarded to any official of the Texas State Soil and Water Conservation Board, Plum Creek Conservation District, Hays County Soil and Water Conservation District (SWCD), or Caldwell-Travis SWCD, (all in the State of Texas), or to any firm in which any official or any member of such official's immediate family of these entities has direct or indirect interest in the pecuniary profits or contracts of such firms.
16. **Execution of Contract and Submission of Post-award Information:** The contract will include items outlined in PART I, Subpart D, Contract Agreement, Article IV. Within five (5) workdays after receipt of Notice of Award of the contract, the successful bidder shall execute the contract agreement and furnish the Contracting Local Organization with required post-award information as outlined in PART III, Supplemental Conditions, Article 4.
17. **Approval of Contract:** The contract will be approved and signed by the Plum Creek Conservation District President. The contract will not be binding upon the Contracting Local Organization until it has been executed by Plum Creek Conservation District and delivered to the Contractor.
18. **Specifications:** Specifications referred to but not included shall include all revisions and amendments in effect on the date of issuance of the IFB.
19. **Beginning of Work:** The Contractor shall commence work within twenty (20) calendar days after receipt of a written Notice to Proceed as issued by the Contracting Officer and shall complete the work within 376 (three hundred seventy-six) calendar days after receipt of the notice. Contractor shall not commence any work prior to issuance of the Notice to Proceed.
20. **Records:** Records listed below may be reviewed by interested parties at Plum Creek Conservation District, 1101 West San Antonio Street, Lockhart, Texas, by contacting Daniel Meyer or Karen Bassett (512-398-2383). Records may be viewed 8:00 a.m. to 5:00 p.m. (closed noon to 1:00 p.m.), Monday through Friday.

Complete official printed copy of IFB No. PCCD-21-PCW2Upgrade-03 bid package, including 22" x 34" set of Drawings (Cover plus Sheets 1 thru 71).

Engineering documents for viewing (also available on PCCD website):

- As-Built Plans, Site 2, 4-E-24,550 5//28/69 (13 total sheets)
- Geologic Investigation Report, 6/12/67, USDA-SCS
- Geologic Investigation Report & Appendices, June 2021, AECOM
- Soil Mechanics Report, 7/18/67, USDA-SCS
- Soil Mechanics Report & appendices, July 2021, AECOM

PART I – GENERAL PROVISIONS

SUBPART C

BID FORMS

Exhibits A through E

EXHIBIT A**OFFER**

Enclosed with this offer (Exhibits A through E) is a bid guarantee (bid bond or cashier's or certified check payable to PLUM CREEK CONSERVATION DISTRICT) in the amount of \$_____. It is agreed that in the event this offer is accepted by the Contracting Local Organization (CLO) and the undersigned bidder fails to execute a contract and submit required post-award information within five (5) workdays after receipt of Notice of Award of contract to him/her, the bidder forfeits the bid guarantee and the CLO may pursue any other action allowed by law. If this offer is accepted, the undersigned bidder agrees to execute a contract and submit required post-award information per contract terms, and also agrees to commence work within twenty (20) calendar days after the date of receipt of written Notice to Proceed and to complete the entire works awarded under IFB No. PCCD-21-PCW2Upgrade-03 within three hundred seventy-six (376) calendar days commencing the day after Contractor receives written Notice to Proceed.

The undersigned acknowledges receipt of the following amendments:

Amendment No. 1 dated _____	Received _____
Amendment No. 2 dated _____	Received _____
Amendment No. 3 dated _____	Received _____
Amendment No. 4 dated _____	Received _____

CONTRACTOR

By _____

Print name: _____

Title: _____

Address: _____

Date: _____

Secretary,
If Contractor is a Corporation

(SEAL)

EXHIBIT B**BID SCHEDULE (Cover Sheet)**

The undersigned, in compliance with Invitation for Bids No. PCCD-21-PCW2Upgrade-03 for Plum Creek Watershed, Floodwater Retarding Structure (FRS) Site 2 UPGRADE, Hays County, Texas, having examined the plans, specifications and bidding documents, the site of the proposed work, and being familiar with all the conditions surrounding performance of the proposed project; agrees to furnish all labor, material and equipment and perform all work required in accordance with the plans, specifications and contract documents for the prices below, if this offer is accepted by the Contracting Local Organization within _____ calendar days after the date bids are due. *[Note: Failure to insert a number means the bidder accepts the minimum thirty (30) calendar days as required in Notice to Bidders.]*

Award Restriction

One award for the aggregate for all bid items will be made under this solicitation.

For other than bid items with a lump-sum "unit," the quantities listed in the bid schedule on which unit prices are requested are estimates only.

-- Bidders are entitled to EXCLUDE exempt taxes in their bid prices --

[See PART I, Subpart B, Instructions to Bidders #4]

TOTAL BID PRICE Plum Creek Watershed Site 2 UPGRADE:

In FIGURES: \$ _____

In WORDS: _____ **Dollars**
and _____ **Cents**

NOTE: AMOUNTS SHALL BE SHOWN IN BOTH WORDS AND FIGURES. IN CASE OF DISCREPANCY, THE AMOUNT SHOWN IN WORDS WILL GOVERN.

Bidder's Name/Title (type or print): _____

Bidder's Signature: _____

Company Name: _____

Date: _____

BID SCHEDULE (Sheet 1 of 2)**PLUM CREEK WATERSHED SITE 2 UPGRADE
Hays County, Texas**

Item No.	Work or Material	Const Spec. No.	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	2	4.4	Acre	\$ _____	\$ _____
2	Structure Removal, Existing Fences	3	1 Job	Lump Sum	\$ xxxxxxxx	\$ _____
3	Structure Removal, Existing Principal Spillway	3	1 Job	Lump Sum	\$ xxxxxxxxx	\$ _____
4	Pollution Control	5	1 Job	Lump Sum	\$ xxxxxxxxx	\$ _____
5	Silt Fence	5	3,320	Lin. Ft.	\$ _____	\$ _____
6	Vegetation, Sprigging	6	26.6	Acre	\$ _____	\$ _____
7	Irrigation System	6	1 Job	Lump Sum	\$ xxxxxxxxx	\$ _____
8	Irrigation Water	6	4,000	1,000 Gal.	\$ _____	\$ _____
9	Construction Surveys	7	1 Job	Lump Sum	\$ xxxxxxxxx	\$ _____
10	Mobilization and Demobilization	8	1 Job	Lump Sum	\$ xxxxxxxxx	\$ _____
11	Removal of Water	11	1 Job	Lump Sum	\$ xxxxxxxxx	\$ _____
12	Excavation, Common	21	70,600	Cu. Yd.	\$ _____	\$ _____
13	Earthfill, Material Type A, Imported Fill	23	1,180	Cu. Yd.	\$ _____	\$ _____
14	Earthfill, Material Type B, Imported Fill	23	7,700	Cu. Yd.	\$ _____	\$ _____
15	Earthfill, Material Type C, On-site Fill	23	3,520	Cu. Yd.	\$ _____	\$ _____
16	Earthfill, Material Type D, On-site Fill	23	20,120	Cu. Yd.	\$ _____	\$ _____
17	Earthfill, Material Type E, On-site Fill	23	6,750	Cu. Yd.	\$ _____	\$ _____
18	Drainfill, Fine Filter	24	1,190	Cu. Yd.	\$ _____	\$ _____
19	Drainfill, Coarse Filter	24	730	Cu. Yd.	\$ _____	\$ _____
20	Topsoiling	26	128,930	Sq. Yd.	\$ _____	\$ _____

(Bid Schedule continued on next page)

EXHIBIT B (continued)**BID SCHEDULE (Sheet 2 of 2)****PLUM CREEK WATERSHED SITE 2 UPGRADE
Hays County, Texas**

Item No.	Work or Material	Const Spec. No.	Quantity	Unit	Unit Price	Amount
21	Concrete, Structural	31	320.0	Cu. Yd.	\$ _____	\$ _____
22	Concrete, Pipe Cradle	31	40.0	Cu. Yd.	\$ _____	\$ _____
23	Reinforcing Steel	34	49,000	Pound	\$ _____	\$ _____
24	Roller Compacted Concrete (RCC)	36	3,430	Cu. Yd.	\$ _____	\$ _____
25	Cementitious Material	36	490.0	Ton	\$ _____	\$ _____
26	Concrete Pressure Pipe, C301, 48" I.D.	41	180	Lin. Ft.	\$ _____	\$ _____
27	Plastic Pipe, PVC, 6" I.D.	45	1,080	Lin. Ft.	\$ _____	\$ _____
28	Rock Riprap	61	7,090	Ton	\$ _____	\$ _____
29	Riprap Bedding	24	260	Cu. Yd.	\$ _____	\$ _____
30	Water Control Slide Gate, 12" x 12"	71	1 Job	Lump Sum	\$ xxxxxxxxx	\$ _____
31	Metal Fabrications	81	1 Job	Lump Sum	\$ xxxxxxxxx	\$ _____
32	Fence, Chain Link	91	280.0	Lin. Ft.	\$ _____	\$ _____
33	Fence, Barbed Wire	92	3,750	Lin. Ft.	\$ _____	\$ _____
34	Contractor Quality Control	94	1 Job	Lump Sum	\$ xxxxxxxxx	\$ _____
35	Geotextile	95	7,600	Sq. Yd.	\$ _____	\$ _____
36	Conduit Abandonment	99	1 Job	Lump Sum	\$ xxxxxxxxx	\$ _____
37	Geotechnical Instrumentation	401	1 Job	Lump Sum	\$ xxxxxxxxx	\$ _____
38	Flexbase	24	610	Cu. Yd.	\$ _____	\$ _____
Total Bid (Plum Creek Site 2 Upgrade).....					\$ _____	

NOTE: Also enter amount of Total Bid in figures and words on Exhibit B, page GP-9 of 18.

---- END OF BID SCHEDULE ----

EXHIBIT C

REFERENCES

Bidder in accordance with PART I, Subpart B, Instructions to Bidders, Section 3(c) References, shall list below up to five (5) recent projects upon which he/she has performed work similar to that specified herein. All lines for each reference shall be filled in completely with up-to-date information. Any omissions to this form, discrepancies in reference, or unverifiable information may be grounds for disqualification of the bidder.

1. Project Name: _____
Owner: _____ Total Contract Cost: \$ _____
Location: _____ Completion Date: _____
Description of Work: _____

Contact: _____ Phone Number: (____) _____

2. Project Name: _____
Owner: _____ Total Contract Cost: \$ _____
Location: _____ Completion Date: _____
Description of Work: _____

Contact: _____ Phone Number: (____) _____

3. Project Name: _____
Owner: _____ Total Contract Cost: \$ _____
Location: _____ Completion Date: _____
Description of Work: _____

Contact: _____ Phone Number: (____) _____

EXHIBIT C (continued)

4. Project Name: _____
Owner: _____ Total Contract Cost: \$ _____
Location: _____ Completion Date: _____
Description of Work: _____

Contact: _____ Phone Number: (____) _____
5. Project Name: _____
Owner: _____ Total Contract Cost: \$ _____
Location: _____ Completion Date: _____
Description of Work: _____

Contact: _____ Phone Number: (____) _____

EXHIBIT D

BID BOND Form

**A BLANK BID BOND FORM (2
pages) IS INSERTED AFTER THIS
PAGE FOR USE OF BIDDERS IN
PREPARATION OF BID.**

<p align="center">BID BOND (See Instructions on Reverse)</p>					Date Bond Executed (Must not be later than bid opening date)	
Principal (Legal name and business address)					Type of Organization ("X" one) <input type="checkbox"/> Individual <input type="checkbox"/> Joint Venture <input type="checkbox"/> Partnership <input type="checkbox"/> Limited Liability Company (LLC) <input type="checkbox"/> Corporation	
					State of Incorporation	
Surety(ies) (Name and business address)						
Penal Sum of Bond					Bid Identification	
Percent Of Bid Price	Amount Not to Exceed				Bid Date	Invitation No. PCCD-21-PCW2Upgrade-03
	Million(s)	Thousand(s)	Hundred(s)	Cents	For: Construction	
<p>KNOW ALL MEN BY THESE PRESENTS, That we, the Principal and Surety(ies) hereto, are firmly bound to Plum Creek Conservation District, Lockhart, Texas, hereinafter called the Contracting Local Organization, in the above penal sum for the payment of which we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally: Provided, That where the Sureties are corporations acting as co-sureties, we, the Sureties, bind ourselves in such sum "jointly and severally" as well as "severally" only for the purpose of allowing a joint action or actions against any or all of us, and for all other purposes each Surety binds itself, jointly and severally with the Principal, for the payment of such sum only as is set forth opposite the name of such Surety, but if no limit of liability is indicated, the limit of liability shall be the full amount of the penal sum.</p> <p>THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Principal has submitted the bid identified above.</p> <p>NOW, THEREFORE, if the Principal, upon acceptance by the Contracting Local Organization of his/her bid identified above, within the period specified therein for acceptance (30 days), shall execute such further contractual documents, if any, and give such bond(s) as may be required by the terms of the bid as accepted within the time specified (5 workdays after receipt of the forms by him/her), or in the event of failure so to execute such further contractual documents and give such bonds, if the Principal shall pay the Contracting Local Organization for any cost of procuring the work which exceeds the amount of his/her bid, then the above obligation shall be void and of no effect.</p> <p>Each Surety executing this instrument hereby agrees that its obligation shall not be impaired by any extension(s) of the time for acceptance of the bid that the Principal may grant to the Contracting Local Organization, notice of which extension(s) to the Surety(ies) being hereby waived; provided that such waiver of notice shall apply only with respect to extensions aggregating not more than sixty (60) calendar days in addition to the period originally allowed for acceptance of the bid.</p> <p>IN WITNESS WHEREOF, the Principal and Surety(ies) have executed this bid bond and have affixed their seals on the date set forth above.</p>						
Principal						
Signature(s)	1. _____ <div align="right">(Seal)</div>				2. _____ <div align="right">(Seal)</div>	
Name(s) & Title(s) [typed]	1. _____				2. _____	

CORPORATE SURETY(IES)				
SURETY A	Name & Address		State of Inc.	Liability Limit
	Signature(s)	1. (Seal)	2. (Seal)	
	Name(s) & Title(s) [typed]	1.	2.	
SURETY B	Name & Address		State of Inc.	Liability Limit
	Signature(s)	1. (Seal)	2. (Seal)	
	Name(s) & Title(s) [typed]	1.	2.	
SURETY C	Name & Address		State of Inc.	Liability Limit
	Signature(s)	1. (Seal)	2. (Seal)	
	Name(s) & Title(s) [typed]	1.	2.	
SURETY D	Name & Address		State of Inc.	Liability Limit
	Signature(s)	1. (Seal)	2. (Seal)	
	Name(s) & Title(s) [typed]	1.	2.	
SURETY E	Name & Address		State of Inc.	Liability Limit
	Signature(s)	1. (Seal)	2. (Seal)	
	Name(s) & Title(s) [typed]	1.	2.	

INSTRUCTIONS

(1) The full legal name and business address of the Principal shall be inserted in the space designated "Principal" on the face of this form. The bond shall be signed by an authorized person. Where such person is signing in a representative capacity (e.g., an attorney-in-fact), but is not a member of the firm, partnership, or joint venture, or an officer of the corporation involved, evidence of his/her authority must be furnished.

(2) The penal sum of the bond may be expressed as a percentage of the bid price if desired. In such cases, a maximum dollar limitation may be stipulated (e.g., 5% of the bid price but the amount not to exceed _____ dollars).

(3) The name of each person signing this bid bond should be typed in the space provided.

(4) The person signing the bond for the surety must submit evidence of his/her authority to act for the surety.

(5) The corporate surety must be approved by the state in which the services or supplies are to be delivered or in which construction is to be performed and must be among those appearing on the U.S. Treasury Department's list of approved sureties.

EXHIBIT E BIDDER CERTIFICATIONS

By submission of this bid, bidder certifies to all Sections in this Exhibit E.

Bidder should **circle appropriate answers** in Sections **A, B, and C**, and fill in blank in Section **E**.

SECTION A: Texas Franchise Tax Certification

Bidder [**IS / IS NOT**] currently delinquent in the payment of any franchise tax owed to the State of Texas, or is exempt from, or not subject to, such tax.

SECTION B: Texas Resident/Nonresident Bidder Certification

Bidder [**IS / IS NOT**] a Texas resident bidder as defined below.

DEFINITIONS: Per State of Texas House Bill 620.

"Nonresident bidder" means a bidder whose principal place of business is not in this state, but excludes a contractor whose ultimate parent company or majority owner has its principal place of business in this state.

"Texas resident bidder" means a bidder whose principal place of business is in this state, and includes a contractor whose ultimate parent company or majority owner has its principal place of business in this state.

SECTION C: Authority to Transact Business in Texas Certificate

Complete ONLY if you are a Texas nonresident bidder.

- (1) Texas nonresident bidder [**IS / IS NOT**] a corporation, limited partnership, or limited liability company.
If answer is "IS NOT", do not complete C(2) and C(3) below.
- (2) Bidder [**HAS / HAS NOT**] obtained a Certificate of Authority through the Texas Secretary of State to transact business in Texas. **Attach a copy of Certificate to bid if available.**
- (3) If response to C(2) is "HAS NOT", bidder agrees to present a current Certificate of Authority to the Contracting Local Organization by date post-award information is due: [**YES / NO**]

SECTION D: Officials Not to Benefit: Bidder certifies that its firm is not an official of the Texas State Soil and Water Conservation Board, Plum Creek Conservation District, Hays County Soil and Water Conservation District (SWCD), or Caldwell-Travis SWCD, (all in the State of Texas), or a firm in which any official or any member of such official's immediate family of these entities has direct or indirect interest in the pecuniary profits or contracts of its firm.

SECTION E: Bonding: Per Texas Administrative Code Rule 293.63(5), bidder must submit, along with the bid, the name of the person, firm, or corporation that will execute payment and performance bonds as required in PART III, Article 13: **List information below:**

SECTION F: Excluded Parties / Foreign Terrorist Organizations. Bidder certifies that it is not listed on the Federal government's terrorism watch list as described in Executive Order 13224. Bidder also represents and warrants that it is not engaged in business with Iran, Sudan, or a foreign terrorist organization, as prohibited by Section 2252.152 of the Texas Government Code.

SECTION G. Bidder hereby certifies he/she is not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency, and is not presently on the State of Texas debarred vendor list maintained by the Texas Comptroller of Public Accounts.

SECTION H: E-Verify. Contractor certifies and ensures that it utilizes and will continue to utilize the U.S. Department of Homeland Security E-Verify system to determine the eligibility of all persons and subcontractors performing duties within Texas during the term of the contract.

SECTION I: Israel Boycott. Bidder represents and warrants that, pursuant to Section 2270.002 of the Texas Government Code, bidder does not boycott Israel and will not boycott Israel during the term of the contract.

-- end of EXHIBIT E Bidder Certifications --

PART I – GENERAL PROVISIONS**SUBPART D****CONTRACT AGREEMENT (Sample)**

THIS AGREEMENT, made the _____ day of _____, 2021, by and between the Plum Creek Conservation District, Lockhart, Texas (hereinafter called Owner) and _____ (hereinafter called Contractor).

WITNESSETH:

THAT WHEREAS: in accordance with law, Owner had contract documents prepared and an Invitation for Bids published, for and in connection with the UPGRADE of Plum Creek Watershed, Floodwater Retarding Structure Site 2, Hays County, Texas; and

WHEREAS, Contractor, in response to the Invitation for Bids, has submitted to Owner, in the manner and at the time specified, a sealed bid in accordance with Instructions to Bidders; and

WHEREAS, Owner, in the manner prescribed by law, has publicly opened, examined, and canvassed the bids submitted, and has determined Contractor to be the lowest responsible bidder for the work and duly awarded to Contractor a contract therefor, for the sum or sums named in Contractor's bid.

NOW, THEREFORE, in consideration of the compensation to be paid to Contractor and of the mutual agreements herein contained, the parties have agreed and hereby agree, Owner for itself and its successors and assigns, and its, his/her, or their executors and administrators, as follows:

ARTICLE I. Contractor shall perform all work, including the assumption of all obligations, duties and responsibilities necessary to the successful completion of the contract and the furnishing of all materials and equipment required to be incorporated in and form a permanent part of the work; tools, equipment, supplies, transportation, facilities, labor, superintendence and services required to perform the work; and bonds, insurance and submittals; all as indicated or specified in the contract documents to be performed or furnished by Contractor for the work included in and covered by Owner's official award of this contract to Contractor, such award being based on the acceptance by Owner of Contractor's bid.

ARTICLE II. Owner shall pay to Contractor for performance of the work embraced in this contract, and Contractor shall accept as full compensation therefor, the sum (subject to adjustment as provided in the contract documents) of _____ Dollars (\$ _____) for all work covered by and included in the contract award and designated in the foregoing Article I; payment thereof to be made in current funds in the manner provided in the contract documents.

ARTICLE III. The Contractor shall complete all work within three hundred seventy-six (376) calendar days from the date Contractor receives written Notice to Proceed.

ARTICLE IV. The contract documents that comprise the Contract between Owner and Contractor, attached hereto and made a part hereof, consist of the following:

- (1) This Contract Agreement.
- (2) Contractor's Bid: Exhibits A - E.
- (3) Invitation for Bids (IFB) Amendment Numbers _____.

- (4) Post-bid information and supplementary information submitted by Contractor prior to execution of this Contract Agreement.
- (5) Notice of Award.
- (6) PART II – General Conditions.
- (7) PART III – Supplemental Conditions.
- (8) PART IV – Construction and Material Specifications.
- (9) PART V – Drawings (Cover page + Sheets 1 through 71).
- (10) PART VI – Prevailing Wage Rates Determination.
- (11) Notice to Proceed.
- (12) Any modifications (change orders) duly delivered or supplemental agreements duly entered into after execution of this Contract Agreement.
- (13) Notices of Final Completion and Acceptance.

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

OWNER**CONTRACTOR**

PLUM CREEK CONSERVATION DISTRICT

By _____
 JAMES A. HOLT, JR.
 President, Plum Creek Conservation District

By _____
 Title _____

(CORPORATE SEAL)

Attest _____

Attest _____

Address for giving notices:
 Plum Creek Conservation District
 1101 West San Antonio Street
 Lockhart, TX 78644

Address for giving notices

This action authorized at an official meeting
 of the Plum Creek Conservation District on
 _____[add date], Lockhart, Texas

License No. _____

Agent for service of process:

 DANIEL MEYER
 PCCD Executive Manager

 (If CONTRACTOR is a corporation, attach
 evidence of authority to sign.)

PART II GENERAL CONDITIONS

Table of Contents

	<u>Page No.</u>
ARTICLE 1	DEFINITIONSGC-1
ARTICLE 2	SPECIFICATIONS AND DRAWINGS.....GC-1
ARTICLE 3	CHANGESGC-1
ARTICLE 4	DIFFERING SITE CONDITIONSGC-2
ARTICLE 5	TERMINATION FOR DEFAULT, DAMAGES FOR DELAY, TIME EXTENSIONS.....GC-2
ARTICLE 6	CLAIMS.....GC-3
ARTICLE 7	PAYMENTS TO CONTRACTOR / INVOICING REQUIREMENTSGC-3
ARTICLE 8	MATERIAL AND WORKMANSHIPGC-5
ARTICLE 9	INSPECTION AND ACCEPTANCE.....GC-5
ARTICLE 10	SUPERINTENDENCE BY CONTRACTORGC-6
ARTICLE 11	PERMITS AND RESPONSIBILITIESGC-6
ARTICLE 12	CONDITIONS AFFECTING THE WORKGC-6
ARTICLE 13	OTHER CONTRACTSGC-6
ARTICLE 14	PATENT INDEMNITYGC-6
ARTICLE 15	ADDITIONAL BOND SECURITY.....GC-6
ARTICLE 16	REAL PROPERTY RIGHTSGC-7
ARTICLE 17	RECORDS OF TEST PITS AND BORINGSGC-7
ARTICLE 18	MATERIALS TO BE FURNISHED BY THE CONTRACTORGC-7
ARTICLE 19	WATERGC-7
ARTICLE 20	WORKWEEK – CONSTRUCTION SCHEDULEGC-7
ARTICLE 21	SUBCONTRACTORS.....GC-8
ARTICLE 22	SURVEYS.....GC-8

	<u>Page No.</u>
ARTICLE 23	SUSPENSION OF WORKGC-8
ARTICLE 24	CLEANUP WORK.....GC-9
ARTICLE 25	ASSIGNMENTGC-9
ARTICLE 26	WEATHERGC-9
ARTICLE 27	NONCOMPLIANCE WITH CONTRACT REQUIREMENTS.....GC-9
ARTICLE 28	QUANTITY VARIATIONSGC-9
ARTICLE 29	FEDERAL, STATE, AND LOCAL TAXESGC-10
ARTICLE 30	SHOP DRAWINGSGC-10
ARTICLE 31	TERMINATION FOR CONVENIENCE OF THE CONTRACTING LOCAL ORGANIZATIONGC-10
ARTICLE 32	PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS.....GC-11
ARTICLE 33	OPERATIONS AND STORAGE AREAS.....GC-11
ARTICLE 34	USE AND POSSESSION PRIOR TO COMPLETIONGC-11
ARTICLE 35	LAYOUT OF WORKGC-11
ARTICLE 36	PRECONSTRUCTION CONFERENCEGC-12
ARTICLE 37	CONTRACTOR RECORDS.....GC-12
ARTICLE 38	ARCHEOLOGICAL OR HISTORIC SITES.....GC-12
ARTICLE 39	CONTROL OF EROSION, SEDIMENTATION, AND POLLUTIONGC-12
ARTICLE 40	[RESERVED]GC-12
ARTICLE 41	ACCIDENT PREVENTION & SAFETY (OSHA Supplement).....GC-12
	A. General Contractor RequirementsGC-13
	B. First Aid and Medical FacilitiesGC-14
	C. Physical Qualifications of EmployeesGC-14
	D. Personal Protective EquipmentGC-15
	E. Machinery and Mechanized EquipmentGC-15
	F. Ladders and ScaffoldingGC-17

PART II - GENERAL CONDITIONS

ARTICLE 1 – DEFINITIONS

Terms used or referred to herein and elsewhere in the contract documents are defined as follows:

(a) Contracting Local Organization (CLO): The organization or agency awarding the contract. (CLO) is the Plum Creek Conservation District, Lockhart, Texas. Also referred to as District, Government, and Owner.

(b) Contracting Officer (CO): The person who is designated and authorized to enter into and administer this contract on behalf of the Contracting Local Organization or his/her duly appointed successor or alternate. No other person has authority to act for the Contracting Officer as stated in these General Conditions or elsewhere in the contract documents unless such person has been delegated authority by the Contracting Officer in writing. Also referred to as Owner's Representative.

(c) Engineer: The person or his/her representative who is responsible for determining that the Contractor's work conforms to the technical requirements as set forth in the drawings and specifications. Also called Project Engineer, and Government Representative (GR).

(d) Inspector: The person who performs daily inspection services for the CLO at the construction site and maintains accurate daily records of the work accomplished and the factors affecting its progress and quality. Also called Government Inspector, CLO Inspector, and Representative of the Engineer.

(e) AECOM Technical Services, Inc. The A-E firm providing Engineer and Inspector to PCCD for this contract.

(f) USDA-NRCS. United States Department of Agriculture, Natural Resources Conservation Service.

(g) Quality Assurance (QA). CLO (AECOM) Construction Inspector (onsite).

(h) Quality Control (QC). Contractor's Construction Inspector (onsite).

(i) Upgrade. Term for dams that are primarily being funded by the Texas State Soil and Water Conservation Board (TSSWCB) in order to upgrade them to meet high hazard criteria. The words Upgrade and Rehabilitation are used interchangeably in these contract documents.

ARTICLE 2 – SPECIFICATIONS AND DRAWINGS

The Contractor shall keep on the worksite a copy of the drawings and specifications and shall at all times give the Contracting Officer access thereto. Anything mentioned in the specifications and not shown on the drawings, or shown on the drawings and not mentioned in the specifications, shall be of like effect as if shown or mentioned in both. In case of difference between drawings and specifications, the specifications shall govern. In case of discrepancy either in the figures, in the drawings, or in the specifications, the matter shall be promptly submitted to the Contracting Officer, who shall promptly make a determination in writing. Any adjustment by the Contractor without such a determination shall be at his/her own risk and expense. The Contracting Officer shall furnish from time to time such detail drawings and other information as considered necessary, unless otherwise provided.

ARTICLE 3 – CHANGES

(a) The Contracting Officer may, at any time, without notice to the sureties, by written order designated or indicated to be a change order, make any change in the work within the general scope of the contract, including but not limited to changes:

- (1) In the specifications (including drawings and designs);
- (2) In the method or manner of performance of the work;
- (3) In the Contracting Local Organization-furnished facilities, equipment, materials, services, or site; or
- (4) Directing acceleration in the performance of the work.

(b) Any other written order or an oral order (which terms as used in this paragraph (b) shall include direction, instruction, interpretation, or determination) from the Contracting Officer, which causes any such change, shall be treated as a change order under this article, provided that the Contractor gives the Contracting Officer written notice stating the date, circumstances, and source of the order and that the Contractor regards the order as a change order.

(c) Except as herein provided, no order, statement, or conduct of the Contracting Officer shall be treated as a change under this article or entitle the Contractor to an equitable adjustment hereunder.

(d) If any change under this article causes an increase or decrease in the Contractor's cost of, or the time required for, the performance of any part of the work under this contract, whether or not changed by any order, an equitable adjustment shall be made and the contract modified in writing accordingly: *Provided, however,*

That except for claims based on defective specifications, no claim for any change under (b) above shall be allowed for any costs incurred more than 20 days before the Contractor gives written notice as therein required: *And provided further*, That in the case of defective specifications for which the Contracting Local Organization is responsible, the equitable adjustment shall include any increased cost reasonably incurred by the Contractor in attempting to comply with such defective specifications.

(e) If the Contractor intends to assert a claim for an equitable adjustment under this article, Contractor must, within 30 days after receipt of a written change order under (a) above or the furnishing of a written notice under (b) above, submit to the Contracting Officer a written statement setting forth the general nature and monetary extent of such claim, unless this period is extended by the Contracting Officer. The statement of claim hereunder may be included in the notice under (b) above.

(f) No claim by the Contractor for an equitable adjustment hereunder shall be allowed if asserted after final payment under this contract.

ARTICLE 4 – DIFFERING SITE CONDITIONS

(a) The Contractor shall promptly, and before such conditions are disturbed, notify the Contracting Officer in writing of: (1) subsurface or latent physical conditions at the site differing materially from those indicated in this contract, or (2) unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inhering in work of the character provided for in this contract. The Contracting Officer shall promptly investigate the conditions, and if he/she finds that such conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performance of any part of the work under this contract, whether or not changed as a result of such conditions, an equitable adjustment shall be made and the contract modified in writing accordingly.

(b) No claim of the Contractor under this article shall be allowed unless the Contractor has given the notice required in (a) above; provided, however, the time prescribed therefor may be extended by the Contracting Officer.

(c) No claim by the Contractor for an equitable adjustment hereunder shall be allowed if asserted after final payment under this contract.

ARTICLE 5 – TERMINATION FOR DEFAULT, DAMAGES FOR DELAY, TIME EXTENSIONS

(a) If the Contractor refuses or fails to prosecute the work, or any separable part thereof, with such diligence as will insure its completion within the time specified in this contract, or any extension thereof, or fails to complete said work within such time, the Contracting Local Organization may, by written notice to the Contractor, terminate Contractor's right to proceed with the work or such part of the work as to which there has been delay. In such event the Contracting Local Organization may take over the work and prosecute the same to completion, by contract or otherwise, and may take possession of and utilize in completing the work such materials, appliances, and plant as may be on the site of the work and necessary therefor. Whether or not the Contractor's right to proceed with the work is terminated, Contractor and his/her sureties shall be liable for any damage to the Contracting Local Organization resulting from his/her refusal or failure to complete the work within the specified time.

(b) If the Contracting Local Organization so terminates the Contractor's right to proceed, the resulting damage will consist of such actual damages until such reasonable time as may be required for final completion of the work together with any increased costs occasioned the Contracting Local Organization in completing the work.

(c) If the Contracting Local Organization does not so terminate the Contractor's right to proceed, the resulting damage will consist of such actual damages until the work is completed or accepted.

(d) The Contractor's right to proceed shall not be so terminated nor the Contractor charged with resulting damage if:

(1) The delay in the completion of the work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not restricted to, acts of God, acts of the public enemy, acts of the Contracting Local Organization in its contractual capacity, acts of another contractor in the performance of a contract with the Contracting Local Organization, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, unusually severe weather, or delays of subcontractors or suppliers arising from unforeseeable causes beyond the control and without the fault or negligence of both the Contractor and such subcontractors or suppliers; and

(2) The Contractor, within 10 days from the beginning of any such delay (unless the Contracting Officer grants a further period of time before the date of final payment under the contract), notifies the Contracting Officer in writing of the causes of delay.

(3) The Contracting Officer shall ascertain the facts and the extent of the delay and extend the time for completing the work when, in his/her judgment, such an extension is justified.

(4) Delays Due to COVID-19. PCCD will utilize OSHA, CDC, and Texas Department of State Health Services guidelines in determining if/when to issue a Suspend Work Order for situations caused by COVID-19. This would include, but is not limited to, any Emergency Management Declaration that affects construction work or if a person working at or visiting the worksite has tested positive. The length of the work suspension also will be based upon the recommendations in these guidelines.

(e) The rights and remedies of the Contracting Local Organization provided in this article are in addition to any other rights and remedies provided by law or under this contract.

(f) As used in paragraph (d)(1) of this article, the term "subcontractors and suppliers" means subcontractors and suppliers at any tier.

ARTICLE 6 – CLAIMS

Any claim by the Contractor arising by virtue of this contract which is not disposed of by agreement shall be submitted in writing, together with any written and oral evidence in support thereof, to the Contracting Officer for decision. Before making a decision the Contracting Officer shall notify the Contractor that any additional written and/or oral evidence in support of the claim may be presented to the Contracting Officer within 30 days from receipt by the Contractor of such notification, or within such further period of time as may be granted by the Contracting Officer. The Contracting Officer shall make a decision in writing and mail or otherwise furnish a signed copy thereof to the Contractor. Pending the decision of the Contracting Officer the Contractor shall proceed diligently with the performance of this contract. *[See Also: PART III, Supplemental Conditions, Article 11 – Disputes/Alternative Dispute Resolution]*

ARTICLE 7 – PAYMENTS TO CONTRACTOR / INVOICING REQUIREMENTS

(a) The Contracting Local Organization will pay the contract price as hereinafter provided and will secure review and approval of Contractor invoices by various agencies as required by funding requirements.

(b) The Contracting Local Organization will make progress payments monthly as the work proceeds, or at more frequent intervals as determined by the Contracting Officer, on estimates approved by the Contracting Officer. If requested by the Contracting Officer, the Contractor shall furnish a breakdown of the total contract price showing the amount included therein for each principal category of the work, in such detail as requested, to provide a basis for determining progress payments. In the preparation of estimates the Contracting Officer, at his/her discretion, may authorize material delivered on the site and preparatory work done to be taken into consideration and if the Contractor furnishes satisfactory evidence that he/she has acquired title to the material and that it will be utilized on the work covered by the contract. Payment for material delivered to the Contractor at locations other than the site will not be authorized.

(c) In making such progress payments, 10 percent of the estimated amount shall be retained until final completion and acceptance of the contract work. However, if the Contracting Officer at any time after 50 percent of the work has been completed finds satisfactory progress is being made, he/she may authorize any of the remaining progress payments to be made in full without retention of a percentage. Also, whenever the work is substantially complete, the Contracting Officer, if he/she finds the amount retained to be in excess of the amount adequate for the protection of the Contracting Local Organization, at his/her discretion may release to the Contractor all or a portion of any excess amount. The Contracting Local Organization shall not be obligated to pay any interest on the 10 percent retainage held on the first 50 percent of work completed. If the Contracting Local Organization holds any retainage on the remaining 50 percent of the work completed, the Contracting Local Organization shall pay interest on such retainage from the date the retainage is withheld to the date of payment to the Contractor. The interest rate to be paid on such retainage shall be the rate of interest paid by the Contracting Local Organization's depository bank on interest bearing accounts of similar amounts during the period of time interest accrues as provided herein. Furthermore, on completion and acceptance of each separate project, public work, or other division of the contract, on which the price is stated separately in the contract, payment may be made without retention of a percentage.

(d) All material and work covered by progress payments made shall thereupon become the sole property of the Contracting Local Organization, but this provision shall not be construed as relieving the Contractor from

the sole responsibility for all material and work upon which payments have been made or the restoration of any damaged work, or as waiving the right of the Contracting Local Organization to require the fulfillment of all of the terms of the contract.

(e) "Properly Executed Invoice" Requirements

(1) The original and one copy of each invoice are to be delivered to the Contracting Officer at the designated payment office.

(2) One copy of each invoice and complete documentation of computations and supporting data as required by PART IV, Construction Specification 7 are to be submitted to the Engineer.

(3) The following must be attached to the original invoice submitted to the Contracting Officer and to the copy submitted to the Engineer:

- (i) A complete remittance address along with vendor's tax identification number.
- (ii) Billing period.
- (iii) If requesting payment for materials delivered but not installed, Contractor will provide evidence of title to the materials and that it will be utilized on the work covered by the contract.
- (iv) Itemization of payment requests by Contract Item Number (CIN) as shown in PART I, Subpart C, Exhibit B—Bid Schedule, of the contract. Invoice will include the quantity performed that is being invoiced, the unit price (if applicable) and the CIN total price, and a sum total of amount of payment requested. Invoice will also include the cumulative quantities and amount by CIN.

(f) Designated Payment Office Contact Point. The contact point described below coordinates the issuance of payments under this contract:

Name: Karen Bassett
 Title: Office Secretary
 Address: Plum Creek Conservation District, 1101 W. San Antonio St., Lockhart, TX 78644
 Telephone: (512) 398-2383 FAX: (512) 398-7776

(g) Final Payment Request

(1) The Contracting Local Organization shall pay the amount due the Contractor under this contract after--

- (i) Completion and acceptance of all work;
- (ii) Presentation of a properly executed invoice; and
- (iii) Presentation of release as indicated in (g)(3) below.

(2) The **FINAL** invoice billing shall include the following information:

- (i) All documentation called for in the contract documents, and
- (ii) Consent of the surety, if required, to final payment.
- (iii) Complete and legally effective releases or waivers (satisfactory to Contracting Local Organization) of all liens arising out of or filed in connection with the work. In lieu thereof and as approved by Contracting Local Organization, Contractor may furnish receipts or releases in full; an affidavit of Contractor that the releases and receipts include all labor, services, material and equipment for which a lien could be filed, and that all payrolls, material and equipment bills, and other indebtedness connected with the work for which Contracting Local Organization or his/her property might in any way be responsible, have been paid or otherwise satisfied. If any subcontractor, manufacturer, fabricator, supplier, or distributor fails to furnish a release of receipt in full, Contractor may furnish a bond or other collateral satisfactory to Contracting Local Organization to indemnify Contracting Local Organization against any lien.

(3) The **FINAL** invoice shall also contain the following **RELEASE OF CLAIMS** statement:

"I, [Name of Contractor], do hereby release the Plum Creek Conservation District, Lockhart, Texas, from any and all claims of any character whatsoever arising under and by virtue of contract number [Identify Contract] dated [Date] as amended, except as herein stated [LIST any Exceptions].

 (Date of Release)

 (Signature of Contractor)

(4) Releases may also be required of the assignee if the Contractor's claim to amounts payable under this contract has been assigned under Article 25 of these General Conditions – Assignment, of this contract.

(h) This contract is subject to regulations incorporated in Texas Government Code, Subtitle F, Chapter 2251 – Payment for Goods and Services, regarding payment due dates, late payment interest, and claims and

disputes. These regulations include, but are not limited to, payments made by Contracting Local Organization, Contractor, and subcontractors for any work, goods, services, etc. provided under this contract.

ARTICLE 8 – MATERIAL AND WORKMANSHIP

(a) Unless otherwise specifically provided in this contract, all equipment, material, and articles incorporated in the work covered by this contract are to be new and of the most suitable grade for the purpose intended. Unless otherwise specifically provided in this contract, reference to any equipment, material, article, or patented process, by trade name, make, or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition, and the Contractor may, at his/her option, use any equipment, material, article, or process which in the judgment of the Contracting Officer, is equal to that named. The Contractor shall furnish to the Contracting Officer for his/her approval the name of the manufacturer, the model number, and other identifying data and information respecting the performance, capacity, nature, and rating of the machinery and mechanical and other equipment which the Contractor contemplates incorporating in the work. When required by this contract or when called for by the Contracting Officer, the Contractor shall furnish the Contracting Officer for approval full information concerning the material or articles which Contractor contemplates incorporating in the work. When so directed, samples shall be submitted for approval at the Contractor's expense, with all shipping charges prepaid. Machinery, equipment, material, and articles installed or used without required approval shall be at the risk of subsequent rejection.

(b) All work under this contract shall be performed in a skillful and workmanlike manner. The Contracting Officer may, in writing, require the Contractor to remove from the work any employee the Contracting Officer deems incompetent, careless, or otherwise objectionable.

ARTICLE 9 – INSPECTION AND ACCEPTANCE

(a) All work (which term includes but is not restricted to materials, workmanship, and manufacture and fabrication of components) shall be subject to inspection and test by the Contracting Local Organization at all reasonable times and at all places prior to acceptance. Any such inspection and test is for the sole benefit of the Contracting Local Organization and shall not relieve the Contractor of the responsibility of providing quality control measures to assure that the work strictly complies with the contract requirements. No inspection or test by the Contracting Local Organization shall be construed as constituting or implying acceptance. Inspection or test shall not relieve the Contractor of responsibility for damage to or loss of the material prior to acceptance, nor in any way affect the continuing rights of the Contracting Local Organization after acceptance of the completed work under the terms of paragraph (f) of this article, except as herein above provided.

(b) The Contractor shall, without charge, replace any material or correct any workmanship found by the Contracting Local Organization not to conform to the contract requirements, unless in the public interest the Contracting Local Organization consents to accept such material or workmanship with an appropriate adjustment in contract price. The Contractor shall promptly segregate and remove rejected material from the premises.

(c) If the Contractor does not promptly replace rejected material or correct rejected workmanship, the Contracting Local Organization (1) may, by contract or otherwise, replace such material or correct such workmanship and charge the cost thereof to the Contractor, or (2) may terminate the Contractor's right to proceed in accordance with Article 5, Termination for Default - Damages for Delay – Time Extensions, of these General Conditions.

(d) The Contractor shall furnish promptly, without additional charge, all facilities, labor, and material reasonably needed for performing such safe and convenient inspection and test as may be required by the Contracting Officer. All inspection and test by the Contracting Local Organization shall be performed in such manner as not unnecessarily to delay the work. Special, full size, and performance tests shall be performed as described in this contract. The Contracting Local Organization reserves the right to charge to the Contractor any additional cost of inspection or test when material or workmanship is not ready at the time specified by the Contractor for inspection or test or when reinspection or retest is necessitated by prior rejection.

(e) Should it be considered necessary or advisable by the Contracting Local Organization at any time before acceptance of the entire work to make an examination of work already completed, by removing or tearing out same, the Contractor shall, on request, promptly furnish all necessary facilities, labor, and material. If such work is found to be defective or nonconforming in any material respect, due to the fault of the Contractor or his/her subcontractors, Contractor shall defray all the expenses of such examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the contract, an equitable adjustment shall be made in the contract price to compensate the Contractor for the additional services involved.

in such examination and reconstruction and, if completion of the work has been delayed thereby, Contractor shall, in addition, be granted a suitable extension of time.

(f) Unless otherwise provided in this contract, acceptance by the Contracting Local Organization shall be made as promptly as practicable after completion and inspection of all work required by this contract, or that portion of the work that the Contracting Officer determines can be accepted separately. Acceptance shall be final and conclusive except as regards latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards the Contracting Local Organization's rights under any warranty or guarantee.

ARTICLE 10 – SUPERINTENDENCE BY CONTRACTOR

The Contractor, at all times during performance and until the work is completed and accepted, shall give his/her personal superintendence to the work or have on the work a competent superintendent, satisfactory to the Contracting Officer and with authority to act for the Contractor.

ARTICLE 11 – PERMITS AND RESPONSIBILITIES

The Contractor shall, without additional expense to the Contracting Local Organization, be responsible for obtaining any necessary licenses and permits, and for complying with any applicable Federal, State, and municipal laws, codes, and regulations, in connection with the prosecution of the work. Contractor shall be similarly responsible for all damages to persons or property that occur as a result of his/her fault or negligence. He/she shall take proper safety and health precautions to protect the work, the workers, the public, and the property of others. He/she shall also be responsible for all materials delivered and work performed until completion and acceptance of the entire construction work, except for any completed unit of construction thereof which theretofore may have been accepted.

ARTICLE 12 – CONDITIONS AFFECTING THE WORK

The Contractor shall be responsible for having taken steps reasonably necessary to ascertain the nature and location of the work, and the general and local conditions which can affect the work or the cost thereof. Any failure by the Contractor to do so will not relieve Contractor from responsibility for successfully performing the work without additional expense to the Contracting Local Organization. The Contracting Local Organization assumes no responsibility for any understanding or representations concerning conditions made by any of its officers or agents prior to the execution of this contract, unless such understanding or representations by the Contracting Local Organization are expressly stated in the contract.

ARTICLE 13 – OTHER CONTRACTS

The Contracting Local Organization may undertake or award other contracts for additional work, and the Contractor shall fully cooperate with such other contractors and Contracting Local Organization employees and carefully fit his/her own work to such additional work as may be directed by the Contracting Officer. The Contractor shall not commit or permit any act which will interfere with the performance of work by any other contractor or by Contracting Local Organization employees.

ARTICLE 14 – PATENT INDEMNITY

Except as otherwise provided, the Contractor agrees to indemnify the Contracting Local Organization and its officers, agents and employees against liability, including costs and expenses, for infringement upon any Letters Patent of the United States (except Letters Patent issued upon an application which is now or may hereafter be, for reasons of national security, ordered by the Government to be kept secret or otherwise withheld from issue) arising out of the performance of this contract or out of the use or disposal by or for the account of the Contracting Local Organization of supplies furnished or work performed hereunder.

ARTICLE 15 – ADDITIONAL BOND SECURITY

If any surety upon any bond furnished in connection with this contract becomes unacceptable to the Contracting Local Organization, or if any such surety fails to furnish reports as to its financial condition from time to time as requested by the Contracting Local Organization, or if the contract price is increased to such an extent that the penal sum of any bond becomes inadequate in the opinion of the Contracting Officer, the Contractor shall promptly furnish such additional security as may be required from time to time to protect the interests of the Contracting Local Organization and of persons supplying labor or materials in the prosecution of the work contemplated by this contract.

ARTICLE 16 – REAL PROPERTY RIGHTS

(a) Adequate real property rights needed in order to perform the work under this contract have been acquired by or on behalf of the Contracting Local Organization. The right to enter, remove, or otherwise make use of adjacent property, roads, utility lines, fences, and other improvements not included within the real property rights provided shall be the sole responsibility of the Contractor.

(b) Where ingress and egress is not defined on the drawings, the Contracting Officer shall designate the right-of-way to be used.

(c) The Contractor shall obtain owner's advance written approval if he/she plans to enter, remove, or otherwise make use of adjacent property, roads, utility lines, fences, and other improvements not included within the real property rights provided by the Contracting Local Organization. A copy of the written approval must be submitted to the Contracting Officer. The Contractor is responsible for any and all expenses associated with these items. Any Contractor-proposed changes to items designated or shown in the plans and specifications (e.g., site entrance, stockpile area, campsite, etc.) must be approved by the Contracting Officer at his/her sole discretion.

ARTICLE 17 – RECORDS OF TEST PITS AND BORINGS

The Contracting Local Organization does not represent that the available records show completely the existing conditions and does not guarantee any interpretation of these records. The Contractor assumes all responsibility for deductions and conclusions as to the nature of rock and other materials to be excavated, the difficulties of making and maintaining the required excavations and of doing other work affected by the geology of the site of the work, and for the final preparation of the foundations for the spillway, dikes, and other structures.

ARTICLE 18 – MATERIALS TO BE FURNISHED BY THE CONTRACTOR

(a) Unless otherwise specified in this contract, the Contractor shall furnish all materials required for the completion of the contract.

(b) Unless otherwise waived in writing by the Contracting Officer, the Contractor shall furnish the Contracting Local Organization with certifications dated and signed by the manufacturer and/or supplier to the effect that the items listed therein meet the requirements of this contract. Such certifications shall be furnished prior to the use of the material in any part of the construction and shall identify the project on which the material is to be used.

ARTICLE 19 – WATER

Unless otherwise specified in this contract, the Contractor shall provide and maintain at his/her own expense an adequate supply of water suitable for purposes of performing the work.

ARTICLE 20 – WORKWEEK—CONSTRUCTION SCHEDULE

(a) Unless furnished prior to contract award, the Contractor shall, prior to commencement of work, submit to the Contracting Officer for approval: (1) a construction schedule showing the order in which he/she proposes to carry on the work indicating the periods during which he/she will perform work on each item listed in the bid schedule; and (2) the hours and days in which he/she proposes to carry on the work.

(b) If, in the opinion of the Contracting Officer, the Contractor falls behind the approved construction schedule, the Contractor shall take such steps as may be necessary to improve his/her process and the Contracting Officer may require him/her to either increase the number of shifts, days or hours of work, or the amount of construction plant, or all of them, and to submit for approval such revised construction schedule as may be deemed necessary to show the manner in which the agreed rate of progress will be regained, all without additional cost to the Contracting Local Organization. If the Contractor fails to submit a revised construction schedule within the time specified by the Contracting Officer, the Contracting Officer may withhold approval of progress payments and/or take such other actions as provided in this contract until such time as the Contractor submits the required construction schedule.

(c) Failure of the Contractor to comply with the requirements of the Contracting Officer under this article shall be grounds for determination by the Contracting Officer that the Contractor is not prosecuting the work with such diligence as will insure completion within the time specified. Upon such determination, the Contracting Officer may terminate the Contractor's right to proceed with the work, or any separable part thereof, in accordance with Article 5 of the General Conditions.

- (d) The maximum workweek that will be approved is:
- Monday through Saturday, up to 10 hours per day (maximum 60 hours per week).
 - Work is permitted during "daylight" hours only.

(e) All work under this contract except minor items of work of an emergency, protective, or maintenance nature will be suspended for the periods listed below. These days are included in the original contract performance time:

- 2021 Thanksgiving Break: November 25, 26, and 27
- 2021 Christmas Break: December 24 and 25
- New Year's Break: December 31, 2021 and January 1, 2022
- Memorial Day: May 30, 2022
- Independence Day: July 4, 2022
- Labor Day: September 5, 2022

(f) If the contract performance time is extended after the contract is awarded due to weather and its effects, or for other reasons, all work (except that of an emergency, protective, or maintenance nature) will be suspended on days listed below and the suspension days will be added to the performance time:

- 2022 Thanksgiving Break: November 24, 25, and 26
- 2022 Christmas Break: December 24 and 26 (*12/25 is a Sunday, nonworkday*)
- New Year's Break: December 31, 2022 and January 2, 2023 (*1/1 is a Sunday, nonworkday*)

ARTICLE 21 – SUBCONTRACTORS

(a) Work shall not be *subcontracted* in whole or in part without the prior written approval of the Contracting Officer. The request shall be in writing with the name and qualifications of the proposed subcontractor and a description of the work to be done.

(b) If at any time the Contracting Officer determines that any subcontractor is incompetent or undesirable, he/she shall notify the Contractor accordingly and the Contractor shall take immediate steps for cancellation of the subcontract.

(c) Subcontracting by subcontractors shall be subject to the above requirements.

(d) Nothing contained in this contract shall create any contractual relationship between any subcontractor and the Contracting Local Organization.

(e) Any *subcontract* awarded under this contract will not be awarded to any official of the Plum Creek Conservation District, Texas State Soil and Water Conservation Board, Hays County Soil and Water Conservation District, or Caldwell-Travis Soil and Water Conservation District (all in the State of Texas), or to any firm in which any official or any member of such official's immediate family of these entities has direct or indirect interest in the pecuniary profits or contracts of such firms.

ARTICLE 22 – SURVEYS

See PART IV, *Construction Specification 7 – Construction Surveys*.

ARTICLE 23 – SUSPENSION OF WORK

(a) The Contracting Officer may order the Contractor in writing to suspend, delay, or interrupt all or any part of the work for such period of time as he/she may determine to be appropriate for the convenience of the Contracting Local Organization. See General Conditions Article 5(d)(4) regarding work suspensions due to COVID-19.

(b) If the performance of all or any part of the work is, for an unreasonable period of time, suspended, delayed, or interrupted by an act of the Contracting Officer in the administration of this contract, or by his/her failure to act within the time specified in this contract (or if no time is specified, within a reasonable time), an adjustment shall be made for any increase in the cost of performance of this contract (excluding profit) necessarily caused by such unreasonable suspension, delay, or interruption and the contract modified in writing accordingly. However, no adjustment shall be made under this article for any suspension, delay, or interruption to the extent (1) that performance would have been so suspended, delayed, or interrupted by any other cause including the fault or negligence of the Contractor or (2) for which an equitable adjustment is provided for or excluded under any other provision of this contract.

(c) No claim under this article shall be allowed (1) for any costs incurred more than 20 days before the Contractor shall have notified the Contracting Officer in writing of the act or failure to act involved (but this requirement shall not apply as to a claim resulting from a suspension order), and
(2) unless the claim, in an amount stated, is asserted in writing as soon as practicable after the termination of such suspension, delay, or interruption, but not later than the date of final payment under the contract.

ARTICLE 24 – CLEANUP WORK

(a) During performance of the work the Contractor shall keep the work site, areas adjacent to the work site and access roads in an orderly condition, free and clear from debris and discarded materials. Care shall be taken to prevent spillage when hauling is being done. Any spillage or debris resulting from the Contractor's operations shall be immediately removed.

(b) Upon completion of the work the Contractor shall remove from the work site, areas adjacent to the work site and access roads: all plant, buildings, debris, unused materials, concrete forms and other like material belonging to Contractor or used under his/her direction during the construction. Contractor shall grade all access roads, other than public, removing wheel tracks and smoothing up such roads.

ARTICLE 25 – ASSIGNMENT

The Contractor shall not assign in whole or in part this contract without the prior written consent of the Contracting Local Organization. The Contractor shall not assign any moneys due or to become due to him/her under this contract without the prior written consent of the Contracting Local Organization.

ARTICLE 26 – WEATHER

(a) The Contracting Officer may order suspension of the work in whole or in part, commencing with the day after receipt of the Notice to Proceed by the Contractor, due to weather or the effects of weather at the site, for such time as he/she considers it unfavorable for satisfactory prosecution of the work.

(b) When the Contracting Officer orders suspension under (a) of this article, the contract completion date shall be extended a full calendar day for each calendar day during suspension of the work if:

(1) All work is suspended except minor items as may be designated in this contract or as approved during the suspension period by the Contracting Officer at his/her sole discretion on a case-by-case basis (work of an emergency, protective or maintenance nature may be performed at any time); and

(2) The hours lost in any one workday of the authorized workweek through suspension equal one-half or more of the hours of an authorized workday.

(c) If the Contracting Officer orders suspension of work as provided in (b) of this article and the hours lost in the workday immediately preceding a nonworkday equal one-half or more of the hours in an authorized workday, the contract completion date shall be extended a full calendar day for each nonworkday during suspension of the work.

(d) When the Contracting Officer orders any suspension of the work under this article, the Contractor shall not be entitled to any cost or damages resulting from such suspension.

(e) When the contract completion date is extended under this article, the contract shall be modified in writing accordingly.

ARTICLE 27 – NONCOMPLIANCE WITH CONTRACT REQUIREMENTS

(a) The Contracting Officer may order suspension of the work in whole or in part for such time as he/she deems necessary because of the failure of the Contractor to comply with any of the requirements of this contract, and the contract completion date shall not be extended on account of any such suspension of the work.

(b) When the Contracting Officer orders any suspension of the work under (a) of this article, the Contractor shall not be entitled to any costs or damages resulting from such suspension.

(c) The rights and remedies of the Contracting Local Organization provided in this article are in addition to any other rights and remedies provided by law or under this contract.

ARTICLE 28 – QUANTITY VARIATIONS

(a) Where the quantity of work shown for an item in the bid schedule, including any modification thereof, is estimated, no adjustment of the contract price nor of the performance time shall be made for overruns or underruns which are within 25 percent of the estimated quantity of any such item.

(b) For overruns of more than 25 percent, the Contracting Officer shall re-estimate the quantity for the item, establish an equitable contract price for the overrun of more than 25 percent, adjust contract performance time equitably, and modify the contract in writing accordingly; this article to thereafter be applicable to the total re-estimated item quantity.

(c) For underruns of more than 25 percent, the Contracting Officer shall determine the quantity for the item, establish an equitable contract price therefor, adjust contract performance time equitably, and modify the contract in writing accordingly.

ARTICLE 29 – FEDERAL, STATE, AND LOCAL TAXES

(a) Except as otherwise provided, contract unit prices shall include all applicable Federal, State, and local taxes.

(b) Texas State, County, and Municipal Sales and Use Tax. (1) The Contracting Local Organization is an exempt entity per §151.309(5) of the Limited Sales, Excise, and Use Tax Act (Texas Tax Code Chapter 151 – Limited Sales, Excise, and Use Tax) and will issue the Contractor an affidavit as proof of this exemption. This contract is a “lump-sum contract” as defined by Texas Administrative Code, Title 34, Part 1, Chapter 3, Subchapter O – State Sales and Use Tax, Rule §3.291 (Contractors).

(2) When purchased by the Contractor for use in performance of this contract, certain tangible personal property and taxable services are exempt from State Sales and Use Tax under Texas Tax Code §151.311, and in most cases are also exempt from County and Municipal Sales and Use Tax. Contractor is subject to tax responsibilities in Texas Administrative Code Rule §3.291, section (c), and is responsible to issue a properly completed exemption certificate to a supplier in accordance with section (c)(5).

(3) Contractor is solely responsible to be adequately familiar with and comply with all requirements of Texas Tax Code, Texas Administrative Codes, and any other State/local regulations when claiming tax exemption for purchase of items for use in the performance of this contract.

(4) “Contractor” as used in this paragraph (b) includes subcontractors as defined in Texas Administrative Code Rule §3.291, section (a)(3).

ARTICLE 30 – SHOP DRAWINGS

(a) The term “shop drawings” includes drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials furnished by the Contractor to explain in detail specific portions of the work required by the contract.

(b) If this contract requires shop drawings, the Contractor shall coordinate all such drawings, and review them for accuracy, completeness, and compliance with contract requirements and shall indicate his/her approval thereon as evidence of such coordination and review. Shop drawings submitted to the Contracting Officer without evidence of the Contractor's approval may be returned for resubmission. The Contracting Officer will indicate his/her approval or disapproval of the shop drawings and if not approved as submitted shall indicate his/her reasons therefor. Any work done prior to such approval shall be at the Contractor's risk. Approval by the Contracting Officer shall not relieve the Contractor from responsibility for any errors or omissions in such drawings, nor from responsibility for complying with the requirements of this contract, except with respect to variations described and approved in accordance with (c) below.

(c) If shop drawings show variations from the contract requirements, the Contractor shall describe such variations in writing, separate from the drawings, at the time of submission. If the Contracting Officer approves any such variation(s), he/she shall issue an appropriate contract modification, except that, if the variation is minor and does not involve a change in price or in time of performance, a modification need not be issued.

ARTICLE 31 – TERMINATION FOR CONVENIENCE OF THE CONTRACTING LOCAL ORGANIZATION

The Contracting Officer, by written notice, may terminate this contract in whole or in part, when it is in the interest of the Contracting Local Organization. If this contract is so terminated, the Contractor shall be compensated for all necessary and reasonable direct costs of performing the work actually accomplished. In addition, the Contractor shall be paid 10 percent for overhead expenses based on said direct costs, and 5 percent for profit based on the total of direct costs and overhead costs. From this will be deducted any payments or reimbursements previously paid and salvage value of materials paid for by the Contracting Local Organization but not used. Provided however, no profit shall be paid if the Contractor would have incurred a loss had the entire contract been completed.

ARTICLE 32 – PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS

(a) The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the Contracting Officer.

(b) The Contractor shall protect from damage all existing improvements and utilities (1) at or near the work site, and (2) on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.

ARTICLE 33 – OPERATIONS AND STORAGE AREAS

(a) The Contractor shall confine all operations (including storage of materials) on Contracting Local Organization premises to areas authorized or approved by the Contracting Officer. The Contractor shall hold and save the Contracting Local Organization, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.

(b) Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Contracting Local Organization. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting Officer, the buildings and utilities may be abandoned and need not be removed.

(c) The Contractor shall, under regulations prescribed by the Contracting Officer, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.

ARTICLE 34 – USE AND POSSESSION PRIOR TO COMPLETION

(a) The Contracting Local Organization shall have the right to take possession of or use any completed or partially completed part of the work. Before taking possession of or using any work, the Contracting Officer shall furnish the Contractor a list of items of work remaining to be performed or corrected on those portions of the work that the Contracting Local Organization intends to take possession of or use. However, failure of the Contracting Officer to list any item of work shall not relieve the Contractor of responsibility for complying with the terms of the contract. The Contracting Local Organization's possession or use shall not be deemed an acceptance of any work under the contract.

(b) While the Contracting Local Organization has such possession or use, the Contractor shall be relieved of the responsibility for the loss of or damage to the work resulting from the Contracting Local Organization's possession or use, notwithstanding the terms of Article 11 (Permits and Responsibilities) of these General Conditions. If prior possession or use by the Contracting Local Organization delays the progress of the work or causes additional expense to the Contractor, an equitable adjustment shall be made in the contract price or the time of completion, and the contract shall be modified in writing accordingly.

ARTICLE 35 – LAYOUT OF WORK

See PART IV, Construction Specification 7 – Construction Surveys.

ARTICLE 36 – PRECONSTRUCTION CONFERENCE

If the Contracting Officer decides to conduct a preconstruction conference, the successful offeror will be notified and will be required to attend. The Contracting Officer's notification will include specific details regarding the date, time, and location of the conference, any need for attendance by subcontractors, and information regarding the items to be discussed.

ARTICLE 37 – CONTRACTOR RECORDS

(a) Access to Records. Contractor shall provide access by Contracting Local Organization, Texas State Soil and Water Conservation Board, or Texas State Auditor's Office, or any of their duly authorized representatives, to any books, documents, papers, and records of the Contractor which are directly pertinent to the contract for the purpose of making audit, examination, excerpts, and transcriptions.

(b) Retention of Records. Contractor shall retain all records requiring access per paragraph (a) above for seven (7) years after the Contracting Local Organization makes final payment under the contract and all other pending matters between the Contracting Local Organization and the Contractor under the contract are closed.

ARTICLE 38 – ARCHEOLOGICAL OR HISTORIC SITES

If a previously unidentified archeological or historic site(s) is encountered, the Contractor shall discontinue work in the general area of the site(s) and notify the Contracting Officer immediately.

ARTICLE 39 – CONTROL OF EROSION, SEDIMENTATION, AND POLLUTION

(a) Operations shall be scheduled and conducted to minimize erosion of soils and to prevent silting and muddying of streams, rivers, irrigation systems, and impoundments (lakes, reservoirs, etc.).

(b) Pollutants such as fuels, lubricants, bitumens, raw sewage, and other harmful materials shall not be discharged on the ground; into or nearby rivers, streams, or impoundments; or into natural or man-made channels. Wash water or waste from concrete or aggregate operations shall not be allowed to enter live streams prior to treatment by filtration, settling, or other means sufficient to reduce the sediment content to not more than that of the stream into which it is discharged.

(c) Mechanized equipment shall not be operated in flowing streams without written approval by the Contracting Officer.

ARTICLE 40 – [RESERVED]**ARTICLE 41 – ACCIDENT PREVENTION AND SAFETY**

(a) The Contractor shall provide and maintain work environments and procedures which will:

(1) Safeguard the public and Contracting Local Organization personnel, property, materials, supplies, and equipment exposed to Contractor operations and activities;

(2) Avoid interruptions of Contracting Local Organization operations and delays in project completion dates; and

(3) Control costs in the performance of this contract.

(b) Whenever the Contracting Officer becomes aware of any noncompliance with these requirements or any condition which poses a serious or imminent danger to the health or safety of the public or Contracting Local Organization personnel, the Contracting Officer shall notify the Contractor orally, with written confirmation, and request immediate initiation of corrective action. This notice, when delivered to the Contractor or the Contractor's representative at the work site, shall be deemed sufficient notice of the noncompliance and that corrective action is required. After receiving the notice, the Contractor shall immediately take corrective action. If the Contractor fails or refuses to promptly take corrective action, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. The Contractor shall not be entitled to any equitable adjustment of the contract price or extension of the performance schedule on any stop work order issued under this article.

(c) The Contractor shall insert this article, including this paragraph (c), with appropriate changes in the designation of the parties, in subcontracts.

(d) Before commencing the work, the Contractor shall--

(1) Submit a written proposed plan for implementing this article. The plan shall include an analysis of the significant hazards to life, limb, and property inherent in contract work performance and a plan for controlling these hazards; and

(2) Meet with representatives of the Contracting Officer to discuss and develop a mutual understanding relative to administration of the overall safety program.

(e) In the event there is a conflict between the requirements contained in the specifications, Contractor's safety program, and U.S. Department of Labor construction safety and health standards, the more stringent requirement will prevail.

(f) Contractor shall comply with OSHA (Occupational Safety and Health Administration) Parts 1910 and 1926 Construction Industry Standards and Interpretations, and with the supplement below:

Supplement to OSHA Parts 1910 and 1926 Construction Industry Standards and Interpretations

Requests for variances or waiver from this supplement are to be made to the Contracting Officer in writing supported by evidence that every reasonable effort has been made to comply with the contractual requirements. A written request for a waiver or a variance shall include--

- (1) Specific reference to the provision or standard in question;
- (2) An explanation as to why the waiver is considered justified; and
- (3) The Contractor's proposed alternative, including technical drawings, materials, or equipment specifications needed to enable Contracting Officer to render a decision.

No waiver or variance will be approved if it endangers any person. The Contractor shall not proceed under any requested revision of a provision until the Contracting Officer has given written approval. The Contractor is to hold and save harmless the Texas State Soil and Water Conservation Board and the Contracting Local Organization free from any claims or causes of action whatsoever resulting from the Contractor or Subcontractors proceeding under a waiver or approved variance.

Copies of OSHA Parts 1910 and 1926, Construction Industry Standards and Interpretations, may be obtained from:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402

A. GENERAL CONTRACTOR REQUIREMENTS

(1) **SAFETY PROGRAM.** Each Contractor is to demonstrate that he or she has facilities for conducting a safety program commensurate with the work under contract. The Contractor is to submit in writing a proposed comprehensive safety program to the Contracting Officer for approval before the start of operations. The program is to specifically state what provisions the Contractor proposes to take for the health and safety of all employees, including subcontractors and rental equipment operators. The program shall be site specific and provide details relevant to the work to be done, the hazards associated with the work, and the actions that will be necessary to minimize the identified hazards.

(2) **PRECONSTRUCTION SAFETY MEETING.** Representatives for the Contractor are to meet with the Contracting Officer or the CO's Representative before commencing work to discuss the safety program and the implementation of all health and safety standards pertinent to the work under this contract.

(3) **JOINT SAFETY POLICY COMMITTEE.** The Contractor or designated on-site representative is to participate in monthly meetings of a joint Safety Policy Committee, composed of Contracting Officer, CLO Engineer and/or Inspector, and Contractor supervisory personnel. At these meetings the Contractor's project manager and the Contracting Officer will review the effectiveness of the Contractor's safety effort, resolve current health and safety problems, and coordinate safety activities for upcoming work.

(4) **SAFETY PERSONNEL.** Each Contractor is to designate a competent supervisory employee satisfactory to Contracting Officer to administer the safety program.

(5) **SAFETY MEETINGS.** A minimum of one "on-the-job" or "toolbox" safety meeting is to be conducted each week by all field supervisors or foremen and attended by mechanics and all personnel at the jobsite. The Contractor is to also conduct regularly scheduled supervisory safety meetings at least monthly for all levels of job supervision.

(6) **SAFETY INSPECTION.** The Contractor shall perform frequent and regular safety inspections of the jobsite, materials, and equipment, and shall correct deficiencies.

(7) **FIRST AID TRAINING.** Every Contractor foreman's work crew must include an employee who has a current first aid certificate from the Mine Safety and Health Administration, American Red Cross, or other state-approved organization.

(8) **REPORTS.** Each contractor is to maintain an accurate record of all job-related deaths, diseases, or disabling injuries. The records shall be maintained in a manner approved by the Contracting Officer. A copy of all reports is to be provided to the Contracting Officer. All fatal or serious injuries are to be reported immediately to the Contracting Officer, and every assistance is to be given in the investigation of the incident, including submission of a comprehensive narrative report to the Contracting Officer. Other occurrences with serious accident potential, such as equipment failures, slides, and cave-ins, must also be reported immediately. The Contractor is to assist and cooperate fully with the Contracting Officer in conducting accident investigations. The Contracting Officer is to be furnished all information and data pertinent to investigation of an accident.

(9) **CERTIFICATION OF INSURANCE.** Contractors are to provide the Contracting Officer with certificates of insurance before the start of operations indicating full compliance with State Worker's Compensation statutes, as well as other certificates of insurance required under the contract. *[See PART III – Supplemental Conditions, Articles 1, 2, and 3.]*

B. FIRST AID AND MEDICAL FACILITIES

(1) **FIRST AID KITS.** A 16-unit first aid kit approved by the American Red Cross is to be provided at accessible, well-identified, locations at the ratio of at least 1 kit for each 25 employees. The first aid kits are to be moistureproof and dusttight, and the contents of the kits are to be replenished as used or as they become ineffective or outdated.

(2) **EMERGENCY FIRST AID.** At least one employee certified to administer emergency first aid must be available on each shift and duly designated by the Contractor to care for injured employees. The names of the certified employees shall be posted at the jobsite.

(3) **COMMUNICATION AND TRANSPORTATION.** Prior to the start of work, the Contractor is to make necessary arrangements for prompt and dependable communications, transportation, and medical care for injured employees. At least one stretcher and two blankets shall be readily available for transporting injured employees.

(4) **FIRST AID AND MEDICAL REPORTS.** The Contractor is to maintain a record system for first aid and medical treatment on the jobsite. Such records are to be readily available to the Contracting Officer and are to include--

(a) A daily treatment log listing chronologically all persons treated for occupational injuries and illnesses;

(b) Cumulative record of injury for each individual;

(c) Monthly statistical records of occupational injuries, classified by type and nature of injury; and

(d) Required records for worker's compensation.

(5) **SIGNS AND DIRECTIONAL MARKINGS.** Adequate identification and directional markers are to be provided to readily denote the location of all first aid stations.

(6) **EMERGENCY LISTING.** A listing of telephone numbers and addresses of doctor, rescue squad, hospital, police, and fire departments is to be provided at all first aid locations.

C. PHYSICAL QUALIFICATIONS OF EMPLOYEES

(1) **GENERAL REQUIREMENTS.** Persons employed throughout the contract are to be physically qualified to perform their assigned duties. Employees must not knowingly be permitted or required to work while their ability or alertness is impaired by fatigue, illness, or any other reason that may jeopardize themselves or others.

(2) **HOIST OPERATORS.** Operators of cranes, cableways, and other hoisting equipment shall be examined annually by a physician and provided with a certification stating that they are physically qualified to safely operate hoisting equipment. The Contractor is to submit a copy of each certification to the Contracting Officer.

(3) **HEAVY EQUIPMENT OPERATORS.** It is recommended that operators of trucks and heavy equipment be given physical examinations to determine if they are physically qualified to perform their assigned work without endangering themselves or others.

(4) **MOTOR VEHICLE OPERATORS.** Operators of motor vehicles engaged primarily in the transportation of personnel are to be 18 years of age or older and have a valid state operator's permit or license for the equipment being operated. The operators must have passed a physical exam administered by a licensed physician within the past year showing that they are qualified to operate vehicles safely.

D. PERSONAL PROTECTIVE EQUIPMENT

(1) **HARD HAT AREAS.** The entire jobsite, with the exception of offices, shall be considered a hard hat area. All persons entering the area are, without exception, required to wear hard hats. The Contractor shall provide hard hats for visitors entering hard hat areas.

(2) **LABELS.** Hard hats shall bear a manufacturer's label indicating design compliance with the appropriate ANSI (American National Standards Institute) standard.

(3) **POSTING.**

(a) Signs at least 3 by 4 feet worded as follows with red letters (minimum 6 inches high) and white background shall be erected at access points to designated hard hat areas:

CONSTRUCTION AREA - HARD HATS
REQUIRED BEYOND THIS POINT

(b) These signs are to be furnished and installed by the Contractor at entries to shops, service yards, and job access points.

(4) **SAFETY GOGGLES (DRILLERS).** DRILLERS AND HELPERS. Drillers and helpers operating pneumatic rock drills must wear protective safety goggles.

E. MACHINERY AND MECHANIZED EQUIPMENT

(1) **SAFE CONDITION.** Before any machinery or mechanized equipment is initially used on the job, it must be inspected and tested by qualified personnel and determined to be in safe operating condition and appropriate for the intended use. Operators shall inspect their equipment prior to the beginning of each shift. Any deficiencies or defects shall be corrected prior to using the equipment. Safety equipment, such as seatbelts, installed on machinery is to be used by equipment operators.

(2) **TAGGING AND LOCKING.** The controls of power-driven equipment under repair are to be locked. An effective lockout and tagging procedure is to be established, prescribing specific responsibilities and safety procedures to be followed by the person or persons performing repair work. Mixer barrels are to be securely locked out before permitting employees to enter them for cleaning or repair.

(3) **HAUL ROADS FOR EQUIPMENT**

(a) **ROAD MAINTENANCE.** The Contractor shall maintain all roadways, including haul roads and access roads, in a safe condition so as to eliminate or control dust and ice hazards. Wherever dust is a hazard, adequate dust-laying equipment shall be available at the jobsite and utilized to control the dust.

(b) **SINGLE-LANE HAUL ROADS.** Single-lane haul roads with two-way traffic shall have adequate turnouts. Where turnouts are not practical, a traffic control system shall be provided to prevent accidents.

(c) **TWO-WAY HAUL ROADS.** On two-way haul roads, arrangements are to be such that vehicles travel on the right side wherever possible. Signs and traffic control devices are to be employed to indicate clearly any variations from a right-hand traffic pattern. The road shall be wide enough to permit safe passage of opposing traffic, considering the type of hauling equipment used.

(d) **DESIGN AND CONSTRUCTION OF HAUL ROADS.** Haul road design criteria and drawings, if requested by the Contracting Officer, are to be submitted for approval prior to road construction. Sustained grades shall not exceed 12 percent and all curves shall have open-sight line with as great a radius as practical. All roads shall be posted with curve signs and maximum speed limits that will permit the equipment to be stopped within one-half the minimum sight distance.

(e) **OPERATORS.** Machinery and mechanized equipment shall be operated only by authorized qualified persons.

(f) **RIDING ON EQUIPMENT.** Riding on equipment by unauthorized personnel is prohibited. Seating and safety belts shall be provided for the operator and all passengers.

(g) **GETTING ON OR OFF EQUIPMENT.** Getting on or off equipment while the equipment is in motion is prohibited.

(h) **HOURS OF OPERATION.** Except in emergencies, an equipment operator shall not operate any mobile or hoisting equipment for more than 12 hours without an 8-hour rest interval away from the job.

(4) POWER CRANES AND HOISTS (TRUCK CRANES, CRAWLER CRANES, TOWER CRANES, GANTRY CRANES, HAMMERHEAD CRANES, DERRICKS, CABLEWAYS, AND HOISTS)

(a) **PERFORMANCE TEST.** Before initial on-site operation, at 12-month intervals, and after major repairs or modification, power cranes, derricks, cableways, and hoists must satisfactorily complete a performance test to demonstrate the equipment's ability to safely handle and maneuver the rated loads. The tests shall be conducted in the presence of a representative of the Contracting Officer (the Engineer and/or Inspector). Test data shall be recorded and a copy furnished to the Contracting Officer.

(b) **PERFORMANCE TEST--POWER CRANES (CRAWLER MOUNTED, TRUCK MOUNTED, AND WHEEL MOUNTED).** The performance test is to be carried out as per ANSI requirements. The test is to consist of raising, lowering and braking the load and rotating the test load through 360° at the specified boom angle or radius. Cranes equipped with jibs or boom tip extensions are to be tested using both the main boom and the jib, with an appropriate test load in each case.

(c) **PERFORMANCE TEST--DERRICKS, GANTRY CRANES, TOWER CRANES, CABLEWAYS, AND HOISTS, INCLUDING OVERHEAD CRANES.** This equipment is to be performance tested as per with ANSI requirements.

(d) **BOOM ANGLE INDICATOR.** Power cranes (including draglines) with booms capable of moving in the vertical plane shall be provided with a boom angle indicator in good working order.

(e) **CRANE TEST CERTIFICATION.** The performance test required by (4)(b) and (c) is fulfilled if the Contractor provides the Contracting Officer a copy of the certificate of inspection made within the past 12 months by a qualified person or by a government or private agency satisfactory to the Contracting Officer.

(f) **POSTING FOR HIGH VOLTAGE LINES.** A notice of the 10-foot (or greater) clearance required by OSHA 1926.550, Subpart N, shall be posted in the operator's cab of cranes, shovels, boom-type concrete pumps, backhoes, and related equipment.

(g) **BOOM STOPS.** Cranes or derricks with cable-supported booms, except draglines, shall have a device attached between the gantry of the A-frame and the boom chords to limit the elevation of the boom. The device shall control the vertical motions of the boom with increasing resistance from 83° or less, until completely stopping the boom at not over 87° above horizontal.

(h) **SAFETY HOOKS.** Hooks used in hoisting personnel or hoisting loads over construction personnel or in the immediate vicinity of construction personnel shall be forged steel equipped with safety keepers. When shackles are used under these conditions, they shall be of the locking type or have the pin secured to prohibit turning.

(5) ROLLOVER PROTECTIVE STRUCTURES (ROPS)

(a) **ROLLOVER PROTECTIVE STRUCTURES.** OSHA 1926, Subpart W, Overhead Protection, Sections 1001 and 1002 are applicable regardless of the year in which the equipment was manufactured and regardless of the struck capacity of the equipment.

(b) **EQUIPMENT REQUIRING ROPS.** The requirement for ROPS meeting (5)(a) above applies to crawler and rubber-tired tractors such as dozers, push-and-pull tractors, winch tractors, tractors with backhoes, and mowers; off-highway, self-propelled, pneumatic-tired earthmovers, including scrapers, motor graders and loaders; and rollers, compactors, water tankers (excluding trucks with cabs). These requirements shall also apply to agricultural and industrial tractors and similar equipment.

(c) **EQUIPMENT REQUIRING SEATBELTS.** The requirements for seatbelts as specified in OSHA Subpart O, Motor Vehicles, Mechanized Equipment, and Marine Operations, Section 1926.602 shall also apply to self-propelled compactors and rollers, and rubber-tired skid-steer equipment.

F. LADDERS AND SCAFFOLDING

(1) **LADDERS.** OSHA 1926, Subpart L - Section 450. Ladders shall be used as work platforms only when use of small hand tools or handling of light material is involved. No work requiring lifting of heavy materials or substantial exertion shall be done from ladders.

(2) **SCAFFOLDING.** OSHA 1926, Subpart L - Section 451. Scaffolds, platforms or temporary floors shall be provided for all work except that which can be done safely from the ground or similar footing.

(3) **SAFETY BELTS, LIFELINE, AND LANYARDS.** OSHA 1926, Subpart E, Section 104. Lifelines, safety belts and lanyards independently attached or attended, shall be used when performing such work as the following when the requirements of F(1) or (2) above cannot be met.

(a) Work on stored material in hoppers, bins, silos, tanks, or other confined spaces.

(b) Work on hazardous slopes, structural steel, or poles; erection or dismantling of safety nets, tying reinforcing bars; and work from Boatswain's chairs, swinging scaffolds, or other unguarded locations at elevations greater than 6 feet.

(c) Work on skips and platforms used in shafts by crews when the skip or cage does not block the opening to within 1 foot of the sides of the shaft, unless cages are provided.

PART III SUPPLEMENTAL CONDITIONS

Table of Contents

		<u>Page No.</u>
ARTICLE 1	TYPES AND LIMITS OF INSURANCE	SC-1
ARTICLE 2	SETTLEMENT OF INSURANCE CLAIMS	SC-2
ARTICLE 3	WORKERS' COMPENSATION INSURANCE COVERAGE.....	SC-2
ARTICLE 4	POST-AWARD INFORMATION	SC-4
ARTICLE 5	PERFORMANCE OF WORK BY CONTRACTOR	SC-4
ARTICLE 6	COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK	SC-4
ARTICLE 7	VENUE	SC-4
ARTICLE 8	WAGES / BENEFITS	SC-4
ARTICLE 9	ETHICS / CONFLICTS OF INTEREST	SC-5
ARTICLE 10	PROTESTS.....	SC-5
ARTICLE 11	DISPUTES / ALTERNATIVE DISPUTE RESOLUTION	SC-7
ARTICLE 12	INDEMNIFICATION CLAUSE.....	SC-8
ARTICLE 13	PERFORMANCE AND PAYMENT BONDS	SC-8
ARTICLE 14	EQUAL EMPLOYMENT OPPORTUNITY	SC-9
ARTICLE 15	CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION – LOWER TIERED COVERED TRANSACTIONS	SC-9

PART III - SUPPLEMENTAL CONDITIONS

ARTICLE 1 – TYPES AND LIMITS OF INSURANCE

Satisfactory certificates of insurance (COI) shall be filed with Contracting Local Organization prior to commencement of any work on this contract. Plum Creek Conservation District shall be listed as Certificate Holder. All approved Subcontractors also must file COI with PCCD that meets these Article 1 requirements. Insurance requirements stated below do not establish limits of the Contractor's or Subcontractor's liability.

(a) Workmen's Compensation and Employer's Liability Insurance

(1) Contractor shall provide workmen's compensation and employee's liability insurance at own expense. This insurance shall protect Contractor against all claims under applicable state workmen's compensation laws. 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 workmen's compensation law.

(2) The liability limits shall be not less than:

Workmen's Compensation	Statutory
Employer's Liability	\$500,000

(b) Comprehensive Automobile Liability Insurance

(1) Contractor shall provide comprehensive automobile liability insurance at own expense. This insurance shall be written in comprehensive form and shall protect Contractor against all claims for injuries to members of the public and damage to property of others arising from the use of motor vehicles, and shall cover operation on or off the site of all motor vehicles licensed for highway use, whether they are owned, non-owned, or hired.

(2) Policy shall list CLO as additional named insured per Article 1(f).

(3) The liability limits shall be not less than:

Combined single limit:	\$1 million each accident
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(c) Comprehensive General Liability Insurance

(1) Contractor shall provide comprehensive general liability insurance at own expense. This insurance shall be written in comprehensive form and shall protect Contractor against all claims arising from injuries to persons other than his/her employees or damage to property of Contracting Local Organization or others arising out of any act or omission of Contractor or his/her agents, employees, or subcontractors. The policy shall also include protection against claims insured by usual personal injury liability coverage, such as a "protective liability" endorsement to insure the contractual liability assumed by Contractor.

(2) To the extent that Contractor's work, or work under his/her direction, may require blasting, explosive conditions, or underground operations, the comprehensive general liability coverage shall contain no exclusion relative to blasting, explosion, collapse of building, or damage to underground property.

(3) Policy shall list CLO as additional named insured per Article 1(f).

(4) The liability limits shall be not less than:

Bodily injury	\$1 million each occurrence
Property damage	\$1 million each occurrence
Aggregate	\$2 million

(d) Umbrella Liability Policy. If aggregate of Comprehensive General Liability Insurance in (c)(4) above does not equal or exceed \$2 million, the Contractor shall provide umbrella liability policy at its own expense. This insurance shall protect Contractor against all claims in excess of the limits provided under the workmen's compensation and employer's liability, comprehensive automobile liability, and general liability policies. The liability limits of the umbrella liability policy shall not be less than \$2 million. The policy shall list CLO as additional named insured per Article 1(f).

(e) Policy Cancellation. Each policy shall contain a provision that the coverage afforded will not be canceled or materially changed until at least 30 days prior written notice has been given to the Contracting Local Organization or Contracting Officer.

(f) Additional Named Insured. The Contracting Local Organization (CLO) shall be listed as an additional named insured on Comprehensive Automobile Liability, Comprehensive General Liability, and Umbrella Liability policies

(g) Waiver of Subrogation. All policies of insurance shall waive all rights of subrogation against the Contracting Local Organization, its officers, employees and agents.

ARTICLE 2 – SETTLEMENT OF INSURANCE CLAIMS

Losses insured under policies that include Contracting Local Organization, as a named insured, shall be adjusted with Contracting Local Organization and made payable to Contracting Local Organization as trustee for the insureds, as their interests may appear.

ARTICLE 3 – WORKERS' COMPENSATION INSURANCE COVERAGE

Contractor shall provide worker's compensation insurance coverage as specified below at own expense.

(a) Definitions. (1) Certificate of coverage ("certificate")—A copy of a certificate of insurance, a certificate of authority to self-insure issued by the TX Department of Insurance, Division of Workers' Compensation, or a coverage agreement (DWC Form-81, DWC Form-82, DWC Form-83, or DWC Form-84), showing statutory workers' compensation insurance coverage for the person's or entity's employees providing services on a project, for the duration of the project.

(2) Duration of the project—Includes the time from the beginning of the work on the project until the Contractor's/person's work on the project has been completed and accepted by the Contracting Local Organization.

(3) Persons providing services on the project ("subcontractor" in §406.096, Texas Labor Code) includes all persons or entities performing all or part of the services the Contractor has undertaken to perform on the project, regardless of whether that person contracted directly with the Contractor and regardless of whether that person has employees. This includes, without limitation, independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity which furnishes persons to provide services on the project. "Services" include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to a project. "Services" does not include activities unrelated to the project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

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

(c) The Contractor must provide a certificate of coverage to the Contracting Local Organization prior to being awarded the contract.

(d) If the coverage period shown on the Contractor's current certificate of coverage ends during the duration of the project, the Contractor must, prior to the end of the coverage period, file a new certificate of coverage with the Contracting Local Organization showing that coverage has been extended.

(e) The Contractor shall obtain from each person providing services on a project, and provide to the Contracting Local Organization:

(1) A certificate of coverage, prior to that person beginning work on the project, so the Contracting Local Organization will have on file certificates of coverage showing coverage for all persons providing services on the project, and

(2) No later than seven days after receipt by the Contractor, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project.

(f) The Contractor shall retain all required certificates of coverage for the duration of the project and then in accordance with PART II, General Conditions, Article 37, Contractor Records.

(g) The Contractor shall notify the Contracting Local Organization in writing by certified mail or personal delivery, within 10 days after the Contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project.

(h) The Contractor shall post on each project site a notice [see paragraph (l) of this Article], in the text, form and manner prescribed by the Texas Department of Insurance, Division of Workers' Compensation, informing all persons providing services on the project that they are required to be covered, and stating how a person may verify coverage and report lack of coverage.

(i) The Contractor shall contractually require each person with whom it contracts to provide services on a project, to:

(1) Provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011 (44) for all of its employees providing services on the project, for the duration of the project;

(2) Provide to the Contractor, prior to that person beginning work on the project, a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the project, for the duration of the project;

(3) Provide the Contractor, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project;

(4) Obtain from each other person with whom it contracts, and provide to the Contractor:

- (i) a certificate of coverage, prior to the other person beginning work on the project; and
- (ii) a new certificate of coverage showing extension of coverage, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the project;

(5) Retain all required certificates of coverage on file for the duration of the project and then in accordance with PART II – General Conditions, Article 37 – Contractor Records;

(6) Notify the Contracting Local Organization in writing by certified mail or personal delivery, within 10 days after the person knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project; and

(7) Contractually require each person with whom it contracts, to perform as required by paragraphs (1) - (7), with the certificates of coverage to be provided to the person for whom they are providing services.

(j) By signing this contract or providing or causing to be provided a certificate of coverage, the Contractor is representing to the Contracting Local Organization that all employees of the Contractor who will provide services on the project will be covered by workers' compensation coverage for the duration of the project, that the coverage will be based on proper reporting of classification codes and payroll amounts, and that all coverage agreements will be filed with the appropriate insurance carrier or, in the case of a self-insured, with the TX Department of Insurance, Division of Workers' Compensation. Providing false or misleading information may subject the Contractor to administrative penalties, criminal penalties, civil penalties, or other civil actions.

(k) The Contractor's failure to comply with any of these provisions is a breach of contract by the Contractor which entitles the Contracting Local Organization to declare the contract void if the Contractor does not remedy the breach within ten days after receipt of notice of breach from the Contracting Local Organization.

(l) Posting of Notice: "REQUIRED WORKER'S COMPENSATION COVERAGE"

"The law requires that each person working on this site or providing services related to this construction project must be covered by workers' compensation insurance. This includes persons providing, hauling, or delivering equipment or materials, or providing labor or transportation or other service related to the project, regardless of the identity of their employer or status as an employee.

Call the Division of Workers' Compensation at 1-800-252-7031 or access the division's website at **www.tdi.texas.gov/wc/indexwc.html** to receive information on the legal requirement for coverage, to verify whether your employer has provided the required coverage, or to report an employer's failure to provide coverage."

ARTICLE 4 – POST-AWARD INFORMATION

Within five (5) workdays after receipt of Notice of Award, Contractor shall submit to the Contracting Officer the following post-award information:

- (a) Two (2) fully executed counterparts of the Contract Agreement including all the contract documents.
- (b) Performance and payment bonds as specified in Article 13 of these Supplemental Conditions.
- (c) Copy of all insurance certificates required in Articles 1, 2, and 3 of these Supplemental Conditions.
- (d) List of proposed subcontractors required in PART II, General Conditions, Article 21(a).
- (e) Major equipment schedule per PART II, General Conditions, Article 8(a). A firm commitment in writing from all suppliers of equipment that will be leased shall be provided. Equipment shall be open to inspection prior to award of the contract or commencement of work to verify soundness and reliability.
- (f) Contractor's proposed workweek (days and clock hours) per PART II, General Conditions, Article 20(a).
- (g) For a nonresident bidder who is a corporation, limited partnership, or limited liability company: a current Certificate of Authority from Texas Secretary of State, if not yet provided.
- (h) Form CIQ, Conflict of Interest Questionnaire, as required by Article 9 of these Supplemental Conditions.

Should the bidder to whom the contract is awarded fail or refuse to enter into a proper contract with the CLO, or fail or refuse to comply with these conditions within the time specified, the bidder forfeits the bid guarantee, and/or the CLO may pursue any other action allowed by law.

ARTICLE 5 – PERFORMANCE OF WORK BY CONTRACTOR

The Contractor shall perform on the site, and with its own organization, work equivalent to at least twenty (20) percent of the total amount of work to be performed under the Contract. This percentage may be reduced by a supplemental agreement to this contract if, during the performance of the work, the Contractor requests a reduction and the Contracting Officer determines that the reduction would be to the advantage of the Contracting Local Organization.

ARTICLE 6 – COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK

- (a) Contractor shall be required to:
 - (1) Commence work under this contract within twenty (20) calendar days from the date of receipt of written Notice to Proceed [note: performance time commences the day after Notice to Proceed is received];
 - (2) Prosecute the work diligently; and
 - (3) Complete the entire work ready for use not later than three hundred seventy-six (376) calendar days from the day after Notice to Proceed is received by Contractor.
- (b) The time stated for completion shall include final cleanup of the premises.

ARTICLE 7 – VENUE

This contract shall be governed, construed and interpreted under the laws of the State of Texas. This contract is performable in Hays County, Texas. The Contracting Local Organization has domicile in Caldwell County, Texas, and any legal action must be filed in Caldwell County, Texas.

ARTICLE 8 – WAGES / BENEFITS**8.1 General**

Contractor shall pay or cause to be paid, without cost or expense to Contracting Local Organization, all Social Security, Unemployment and Federal Income Withholding Taxes of all such employees, and all such employees shall be paid wages and benefits as required by Federal and/or State law (including but not restricted to unemployment compensation coverage) and per wage rates requirements in Article 8.2 below. In accordance with Texas Labor Code §61.012, Contractor shall post in conspicuous places in the workplace notices indicating the paydays.

8.2 Laborers and Mechanics – Prevailing Wage Rates

- (a) This contract requires the Contractor and any of his/her subcontractors at any tier to pay prevailing wage rates as specified in this article and to follow requirements contained in Texas Government Code, Chapter 2258, Prevailing Wage Rates.

(b) A copy of the Prevailing Wage Rates Determination that must be followed is included in PART VI of the contract.

(c) A worker employed or working upon the site of the work shall be paid the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) computed at rates not less than those contained in the Prevailing Wage Rates Determination for regular work and for legal holiday and overtime work, regardless of any contractual relationship which may be alleged to exist between the Contractor and such workers. "Worker" includes laborers or mechanics.

(d) Workers shall be paid not less than the appropriate wage rate and fringe benefits in the wage determination for the classification of work actually performed, without regard to skill. Those performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein; provided that the employer's payroll records accurately set forth the time spent in each classification in which work is performed.

(e) The wage determination shall be posted at all times by the Contractor and subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by workers.

(f) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the Contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(g) The Contractor or subcontractor shall insert in any subcontracts this Article 8, and also a clause requiring subcontractors to include Article 8 in any lower tier subcontracts. The Prime Contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with this article.

(h) Payroll records. A Contractor and subcontractor shall keep a record showing: (i) the name and occupation of each worker (includes a laborer or mechanic) employed by the Contractor or subcontractor in the construction of the public work; and (ii) the actual per diem wages paid to each worker. The record shall be open at all reasonable hours to inspection by the officers and agents of the Contracting Local Organization and others as required by PART II, General Conditions, Article 37 (Contractor Records).

(i) A Contractor or subcontractor who violates this article shall pay to the Contracting Local Organization a penalty of \$60 for each worker employed for each calendar day or part of the day that the worker is paid less than the wage rates stipulated.

ARTICLE 9 – ETHICS / CONFLICTS OF INTEREST

(a) Texas Local Government Code Chapter 171 provisions apply to award of this contract.

(b) A bidder and/or Contractor shall not offer or accept gifts or anything of value nor enter into any business arrangement with any employee, official or agent of the Contracting Local Organization or Texas State Soil and Water Conservation Board.

(c) Contractor shall submit Form CIQ, Conflict of Interest Questionnaire, to PCCD with its Post-Award Information (see Article 4 of these General Conditions) and update the submittal if there are any changes during performance of the contract.

(d) Section 2252.908, Texas Government Code, as amended, required that all contracts with private business entities requiring approval by the PCCD Board of Directors, and/or with the amount of the contract being in excess of \$1,000,000, will require the on-line completion of Form 1295, Certificate of Interested Parties. Form 1295 is also required for any and all contract amendments, extensions or renewals. The awarded Contractor will be required to complete and file electronically with the Texas Ethics Commission using the online filing application. If you have any questions about compliance, please consult your own legal counsel. Compliance is the individual responsibility of the Contractor. Please visit State of Texas Ethics Commission websites for more information: <https://www.ethics.state.tx.us>

ARTICLE 10 – PROTESTS

(a) Any actual or prospective bidder, offeror, proposer, or contractor who is aggrieved in connection with the solicitation, evaluation, or award of a contract may formally protest to the Contracting Officer. Such protests must be in writing and received by the Contracting Officer within ten working days after such aggrieved person knows, or should have known, of the occurrence of the action which is protested. Formal protests must conform to the requirements of this article and subsection (c) of this article, and shall be resolved in accordance with the procedure set forth in subsections (d) and (e) of this article. Copies of the protest must be mailed or delivered by the protesting person to the project manager, if any, and other

interested persons. For the purposes of this section, "interested persons" means all vendors who have submitted bids or proposals for the contract involved.

(b) In the event of a timely protest or appeal under this section, the Contracting Local Organization shall not proceed further with the solicitation or with the award of the contract unless the Contracting Officer makes a written determination that the award of a contract without delay is necessary to protect substantial interests of the state.

(c) A formal protest must be sworn and notarized and contain:

(1) a specific identification of the statutory or regulatory provision(s) that the action complained of is alleged to have violated;

(2) a specific description of each act alleged to have violated the statutory or regulatory provision(s) identified in paragraph (1) of this subsection;

(3) a precise statement of the relevant facts;

(4) an identification of the issue or issues to be resolved;

(5) argument and authorities in support of the protest; and

(6) a statement that copies of the protest have been mailed or delivered to other identifiable interested persons.

(d) The Contracting Officer may settle and resolve the dispute concerning the solicitation or award of a contract by mutual agreement with the protesting person. The Contracting Officer may solicit written responses to the protest from other interested persons.

(e) If the protest is not resolved by mutual agreement, the Contracting Officer will issue a written determination on the protest.

(1) If the Contracting Officer determines that no violation of rules or statutes has occurred, he or she shall inform the protesting person and other interested persons by letter which sets forth the reasons for the determination.

(2) If the Contracting Officer determines that a violation of the rules or statutes has occurred in a case where a contract has not been awarded, he or she shall inform the protesting person and other interested persons by letter that sets forth the reasons for the determination and the appropriate remedial action.

(3) If the Contracting Officer determines that a violation of the rules or statutes has occurred in a case where a contract has been awarded, he or she shall inform the protesting person and other interested persons by letter which sets forth the reasons for the determination, and the appropriate remedial action, which may include ordering the contract void.

(f) After the Contracting Officer's determination has been made, the aggrieved person or interested persons may request reconsideration of the Contracting Officer's determination to be made by the Plum Creek Conservation District Board President or his/her designee. Such request must be in writing and must be received in the Board office no later than ten working days after the date of the Contracting Officer's determination, which shall be calculated from the date the Contracting Officer's letter is hand-delivered, delivered by a nationally recognized courier service, or mailed by certified or registered mail. The request shall be limited to review of the Contracting Officer's determination. Copies of the request must be mailed or delivered by the aggrieved person to other interested persons. The request must contain an affidavit that such copies have been provided.

(g) The Plum Creek Conservation District Board President shall issue a final determination on the protest within 15 days after receipt of the aggrieved person's request for reconsideration.

(h) A decision issued in writing by the Plum Creek Conservation District Board President in response to a request for reconsideration shall be the final administrative action of the Board.

(i) Unless good cause for delay is shown or the Contracting Officer or Plum Creek Conservation District Board President determines that a protest or appeal raises issues significant to procurement practices or procedures, a protest or appeal that is not filed timely will not be considered.

(j) In the event of a protest, all documents collected by the Plum Creek Conservation District Board as part of a solicitation, evaluation, and/or award of a contract shall be retained by the Board for a period of four years to include the current fiscal year and three additional fiscal years.

ARTICLE 11 – DISPUTES / ALTERNATIVE DISPUTE RESOLUTION (ADR)

[This article supplements PART II, General Conditions, Article 6 – Claims]

11.1 Claims

(a) The Contracting Local Organization's policy is to try to resolve all contractual issues in controversy by mutual agreement at the Contracting Officer's level. Reasonable efforts should be made to resolve controversies prior to the submission of a claim. Use of ADR procedures to the maximum extent practicable is encouraged.

(b) Initiation of a claim. (1) Contractor claims shall be submitted, in writing, to the Contracting Officer for a decision no later than the 180th day after accrual of a claim. The claim must state with particularity the nature of the breach, the amount the Contractor seeks as damages, and the legal theory of recovery. The Contracting Officer shall document the contract file with evidence of the date of receipt of any submission from the Contractor deemed to be a claim by the Contracting Officer. The Contracting Officer must assert, in a writing delivered to the Contractor, any counterclaim not later than the 90th day after the date of receipt of Contractor's written claim

(2) The Contracting Local Organization shall issue a written decision on any Contracting Local Organization claim initiated against a Contractor no later than the 180th day after accrual of the claim. This time period shall not apply to a Contracting Local Organization claim based on a Contractor claim involving fraud.

(c) Contractor certification. Contractor shall provide the certification specified below when submitting any claim exceeding \$100,000, or regardless of the amount claimed when using ADR procedures. The certification requirement does not apply to issues in controversy that have not been submitted as all or part of a claim. The certification may be executed by any person duly authorized to bind the Contractor with respect to the claim. The certification shall state as follows:

"I certify that the claim is made in good faith; that the supporting data are accurate and complete to the best of my knowledge and belief; that the amount requested accurately reflects the contract adjustment for which the Contractor believes the Contracting Local Organization is liable; and that I am duly authorized to certify the claim on behalf of the Contractor."

(d) The Contracting Local Organization shall pay interest on a Contractor's claim on the amount found due and unpaid from the date that the Contracting Officer receives the claim (certified if required by Article 11.1(c) above); or payment otherwise would be due, if that date is later, until the date of payment. If a claim has a defective certification, interest shall be paid from the date that the Contracting Local Organization receives a proper certification. Amount of interest due will be per Texas and local law and regulation.

11.2 Alternative Dispute Resolution (ADR)

(a) The objective of using ADR procedures is to increase the opportunity for relatively inexpensive and expeditious resolution of issues in controversy. Essential elements of ADR include:

- (1) Existence of an issue in controversy,
- (2) A voluntary election by both parties to participate in the ADR process,
- (3) An agreement on alternative procedures and terms to be used in lieu of formal litigation,
- (4) Participation in the process by officials of both parties who have the authority to resolve the issue in controversy, and

(5) Certification by the Contractor in accordance with Article 11.1(c) when using ADR procedures to resolve all or part of a claim.

(b) If either party rejects a request for ADR from the other party, the rejecting party shall inform the other party in writing of the specific reasons for rejecting the request, including but not limited to why ADR procedures are inappropriate for the resolution of the dispute.

(c) ADR procedures may be used at any time that the Contracting Officer has authority to resolve the issue in controversy. If a claim has been submitted, ADR procedures may be applied to all or a portion of the claim. When ADR procedures are used subsequent to the issuance of a Contracting Officer's final decision, their use does not constitute a reconsideration of the final decision.

(d) When appropriate, a neutral person may be used to facilitate resolution of the issue in controversy using the procedures chosen by the parties.

(e) The rights of Contracting Local Organization and Contractor to exercise such rights or remedies as either party may otherwise have under the contract or by laws or regulations in respect of any claims, disputes, and other issues in controversy are not affected by action taken under this Article.

(f) ADR procedures must be consistent with Chapter 154, Texas Civil Practice and Remedies Code, and Chapter 2009, Texas Government Code, Alternative Dispute Resolution for Use by Governmental Bodies.

11.3 Definitions

(a) Accrual of a claim occurs on the date when all events, which fix the alleged liability of either the Contracting Local Organization or the Contractor and permit assertion of the claim, were known or should have been known. For liability to be fixed, some injury must have occurred. However, monetary damages need not have been incurred.

(b) Alternative dispute resolution (ADR) means any procedure or combination of procedures voluntarily used to resolve issues in controversy without the need to resort to litigation. These procedures may include, but are not limited to, assisted settlement negotiations, conciliation, facilitation, mediation, fact-finding, mini-trials, and arbitration.

(c) Claim as used in this Article means a written demand or written assertion by one of the contracting parties seeking as a matter of right, the payment of money in a sum certain, the adjustment or interpretation of contract terms, or other relief arising under or relating to the contract. A claim arising under a contract, unlike a claim relating to that contract, is a claim that can be resolved under a contract clause that provides for the relief sought by the claimant. However, a written demand or written assertion by the contractor seeking the payment of money exceeding \$100,000 is not a claim under this Article until certified as required by Article 11.1(c) above. A voucher, invoice, or other routine request for payment that is not in dispute when submitted is not a claim. The submission may be converted to a claim, by written notice to the Contracting Officer within time limits in section 11.1(b) of this Article, if it is disputed either as to liability or amount or is not acted upon in a reasonable time.

(d) Defective certification as used in this Article means a certificate which alters or otherwise deviates from the language in this Article or which is not executed by a person duly authorized to bind the Contractor with respect to the claim. Failure to certify shall not be deemed to be a defective certification.

(e) Issue in controversy means a material disagreement between the Contracting Local Organization and the Contractor which:

- (1) May result in a claim, or
- (2) Is all or part of an existing claim.

(f) Misrepresentation of fact as used in this Article means a false statement of substantive fact, or any conduct which leads to the belief of a substantive fact material to proper understanding of the matter in hand, made with intent to deceive or mislead.

(g) Neutral person as used in this Article means an impartial third party, who serves as a mediator, fact finder, or arbitrator, or otherwise functions to assist the parties to resolve the issues in controversy. A neutral person may be a permanent or temporary officer or employee of the Contracting Local Organization, or the Federal government, or any other individual who is acceptable to the parties. A neutral person shall have no official, financial, or personal conflict of interest with respect to the issues in controversy, unless such interest is fully disclosed in writing to all parties and all parties agree that the neutral person may serve. An "impartial third party" must possess the qualifications required under Section 154.052, Texas Civil Practice and Remedies Code.

ARTICLE 12 – INDEMNIFICATION CLAUSE

The Contractor shall defend, indemnify, and hold harmless the Contracting Local Organization, all of its officers, agents and employees from and against all claims, actions, suits, demands, proceedings, costs, damages, and liabilities, arising out of, connected with, or resulting from any acts or omissions of Contractor or any agent, employee, subcontractor, or supplier of Contractor in the execution of performance of this contract.

ARTICLE 13 – PERFORMANCE AND PAYMENT BONDS

13.1 General

(a) This contract requires performance and payment bonds as outlined in 13.2 below. Such bonds are due within five (5) workdays after receipt of Notice of Award (see Article 4 of these Supplemental Conditions). The Contracting Local Organization will attach to the Notice of Award the bond forms to be used.

(b) Bonds shall be made payable to: Plum Creek Conservation District.

(c) Bonds are subject to requirements stated in this Article and requirements of Texas Government

Code, Chapter 2253, Public Work Performance and Payment Bonds, and must be executed by a corporate surety in accordance with Texas Insurance Code, Chapter 3503 (Surety Bonds and Related Instruments), Subchapter A.

13.2 Performance and Payment Bonds—Construction

(a) **Definitions.** As used in this clause-- "Contract price" means the award price of the contract. "Government" means the Contracting Local Organization.

(b) The successful offeror shall be required to furnish performance and payment bonds to the Contracting Officer as follows:

(1) **Performance Bond:**

- (i) The penal amount of performance bond shall be 100 percent of the original contract price.
- (ii) The Government may require additional performance bond protection when the contract price is increased. The increase in protection shall generally equal 100 percent of the increase in contract price.
- (iii) The Government may secure additional protection by directing the Contractor to increase the penal amount of the existing bond or to obtain an additional bond.

(2) **Payment Bond:**

- (i) The penal amount of payment bond shall be 100 percent of the original contract price.
- (ii) The Government may require additional performance bond protection when the contract price is increased. The increase in protection shall generally equal 100 percent of the increase in contract price.
- (iii) The Government may secure additional protection by directing the Contractor to increase the penal sum of the existing bond or to obtain an additional bond.

(c) The Contractor shall furnish all executed bonds, including any necessary reinsurance agreements, to the Contracting Officer, within the time period specified in 13.1 above.

(d) A bond may be executed only by a corporate surety company that is authorized and admitted to write surety bonds in the State of Texas.

(e) For both the Performance bond and Payment bond, the surety must (i) hold a certificate of authority from the United States Secretary of the Treasury to qualify as a surety on obligations permitted or required under federal law; or (ii) have obtained reinsurance for any liability in excess of \$1,000,000 from a reinsurer that is an authorized reinsurer in the State of Texas or is a holder of a certificate of authority from the United States Secretary of the Treasury to qualify as a surety or reinsurer on obligations permitted or required under federal law. U.S. Treasury Department Circular 570 is published in the *Federal Register* and lists Treasury approved surety companies and their underwriting limitations.

(f) All bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.

(g) A bond required under this Article must clearly and prominently display on the bond or on an attachment to the bond: (1) the name, mailing address, physical address, and telephone number, including the area code, of the surety company to which any notice of claim should be sent; or (2) the toll-free telephone number maintained by the Texas Department of Insurance under Subchapter B, Chapter 521, Insurance Code, and a statement that the address of the surety company to which any notice of claim should be sent may be obtained from the Texas Department of Insurance by calling the toll-free telephone number.

ARTICLE 14 – EQUAL EMPLOYMENT OPPORTUNITY

Contractor will not discriminate against any employee or applicant for employment because of race, religion, ethnicity, gender, age, national origin, disability, veterans status or any other status or condition protected by applicable Federal and State laws. Contractor will take affirmative action to ensure that applicants and employees are not discriminated against.

ARTICLE 15 – CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION—LOWER TIER COVERED TRANSACTIONS

Contractor shall not subcontract to perform work under this contract with any firm that is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency, or with a firm that is presently on the State of Texas debarred vendor list maintained by the Texas Comptroller of Public Accounts.

PART IV: SPECIFICATIONS

Plum Creek Watershed – Site 2 UPGRADE

Construction Specifications

No.	Title	Total # Pages	Spec Date
Site Preparation			
2	Clearing and Grubbing	4	5/01
3	Structure Removal	4	5/01
5	Pollution Control	6	1/14
6	Seeding, Sprigging, and Mulching	6	9/18
7	Construction Surveys	4	1/09
8	Mobilization and Demobilization	4	5/01
9	Traffic Control	4	5/01
Foundation Work			
11	Removal of Water	4	5/01
Earthwork			
21	Excavation	8	5/01
23	Earthfill	10	2/20
24	Drainfill	6	5/01
26	Topsoiling	4	5/01
Concrete and Reinforcement			
31	Concrete for Major Structures	20	9/18
34	Steel Reinforcement	6	9/18
36	Roller Compacted Concrete	20	9/18
Nonmetal Pipe Conduits and Drains			
41	Reinforced Concrete Pressure Pipe Conduits	4	1/14
45	Plastic Pipe	10	1/09
53	Ductile-Iron Pipe	4	5/01
Riprap and Slope Protection			
61	Rock Riprap	4	9/18
Water Control Gates and Valves			
71	Water Control Gates	4	5/01
Miscellaneous Structural Work			
81	Metal Fabrication and Installation	4	5/01
Miscellaneous Construction			
91	Chain Link Fence	4	9/18
92	Field Fence	4	1/09
94	Contractor Quality Control	10	1/09
95	Geotextile	4	1/14
99	Conduit Abandonment	6	2/15
401	Geotechnical Instrumentation	18	7/21

Material Specifications

No.	Title	# Pages	Date
Aggregates and Rock			
521	Aggregates for Drainfill and Filters	2	1/2014
522	Aggregates for Portland Cement Concrete	2	5/2001
523	Rock for Riprap	4	9/2018
524	Aggregates for Roller Compacted Concrete	2	1/2014
Concrete Materials			
531	Portland Cement	2	5/2001
532	Supplementary Cementitious Materials	2	4/2015
533	Chemical Admixtures for Concrete	2	11/2005
534	Concrete Curing Compound	2	1/2009
535	Preformed Expansion Joint Filler	2	5/2001
536	Sealing Compound for Joints for Concrete and Concrete Pipe	2	9/2018
537	Nonmetallic Waterstops	4	5/2001
539	Steel Reinforcement (for concrete)	2	1/2009
Nonmetal Pipe and Fittings			
541	Reinforced Concrete Pressure Pipe	4	5/2001
547	Plastic Pipe	4	10/2017
553	Ductile-Iron Pipe	2	1/2014
Water Control Gates and Valves			
571	Slide Gates	6	9/2018
Miscellaneous Structural Materials			
581	Metal	2	11/2005
582	Galvanizing	2	5/2001
Miscellaneous Construction Materials			
591	Field Fencing Material	2	9/2018
592	Geotextile	4	9/2018

Construction Specification 2—Clearing and Grubbing

1. Scope

The work consists of clearing and grubbing and disposal of trees, snags, logs, brush, stumps, shrubs, and rubbish from the designated areas.

2. Protection of existing vegetation

Trees and other vegetation designated to remain undisturbed shall be protected from damage throughout the duration of the construction period. Any damages resulting from the contractor's operations or neglect shall be repaired by the contractor.

Earthfill, stockpiling of materials, vehicular parking, and excessive foot or vehicular traffic shall not be allowed within the drip line of vegetation designated to remain in place. Vegetation damaged by any of these or similar actions shall be replaced with viable vegetation of the same species, similar condition, and like size unless otherwise approved by the contracting officer.

Any cuts, skins, scrapes, or bruises to the bark of the vegetation shall be carefully trimmed and local nursery accepted procedures used to seal damaged bark.

Any limbs or branches 0.5 inch or larger in diameter that are broken, severed, or otherwise seriously damaged during construction shall be cut off at the base of the damaged limb or branch flush with the adjacent limb or tree trunk. All roots 1-inch or larger in diameter that are cut, broken, or otherwise severed during construction operations shall have the end smoothly cut perpendicular to the root. Roots exposed during excavation or other operations shall be covered with moist earth or backfilled as soon as possible to prevent the roots from drying out.

3. Marking

The limits of the area(s) to be cleared and grubbed will be marked by stakes, flags, tree markings, or other suitable methods. Trees to be left standing and uninjured will be designated by special markings placed on the trunk about 6 feet above the ground surface.

4. Clearing and grubbing

All trees not marked for preservation and all snags, logs, brush, stumps, shrubs, rubbish, and similar materials shall be cleared from within the limits of the designated areas. Unless otherwise specified, all stumps, roots, and root clusters that have a diameter of 1 inch or larger shall be grubbed out to a depth of at least 2 feet below subgrade for concrete structures and 1 foot below the ground surface at embankment sites and other designated areas.

5. Disposal

All materials cleared and grubbed from the designated areas shall be disposed of at locations shown on the drawings or in a manner specified in section 7. The contractor is responsible for complying with all local rules and regulations and the payment of any and all fees that may result from disposal at locations away from the project site.

6. Measurement and payment

Method 1—For items of work for which specific units prices are established in the contract, the cleared and grubbed area is measured to the nearest 0.1 acre. Payment for clearing and grubbing is made for the total area within the designated limits at the contract unit price. Such payment will constitute full compensation for all labor, equipment, tools, and all other items necessary and incidental to the completion of the work.

Method 2—For items of work for which specific unit prices are established in the contract, the length of the cleared and grubbed area is measured to the nearest full station (100 feet) along the line designated on the drawing or identified in the specifications. Payment for clearing and grubbing is made for the total length within the designated limits at the contract unit price. Such payment will constitute full compensation for all labor, equipment, tools, and all other items necessary and incidental to the completion of the work.

Method 3—For items of work for which specific unit prices are established in the contract, each tree, stump, and snag having a diameter of 4 inches or larger and each log having a diameter of 4 inches or larger and a length of 10 feet are measured before removal. The size of each tree and snag is determined by measuring its trunk at breast height above the natural ground surface. The size of each log is determined by measuring the butt and by measuring its length from butt to tip. The size of each stump is measured at the top. Diameter is determined by dividing the measured circumference by 3.14.

Payment for clearing and grubbing of each tree, stump, and snag having a diameter of 4 inches or larger and each log having a diameter of 4 inches or larger and a length of 10 feet or larger is made at the contract unit price for its size designation as determined by the following schedule:

Measured diameter (in)	Size designation (in)
4 to 8	6
8 to 12	10
12 to 24	18
24 to 36	30
36 to 60	48
Over 60	60

The sum of such payments shall constitute full compensation for clearing and grubbing (including the clearing and grubbing of smaller trees, stumps, snags, logs, brush, shrubs, and roots), applicable permits and associated fees, and rubbish removal. Such payment shall constitute full compensation for all labor, equipment, tools, and all other items necessary and incidental to the completion of the work.

Method 4—For items of work for which specific lump sum prices are established in the contract, payment for clearing and grubbing is made at the contract lump sum price. Such payment shall constitute full compensation for all labor, equipment, tools, and all other items necessary and incidental to the completion of the work.

All Methods—The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 7.

7. Items of work and construction details

7. Items of Work and Construction Details

In Section 5, Disposal, all materials removed from the cleared and grubbed areas shall be chipped and used on-site for mulch or disposed of at an offsite disposal area of the Contractor's own choosing in accordance with state and local regulations, or buried at areas designated or approved by the Engineer.

In Section 6, Measurement and payment, Method 1 shall apply.

Locations for buried materials shall be designated at the time of the showing of the site to prospective bidders. Buried material shall have a minimum earthfill cover of not less than 2 feet. The cover shall be placed in two lifts with each lift compacted by traversing the entire surface with one tread track of the material placement equipment. The top lift shall be mounded at least 6 inches higher than the surrounding undisturbed area to prevent unsightly depressions after settlement. The finished surface of the disposal area shall be uniformly graded to prevent ponding of water.

All trees, snags, logs, brush, shrubs, stumps, and rubbish that are felled, detached, or otherwise dislocated in or near stream channels shall be disposed of as specified or removed to higher ground prior to the end of each workday. The Contractor is to take precaution, when temporarily stockpiling cleared and grubbed materials, to guard against such cleared and grubbed materials being floated or transported off the worksite by rainstorm runoff.

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item 1, Clearing and Grubbing

- (1) This item shall consist of all clearing and grubbing and disposal within the work limits. This includes the disposal of existing brush piles and downed debris required for construction of the works of improvement as shown on the drawings.
- (2) The actual limits of required clearing and grubbing will be as designated or staked at the time of the showing the site to prospective bidders.
- (3) Existing brush piles and downed debris shall be disposed as specified above and shall be designated at the time of the showing the site to prospective bidders.
- (4) Upon completion of the clearing and grubbing operation, all areas which have been cleared and grubbed shall be dressed to be reasonably smooth by blading, dragging or floating. The entire area shall be reasonably free of abrupt mounds, dips and windrows to provide a clear area for construction staking.

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Construction Specification 3—Structure Removal

1. Scope

The work shall consist of the removal, salvage, and disposal of structures (including fences) from the designated areas.

2. Marking

Method 1—Each structure or structure part to be removed will be marked with stakes, flags, paint, or other suitable method.

Method 2—The area boundaries from which structures must be removed will be marked using stakes, flags, paint, or other suitable method. Structures to remain undisturbed or to be salvaged will be designated by special markings.

3. Removal

Method 1—All structures designated for removal in the contract shall be removed to the specified extent and depth.

Method 2—Within the areas so marked, all visible and buried structures identified shall be removed to the specified extent and depth.

4. Salvage

Structures or structure parts that are designated to be salvaged shall be carefully removed and neatly placed in the specified or approved storage location. Salvaged structures that are capable of being disassembled shall be dismantled into individual members or sections. Such structures shall be neatly and systematically match marked with paint before disassembly. All connectors and other parts shall be marked to indicate their proper location within the structure and shall be fastened to the appropriate structural member or packed in suitable containers.

Material from fences designated to be salvaged shall be placed outside the work area on the property on which the fence was originally located. Fence wire shall be rolled into uniform rolls of suitable size and neatly piled with other salvaged materials. Posts and rails shall be neatly stacked.

5. Disposal of refuse materials

Refuse materials resulting from structure removal shall be disposed of in a manner and at locations specified in section 7 of this specification or in an acceptable manner and at locations approved by the contracting officer. Disposal by burning shall be in accordance with local rules and regulations.

6. Measurement and payment

Method 1—For items of work for which specific unit prices are established by the contract, payment for the removal of each structure unit, except fences, is made at the contract unit price. Fences removed or removed and salvaged are measured to the nearest linear foot. Payment for fence removal or removal and salvage is made at the contract unit prices for each type and size of fence.

Such payment will constitute full compensation for all labor, equipment, tools, applicable permits and associated fees for burning and disposal of refuse, and all other items necessary and incidental to the completion of the work.

Method 2—For items of work for which specific lump sum prices are established by the contract, payment for structure removal is made at the contract lump sum price.

Such payment will constitute full compensation for all labor, equipment, tools, applicable permits and associated fees for burning and disposal of refuse, and all other items necessary and incidental to the completion of the work.

All Methods—The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed as a contract line item number in the bid schedule, is included in the payment for the item of work to which it is made subsidiary. Such items and items to which they are made subsidiary are identified in section 7 of this specification.

7. Items of work and construction details

7. Items of Work and Construction Details

In Section 2, Marking, Method 1 shall apply.

Disposal shall be at off-site locations in compliance with local codes.

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item 2, Structure Removal, Existing Fences

- (1) This item shall consist of the removal and disposal of all designated fences in the construction area.
- (2) The limits of fences to be removed shown on the drawings are approximate. Additionally, some fences may exist within the construction areas that are not delineated on the drawings. The actual limits of fences required to be removed will be marked on the site at the time of the showing of the site to prospective bidders.
- (3) In Section 3, Removal, Method 2 shall apply. The fences shall be removed to the bottom of the footing and/or post.
- (4) In Section 6, Measurement and payment, Method 2 shall apply.

b. Bid Item 3, Structure Removal, Existing Principal Spillway

- (1) This item shall consist of removing and disposing of the existing principal spillway inlet structure, specified segments of the existing reinforced concrete pipe, concrete cradle, and removing and disposing of all miscellaneous metalwork and equipment including, but not limited, to: concrete reinforcement, metal grating, and trash racks.
- (2) The existing principal spillway conduit shall be used for dewatering and shall remain open until the new principal spillway system, including inlet, conduit, impact basin, and outlet channel are constructed and fully operational, and the dam is reconstructed to the full design cross-section over the conduit.
- (3) In Section 3, Removal, Method 1 shall apply. The limits of removal shall be as shown on the drawings.
- (4) In Section 6, Measurement and payment, Method 2 shall apply.
- (5) Items of Work subsidiary to this bid item are:
 - (a) Excavation, Common, Structure Removal as specified in Construction Specification 21.
 - (b) Earthfill, Structure Removal as specified in Construction Specification 23.

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Construction Specification 5—Pollution Control

1. Scope

The work consists of installing measures or performing work to control erosion and minimize the production of sediment and other pollutants to water and air from construction activities.

The following BioPreferred® product categories are applicable to this specification:

- mulch and compost materials
- erosion control materials
- fertilizers
- dust suppressants
- agricultural spray adjuvants

2. Material

Silt fence shall conform to the requirement of Materials Specification 592, Geotextile. All other material furnished shall meet the requirements of the material specifications listed in section 8 of this specification.

3. Erosion and sediment control measures and works

The measures and works shall include, but are not limited to, the following:

Staging of earthwork activities—The excavation and moving of soil materials shall be scheduled to minimize the size of areas disturbed and unprotected from erosion for the shortest reasonable time.

Seeding—Seeding to protect disturbed areas shall occur as soon as reasonably possible following completion of that earthwork activity.

Mulching—Mulching to provide temporary protection of the soil surface from erosion.

Diversions—Diversions to divert water from work areas and to collect water from work areas for treatment and safe disposition. They are temporary and shall be removed and the area restored to its near original condition when the diversions are no longer required or when permanent measures are installed.

Stream crossings—Culverts or bridges where equipment must cross streams. They are temporary and shall be removed and the area restored to its near original condition when the crossings are no longer required or when permanent measures are installed.

Sediment basins—Sediment basins collect, settle, and eliminate sediment from eroding areas from impacting properties and streams below the construction site(s). These basins are temporary and shall be removed and the area restored to its original condition when they are no longer required or when permanent measures are installed.

Sediment filters—Straw bale filters or geotextile silt fences trap sediment from areas of limited runoff. Sediment filters shall be properly anchored to prevent erosion under or around them. Silt fences shall be installed and maintained in accordance with ASTM D6462. These filters are temporary and shall be removed and the area restored to its original condition when they are no longer required or when permanent measures are installed.

Waterways—Waterways for the safe disposal of runoff from fields, diversions, and other structures or measures. These works are temporary and shall be removed and the area restored to its original condition when they are no longer required or when permanent measures are installed.

Other—Additional protection measures as specified in section 8 of this specification or required by Federal, State, or local government.

4. Chemical pollution

The contractor shall provide watertight tanks or barrels or construct a sump sealed with plastic sheets to collect and temporarily contain chemical pollutants, such as drained lubricating or transmission fluids, grease, soaps, concrete mixer washwater, or asphalt, produced as a by-product of the construction activities. Pollutants shall be disposed of in accordance with appropriate state and Federal regulations. At the completion of the construction work, tanks, barrels, and sumps shall be removed and the area restored to its original condition as specified in section 8 of this specification. Sump removal shall be conducted without causing pollution.

Sanitary facilities, such as chemical toilets, or septic tanks shall not be located next to live streams, wells, or springs. They shall be located at a distance sufficient to prevent contamination of any water source. At the completion of construction activities, facilities shall be disposed of without causing pollution as specified in section 8 of this specification.

5. Air pollution

The burning of brush or slash and the disposal of other materials shall adhere to state and local regulations.

Fire prevention measures shall be taken to prevent the start or spreading of wildfires that may result from project activities. Firebreaks or guards shall be constructed and maintained at locations shown on the drawings.

All public access or haul roads used by the contractor during construction of the project shall be sprinkled or otherwise treated to fully suppress dust. All dust control methods shall ensure safe construction operations at all times. If chemical dust suppressants are applied, the material shall be a commercially available product specifically designed for dust suppression and the application shall follow manufacturer's requirements and recommendations. A copy of the product data sheet and manufacturer's recommended application procedures shall be provided to the engineer 5 working days before the first application.

6. Maintenance, removal, and restoration

All pollution control measures and temporary works shall be adequately maintained in a functional condition for the duration of the construction period. All temporary measures shall be removed and the site restored to near original condition.

7. Measurement and payment

Method 1—For items of work for which specific unit prices are established in the contract, each item is measured to the nearest unit applicable. Payment for each item is made at the contract unit price for that item. For water or chemical suppressant items used for dust control for which items of work are established in section 8 of this specification, measurement for payment will not include water or chemical suppressants that are used inappropriately or excessive to need. Such payment will constitute full compensation for the completion of the work.

Method 2—For items of work for which lump sum prices are established in the contract, payment is made as the work proceeds and supported by invoices presented by the contractor that reflect actual costs. If the total of all progress payments is less than the lump sum contract price for this item, the balance remaining for this item will be included in the final contract payment. Payment of the lump sum contract price will constitute full compensation for completion of the work.

Method 3—For items of work for which lump sum prices are established in the contract, payment will be prorated and provided in equal amounts on each monthly progress payment estimate. The number of months used for prorating shall be the number estimated to complete the work as outlined in the contractor's approved construction schedule. The final month's prorate amount will be provided with the final contract payment. Payment as described will constitute full compensation for completion of the work.

All Methods—The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items, and the items to which they are made subsidiary, are identified in section 8 of this specification.

8. Items of work and construction details

8. Items of Work and Construction Details

This construction site is greater than five (5) acres in area and is subject to the Texas Pollutant Discharge Elimination System (TPDES) requirements administered by the Texas Commission on Environmental Quality (TCEQ). Rules for the TPDES process relative to construction sites are contained in the TPDES General Permit NO. TXR150000. A copy of General Permit No. TXR150000 may be found at the TCEQ website.

In conformance with TPDES General Permit TXR150000, a Storm Water Pollution Prevention Plan (SWP3) is required for the construction site. A SWP3 is provided. The Contractor shall review the SWP3, and shall amend the plan with a detailed work sequence outline which defines and delineates the proposed construction operation. The amended SWP3 shall be signed by the Contractor and submitted to the Contracting Officer prior to issuance of the Notice to Proceed. A copy of the approved SWP3, as amended, will be maintained at the construction site by the Contractor. A copy of the permit shall be attached to the SWP3.

A copy of the Notice of Intent (NOI) shall be posted at the site until the TPDES permit number is issued for the site. An 8 ½" x 11" notice shall be posted at the site giving the following information about the permit: permit number, contact name, contact phone and project description. If a permit number has not been issued, a copy of the NOI shall be posted with the notice.

If the Contractor identifies sediment control items, which are considered essential to the anticipated construction operation but which are not reflected by the contract bid schedule, a written request for a contract modification will be provided to the Contracting Officer. The request will identify the items, operation, and provide an assessment of changes to the contract cost and performance time.

TPDES also requires an NOI and Notice of Termination (NOT) to be filed with TCEQ. The Contractor will be responsible for submitting the Contractor's copy of the NOI to the Engineer at least five business days before work begins. When the contract is completed, the Contractor shall provide the Project Engineer a copy of the NOT that he/she will file with the TCEQ.

In conformance with TPDES requirements, the Inspector and the Contractor (or the Contractor's Quality Control person) shall perform periodic inspections of the sediment control practices.

Inspections will be conducted bi-weekly (first work day of each week) and within 24 hours of any rainfall event of more than 0.5 inch at the construction site. After each inspection, a written report will be prepared which summarizes the status of inspected items. The reports will (a) evaluate effectiveness, (b) identify maintenance needs and/or (c) recommend remedial corrective action and will be prepared and signed by the Engineer and the Contractor. The report shall be filed on site in the same location as the SWP3. The Contractor shall be responsible for identified corrective maintenance needs.

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item 4, Pollution Control

- (1) This item shall consist of performing all work and furnishing all materials necessary to accomplish the work defined in Section 1 of this specification, including all works required to implement the Storm Water Pollution Prevention Plan, installation and maintenance of

the rock filter dam, stabilized construction entrance and maintenance of sediment filters, but not the installation of the fabric sediment filters.

- (2) A rock filter dam shall be installed as shown on the drawings.
- (3) Rock filter dam and silt fence and shall be removed when the site is completely stabilized.
- (4) A stabilized construction entrance shall be installed as shown on the drawings and shall be left in place at the end of construction with the exception of removing the riprap and smoothing and leveling the area disturbed.
- (5) In Section 7, Measurement and payment, Method 3 shall apply.

b. Bid Item 5, Silt Fence

- (1) This item shall consist of furnishing and installing silt fence to the lengths and locations designated on the drawings and otherwise needed to control sediment from leaving the construction site. Maintenance and removal of installed silt fence shall be paid for under the bid item for Pollution Control.
- (2) In Section 3, Erosion and sediment control measures and works, Sediment filters shall be limited to geotextile sediment filters.
- (3) In Section 7, Measurement and payment, Method 1 shall apply.

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Construction Specification 6—Seeding, Sprigging, and Mulching

1. Scope

The work consists of preparing the area for treatment; furnishing and placing seed, sprigs, mulch, fertilizer, inoculant, lime, and other soil amendments; and anchoring mulch in designated areas as specified.

The following BioPreferred® product categories are applicable to this specification:

- Mulch and compost materials
- Erosion control materials
- Fertilizers
- Agricultural spray adjuvants

2. Material

Seed—All seed must conform to the current rules and regulations of the State where it is being used and must be from the latest crop available. It must meet or exceed the standard for purity and germination listed in section 7.

Seed must be labeled in accordance with State laws and U.S. Department of Agriculture rules and regulations under the Federal Seed Act in effect on the date of invitations for bids. Bag tag figures are evidence of purity and germination. No seed may be accepted with a test date of more than 9 months before the date of delivery to the site.

Seed that has become wet, moldy, or otherwise damaged in transit or storage will not be accepted. The percent of noxious weed seed allowable must be as defined in the current State laws relating to agricultural seeds. Each type of seed must be delivered in separate sealed containers and fully tagged unless an exception is granted in writing by the contracting officer.

Fertilizer—Unless otherwise specified, the fertilizer must be a commercial-grade fertilizer. It must meet the standard for grade and quality specified by State law. Where fertilizer is furnished from bulk storage, the contractor must furnish a supplier's certification of analysis and weight. When required by the contract, a representative sample of the fertilizer must be furnished to the contracting officer for chemical analysis.

Inoculants—The inoculant for treating legume seeds must be a pure culture of nitrogen-fixing bacteria prepared specifically for the species and must not be used later than the date indicated on the container or as otherwise specified. A mixing medium, as recommended by the manufacturer, must be used to bond the inoculant to the seed. Two times the amount of the inoculant recommended by the manufacturer must be used, except that four times the amount must be used when seed is applied using a hydraulic seeder. Seed must be sown within 24 hours of treatment and must not remain in the hydraulic seeder longer than 4 hours.

Lime and other soil amendments—Lime must consist of standard ground agriculture limestone, or approved equivalent. Standard ground agriculture limestone is defined as ground limestone meeting current requirements of the State department of agriculture. Other soil amendments must meet quality criteria and application requirements specified in section 7.

Mulch tackifiers—Asphalt emulsion tackifiers must conform to the requirements of ASTM D977, Specification for Emulsified Asphalt. The emulsified asphalt may be rapid setting, medium setting, or slow setting. Nonasphaltic tackifiers required because of environmental considerations must be as specified in section 7.

Straw mulch material—Straw mulch must consist of wheat, barley, oat or rye straw, hay, grass cut from native grasses, or other plants as specified in section 7. The mulch material must be air-dry, reasonably light in color, and must not be musty, moldy, caked, or otherwise of low quality. The use of mulch that contains noxious weeds is not permitted. The contractor must provide a method satisfactory to the contracting officer for determining weight of mulch furnished.

Other mulch materials—Mulching materials, such as wood cellulose fiber mulch, mulch tackifiers, synthetic fiber mulch, netting, and mesh may be required for specialized locations and conditions. These materials, when specified, must be accompanied by the manufacturer's recommendations for methods of application.

3. Seeding mixtures, sod, sprigs, and dates of planting

The application rate per acre for seed mixtures, sprigs, or sod and date of seeding or planting must be as shown on the plans or as specified in section 7.

4. Seedbed preparation and treatment

Areas to be treated must be dressed to a smooth, firm surface. On sites where equipment can operate on slopes safely, the seedbed must be adequately loosened (4 to 6 inches deep) and smoothed. Depending on soil and moisture conditions, disking or cultipacking, or both, may be necessary to properly prepare a seedbed. Where equipment cannot operate safely, the seedbed must be prepared by hand methods by scarifying to provide a roughened soil surface so that broadcast seed will remain in place.

If seeding is to be accomplished immediately following construction operations, seedbed preparation may not be required except on a compacted, polished, or freshly cut soil surface.

Rocks larger than 6 inches in diameter, trash, weeds, and other debris that will interfere with seeding or maintenance operations must be removed or disposed of as specified in section 7.

Seedbed preparation must be discontinued when soil moisture conditions are not suitable for the preparation of a satisfactory seedbed as determined by the responsible engineer.

5. Seeding, sprigging, fertilizing, mulching, and stabilizing

All seeding or sprigging operations must be performed in such a manner that the seed or sprigs are applied in the specified quantities uniformly in the designated areas. The method and rate of seed application must be as specified in section 7. Unless otherwise specified, seeding or sprigging must be accomplished within 2 days after final grading is completed and approved.

Fertilizer, lime, and other soil amendments must be applied as specified in section 7. When specified, the fertilizer and soil amendments must be thoroughly incorporated into the soil immediately following surface application.

The rate, amount, and kind of mulching or mesh must be as specified in section 7. Mulches must be applied uniformly to the designated areas. They must be applied to areas seeded not later than 2 working days after seeding has been performed. Straw mulch material must be stabilized within 24 hours of application using a mulch crimper or equivalent anchoring tool or by a suitable tackifier. When the mulch crimper or equivalent anchoring tool is used, it must have straight blades and be the type manufactured expressly for and capable of firmly punching the mulch into the soil. Where the equipment can be safely operated, it must be operated on the contour. Hand methods must be used where equipment cannot safely operate to perform the work required.

The tackifier must be applied uniformly over the mulch material at the specified rate, or it must be injected into the mulch material as it is being applied. Mesh or netting stabilizing materials must be applied smoothly but loosely on the designated areas. The edges of these materials must be buried or securely anchored using spikes or staples as specified in section 7.

The contractor must maintain the mesh or netting areas until all work under the contract has been completed and accepted. Maintenance must consist of the repair of areas damaged by water erosion, wind, fire, or other causes. Such areas must be repaired to reestablish the intended condition and to the design lines and grades required by the contract. The areas must be refertilized, reseeded, and remulched before the new application of the mesh or netting.

6. Measurement and payment

Method 1—For items of work for which specific unit prices are established in the contract, each area treated is measured as specified in section 7 and the area is calculated to the nearest 0.1 acre. Payment for treatment is made at the contract unit price for the designated treatment, which will constitute full compensation for completion of the work.

When specified as an item of work, mesh or netting is measured to the nearest square yard of surface area covered and accepted. Payment is made at the contract unit price and will constitute full compensation for completion of the work.

Method 2—For items of work for which specific lump-sum prices are established in the contract, the quantity of work will not be measured for payment. Payment for this item is made at the contract lump-sum price for the item and constitutes full compensation for the completion of the work.

Method 3—For items of work for which lump-sum prices are established in the contract, payment is made as the work proceeds. Progress payments are determined as specified in section 7. Payment of the lump sum contract price constitutes full compensation for completion of the work.

All Methods—The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 7.

7. Items of work and construction details

7. Items of Work and Construction Details

In Section 5, Seeding, sprigging, fertilizing, mulching, and stabilizing, straw mulch material shall consist of coastal bermudagrass or a native bluestem mix and the rate of application shall be 2-1/2 tons per acre. Mulches shall be stabilized by a non-asphaltic tackifier and shall be applied at a rate of 40 pounds per acre or by a mechanical crimper. The Contractor shall submit the manufacturer's product data and installation instructions for the tackifier to the Contracting Officer for approval of the product.

When working on slopes which are steeper than 3:1 horizontal to vertical, all rubber tire equipment on the slope will be held with truck or tractor and winch line with the truck or tractor operating along the crown of the embankment or other suitable flat surface. As an alternative, track (crawler) equipment with a low center of gravity may be used to perform work on slopes without a winch line requirement when operated in accordance with applicable OSHA requirements.

Fertilizer shall be of the pelleted form and shall be uniformly mixed. Prior to planting the grasses, fertilizer shall be applied and worked into the soil by disking with a weighted tandem disk to a depth of approximately 4 inches. No fertilizer shall be applied when the ground is excessively wet, frozen, or otherwise in an untillable condition. The rate of application of the fertilizer shall be thirty (30) pounds of nitrogen (N), forty (40) pounds of phosphorus (P) and zero (0) pounds of potassium (K) per acre.

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item 6, Vegetation, Sprigging

- (1) This item shall consist of preparing the seedbed and furnishing and applying sprigs, straw mulch, tackifier and fertilizer to all areas on which topsoil is designated to be placed and other disturbed areas except those located below the lowest ungated outlet (elevation 640.4) on the upstream side of the dam.
- (2) In Section 6, Measurement and payment, Method 1 will apply.
- (3) Sprigging shall be conducted between February 15 and May 1.
- (4) Sprigging shall be conducted with a mechanical sprigging machine. Coastal bermudagrass sprigs shall be applied at the rate of 48 bushels or 60 cu. ft. per acre. The distance between rows shall not exceed 20 inches. Sprigs shall be placed in moist soil approximately 3 inches deep and packed. Hand sprigging may be used in addition to the sprigging machine in inaccessible areas.
- (5) Coastal bermudagrass sprigs shall consist of healthy, uninjured, live stolons and rhizomes free from excessive foreign matter. Excess top growth shall be removed before sprigs are harvested. Sprigs shall be obtained from a source within a radius of 100 miles of the works of improvement to be planted. Sprigs shall not be cut or chopped shorter than 4 inches. Care shall be exercised to see that harvested sprigs do not lie exposed to the sun for more than 30 minutes before they are stacked in piles and covered or loaded for transporting to the planting site. Harvested sprigs shall be watered en route to the planting site and kept covered and moist until planted. Not more than 30 hours shall elapse between initial harvest and planting the sprigs.

- (6) Disturbed areas and slopes in the reservoir area below the elevation of the lowest ungated outlet shall not be chisel plowed or disked. Permanent vegetation is required on disturbed areas but not on areas within the reservoir below the elevation of the lowest ungated outlet. The plowing shall be on the approximate contour. Plowing will not be permitted when the soil is in an excessively wet or frozen or otherwise untillable condition. The ground surface shall be left reasonably smooth and free of windrows, ridges, or depressions.

b. Bid Item 7, Irrigation System

- (1) This item shall consist of furnishing and installing a temporary solid set sprinkler irrigation system as needed to irrigate the areas as designated in Section 7.a. of this specification.
- (2) The Contractor shall furnish to the Contracting Officer, in writing, a proposed plan for the irrigation system and application 30 days before installing the irrigation system. The plan shall show the layout, size of all components, sprinkler head spacing, and methods to determine the application and distribution efficiencies. Acceptance of this plan or the waiving of the plan requirement will not relieve the Contractor of the responsibilities for completing the specified work.
- (3) The system shall be adequate to apply the volume of water and meet the application requirements specified in Sections 7.c. (2) and 7.c. (4) of this specification. The application of irrigation shall not cause runoff. The application shall be uniform ensuring that at any point the irrigated area shall be within 20% of the required application.
- (4) The Contractor shall furnish all equipment, operators, maintenance, operating supplies, and materials needed to install the system. The Contractor shall furnish in-line, propeller type water meter (s) with volumetric calibration. The meter(s) shall be installed so that all water applied for the irrigation of vegetated areas under the contract will be metered.
- (5) Unless otherwise noted, the system shall be removed upon completion of all irrigation applications.
- (6) In Section 6, Measurement and payment, Method 2 will apply.

c. Bid Item 8, Irrigation Water

- (1) This item shall consist of applying irrigation water to the areas designated in Section 7.a. of this specification. It shall include the cost of water and labor.
- (2) The estimated application rate and schedule of irrigations will be as follows: 1st irrigation 2 inches, 2nd, 3rd and 4th irrigations ½ inch at 2-day intervals and then twice a week for the next 4 weeks at ½ inch applications. Additional irrigation or adjustment in the application rates may be required as determined and approved by the Engineer until 50% vegetative cover is established.
- (3) The Contractor shall be responsible for the water source.
- (4) All areas will be irrigated with a sprinkler irrigation system. The total irrigation at any one time will be based on need as determined by the Engineer. The irrigation system shall produce a reasonable uniform distribution of the required application over the irrigated area without excessive runoff or erosion. The watering efficiency shall not be less than 85%.

Adjustments in sprinkler spacing, nozzle sizes, pressures, or in the gross water applied shall be made when needed to accomplish the above objectives.

- (5) In Section 6, Measurement and payment, Method 1 will apply. Measurement for payment will be 1,000 gallon units and will be measured to the nearest 1,000 gallons based on the applied volume determined from the readings of the in-line water meter(s). An adjustment in the volume of water shall be applied for application efficiency less than 85%.

Construction Specification 7—Construction Surveys

1. Scope

The work consists of performing all surveys, measurements, and computations required by this specification.

2. Equipment and material

Equipment for construction surveys shall be of a quality and condition to provide the required accuracy. The equipment shall be maintained in good working order and in proper adjustment at all times. Records of repairs, calibration tests, accuracy checks, and adjustments shall be maintained and be available for inspection by the engineer. Equipment shall be checked, tested, and adjusted as necessary in conformance with manufacturer's recommendations.

Material is field notebooks, stakes, templates, platforms, equipment, spikes, steel pins, tools, and all other items necessary to perform the work specified.

3. Quality of work

All work shall follow recognized professional practice and the standards of the industry unless otherwise specified in section 9 of this specification. The work shall be performed to the accuracy and detail appropriate for the type of job. Notes, sketches, and other data shall be complete, recorded neatly, legible, reproducible and organized to facilitate ease in review and allow reproduction of copies for job documentation. Survey equipment that requires little or no manual recording of field data shall have survey information documented as outlined in section 9 of this specification.

All computations shall be mathematically correct and shall include information to identify the bid item, date, and who performed, checked, and approved the computations. Computations shall be legible, complete, and clearly document the source of all information used including assumptions and measurements collected.

If a computer program is used to perform the computations, the contractor shall provide the engineer with the software identification, vendor's name, version number, and other pertinent data before beginning survey activities. Computer generated computations shall show all input data including values assigned and assumptions made.

The elevations of permanent and temporary bench marks shall be determined and recorded to the nearest 0.01 foot. Differential leveling and transit traverses shall be of such precision that the error of vertical closure in feet shall not exceed plus or minus 0.1 times the square root of the traverse distance in miles. Linear measurements shall be accurate to within 1 foot in 5,000 feet, unless otherwise specified in section 9 of this specification. The angular error of closure for transit traverses shall not exceed 1 minute times the square root of the number of angles turned.

The minimum requirements for placing slope stakes shall be at 100-foot stations for tangents, as little as 25 feet for sharp curves, breaks in the original ground surface and at any other intermediate stations necessary to ensure accurate location for construction layout and measurement. Slope stakes and cross sections shall be perpendicular to the centerline. Significant breaks in grade shall be determined for cross sections. Distances shall be measured horizontally and recorded to the nearest 0.1 foot. Side shots for interim construction stakes may be taken with a hand level.

Unless otherwise specified in section 9 of this specification, measurements for stationing and establishing the location of structures shall be made to the nearest 0.1 foot.

Elevations for concrete work, pipes, and mechanical equipment shall be determined and recorded to the nearest 0.01 foot. Elevations for earth work shall be determined and recorded to the nearest 0.1 foot.

4. Primary control

The baselines and bench marks for primary control, necessary to establish lines and grades needed for construction, are shown on the drawings and have been located on the job site.

These baselines and bench marks shall be used as the origin of all surveys, layouts, and measurements to establish construction lines and grades. The contractor shall take all necessary precautions to prevent the loss or damage of primary control points. Any stakes or control points lost or damaged by construction activity will be reestablished by the contractor or at contractor expense.

5. Construction surveys

Before work starts that requires contractor performed surveys, the contractor shall submit in writing for the engineer's review: the name, qualifications, and experience of the individuals to be assigned to the survey tasks.

Method 1—Contractor performed surveys shall include:

- checking and any supplemental or interim staking
- performing quantity surveys, measurements, and computations for progress payment
- other surveys as described in section 9 of this specification

Method 2—Contractor performed surveys shall consist of all work necessary for:

- establishing line and grade for all work
- setting slope stakes for all work
- checking and any supplemental or interim staking
- establishing final grade stakes
- performing quantity surveys, measurements, and computations for progress payment
- other surveys as described in section 9 of this specification

Method 3—Contractor performed surveys shall consist of all work necessary for:

- establishing line and grade for all work
- setting slope stakes for all work
- checking and any supplemental or interim staking
- establishing final grade stakes
- performing quantity surveys, measurements, and computations for progress payments
- performing original (initial) and final surveys for determinations of final quantities
- other surveys as described in section 9 of this specification.

6. Staking

The construction staking required for the item shall be completed before work on any item starts. Construction staking shall be completed as follows or as otherwise specified in section 9 of this specification:

Clearing and grubbing—The boundary of the area(s) to be cleared and grubbed shall be staked or flagged at a maximum interval of 200 feet, closer if needed, to clearly mark the limits of work. When contractor staking is the basis for determining the area for final payment, all boundary stakes will be reviewed by the engineer before start of this work item.

Excavation and fill—Slope stakes shall be placed at the intersection of the specified slopes and ground line. Slope stakes and the reference stakes for slopes shall be marked with the stationing, required cut or fill, slope ratio, and horizontal distance from the centerline or other control line. The minimum requirements for placing slope stakes is outlined in section 3, Quality of work.

Structures—Centerline and offset reference line stakes for location, alignment, and elevation shall be placed for all structures.

7. Records

All survey data shall be recorded in fully identified standard hard-bound engineering survey field notebooks with consecutively numbered pages. All field notes and printed data shall include the purpose or description of the work, the date the work was performed, weather data, sketches, and the personnel who performed and checked the work. Electronically generated survey data and computations shall be bound, page numbered, and cross referenced in a bound field notebook containing the index for all survey activities. All work shall follow recognized professional practice.

The construction survey records shall be available at all times during the progress of the work for examination and use by the engineer and when requested, copies shall be made available. The original field notebooks and other records shall be provided to and become the property of the owner before final payment and acceptance of all work.

Complete documentation of computations and supporting data for progress payments shall be submitted to the engineer with each invoice for payment as specified in section 9 of the specification. When the contractor is required to conduct initial and final surveys as outlined in section 5, Construction Surveys, notes shall be provided as soon as possible after completion to the engineer for the purpose of determining final payment quantities.

8. Payment

Method 1—For items of work for which lump sum prices are established in the contract, payment is made as the work proceeds, after presentation of correct and accurate invoices by the contractor showing related costs and evidence of the charges of suppliers, subcontractors, and others for supplies furnished and work performed. Invoices for the total amount of the contract price will not be accepted until all surveys are complete and required documentation has been determined complete. If the total of such payments is less than the lump sum contract price for this item, the unpaid balance will be included in the final contract payment. Payment of the lump sum contract price will constitute full compensation for completion of all work under the bid item.

Method 2—For items of work for which lump sum prices are established in the contract, payment is made as the work proceeds with progress payment amounts determined as a percentage of the total work planned as projected from the contractor's approved construction schedule. Payment of the lump sum contract price will constitute full compensation for completion of all work under this bid item.

All Methods—Payment will not be provided under this item for the purchase price of materials or equipment having a residual value.

Compensation for any item of work described in the contract, but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the item to which they are made subsidiary are identified in section 9 of this specification.

9. Items of work and construction details

9. Items of Work and Construction Details

In Section 5, Construction surveys, Method 2 shall apply. Earthfill and excavation slopes shall be checked and corrected to planned slope as work progresses. Finish grades of these surfaces shall be "bluetopped" at least at each 5-foot vertical interval.

In Section 8, Payment, Method 2 shall apply.

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 9, Construction Surveys

- (1) This item shall consist of performing all work required by Section 1 of this specification.
- (2) All surveys shall proceed from benchmarks; reference points and/or stakes set or established by the Contracting Local Organization (CLO). The benchmarks are shown on the drawings.
- (3) Initial and final surveys for determinations of final quantities will be performed by the CLO.
- (4) The item of work subsidiary to this bid item is Establishment of Permanent Reference Markers (PRM), as specified in Construction Specification 31.

Construction Specification 8—Mobilization and Demobilization

1. Scope

The work consists of the mobilization and demobilization of the contractor's forces and equipment necessary for performing the work required under the contract. It does not include mobilization and demobilization for specific items of work for which payment is provided elsewhere in the contract. Mobilization will not be considered as work in fulfilling the contract requirements for commencement of work.

2. Equipment and material

Mobilization shall include all activities and associated costs for transportation of contractor's personnel, equipment, and operating supplies to the site; establishment of offices, buildings, and other necessary general facilities for the contractor's operations at the site; premiums paid for performance and payment bonds including coinsurance and reinsurance agreements as applicable; and other items specified in section 4 of this specification.

Demobilization shall include all activities and costs for transportation of personnel, equipment, and supplies not required or included in the contract from the site; including the disassembly, removal, and site cleanup of offices, buildings, and other facilities assembled on the site specifically for this contract.

This work includes mobilization and demobilization required by the contract at the time of award. If additional mobilization and demobilization activities and costs are required during the performance of the contract as a result of changed, deleted, or added items of work for which the contractor is entitled to an adjustment in contract price, compensation for such costs will be included in the price adjustment for the item or items of work changed or added.

3. Payment

Payment will be made as the work proceeds, after presentation of paid invoices or documentation of direct costs by the contractor showing specific mobilization and demobilization costs and supporting evidence of the charges of suppliers, subcontractors, and others. When the total of such payments is less than the lump sum contract price, the balance remaining will be included in the final contract payment. Payment of the lump sum contract price for mobilization and demobilization will constitute full compensation for completion of the work.

Payment will not be made under this item for the purchase costs of materials having a residual value, the purchase costs of materials to be incorporated in the project, or the purchase costs of operating supplies.

4. Items of work and construction details

4. Items of Work and Construction Details

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item 10, Mobilization and Demobilization

- (1) This item shall consist of performing all items of work for mobilization and demobilization as required by Sections 1 and 2 of this specification.
- (2) The mobilization operation shall include but not be limited to the items in Section 2 of this specification and the following items of work:
 - (a) Primary access to the work area shall be off of Lehman Road as shown on the drawings. Road base or rock, approved by the Contracting Officer, shall be placed on the access road from Lehman Road to the construction campsite. The access road shall be a minimum of 14 feet wide and be graded and smoothed to provide a surface which can be easily traversed by automobiles. The road shall be maintained in a smooth rut-free condition throughout the contract period. A Stabilized Construction Entrance shall be built as shown on the drawings. The Stabilized Construction Entrance shall be constructed without modification to the existing curb on Lehmann Road. Any damage to the existing curb shall be reconstructed per City of Kyle Public Works requirements including but not limited to sawcut asphalt and concrete curb and full reconstruction matching the existing construction. Grading of Stabilized Construction Entrance shall not impede the drainage on the shoulders of Lehmann Road. Any existing culverts within 100 feet upstream and downstream of the Stabilized Construction Entrance along Lehmann Road shall be protected and maintained to pass stormwater flows.
 - (b) As a part of this bid item the Contractor shall furnish a facility at the construction campsite suitable for use as a Field Office for the Contracting Local Organization. The facility shall contain not less than 240 square feet (8-ft-wide by 30-ft-long) having a minimum 7-ft-high ceiling. The facility shall be constructed in a workmanlike manner and shall be weather-tight. It shall have not less than three windows and one door. It shall have a cabinet top range (either gas or electric) with a minimum of two burners or elements and may be either built in or portable. A microwave oven 0.80 cubic feet in size and having a minimum power rating of 650 watts output shall be provided. A substantial workbench and a table, each 3-ft-wide by 8-ft-long with the work surface 42 inches above floor level and covered with laminated plastic, shall be provided. Cabinet storage shelves shall be included with the workbench. Two standard 60" x 30" office desks with drawers and leg space, as well as one 48" x 30" adjustable top drafting table shall be provided. Two office swivel chairs and four straight chairs shall be provided. The floor shall have a heavy-duty vinyl or similar covering. Walls, ceilings and floors shall be constructed in such a manner as to provide a minimum of 1.5 inches of space between inside and outside surfaces. The 1.5-inch space shall be filled with a high-density insulation material. A closet (30" wide x 42" long) having a 28-inch-wide door shall be included. The facility shall be wired for electricity with a minimum of three ceiling fixtures and a minimum of three wall outlets on each long wall. The facility shall be plumbed and connected to a permanent source of pressurized water. The Contractor shall furnish a source of potable drinking water inside the Government's field trailer and shall

maintain a supply of potable drinking water throughout the contract period. A flush toilet and a wash basin (lavatory) shall be provided within a private area, and shall be properly connected to a sanitary sewer or sanitary holding tank. If a sanitary holding tank is utilized it shall be serviced as frequently as necessary to maintain the flush toilet and wash basin in proper working order and to minimize objectionable odor. A thermostatically controlled means that is capable of maintaining the temperature inside the facility at 75°F in the summer with refrigerated air and 80 °F in the winter, for heating and air conditioning the facility shall be provided. The facility shall be built in such a manner that it is substantial and can be easily moved. A prefabricated building or trailer will be an acceptable facility if approved by the Contracting Officer. The Contractor shall furnish and install all utilities to the facility. The facility shall be maintained in good condition throughout the contract period by the Contractor, except for damages caused by negligence of the Government or Contracting Local Organization (CLO). The facility shall be separate and apart from any building or facilities of the Contractor and shall be for sole use of the Government or CLO.

- (c) The facility shall be securely anchored or tied-down to provide maximum possible stability against overturning by high winds. Flashing or skirting shall be installed around the facility from floor level to ground level.
- (d) Access to the door to the facility from the ground shall be provided by substantial steps leading to a landing having a minimum size of 5 feet wide by 6 feet long. Substantial handrails shall be provided for the steps and the landing.
- (e) The facility shall be enclosed by a 6-ft-high chain link fence placed to provide a minimum of 6 feet clearance between the fence and the outside walls of the facility. One gate 4 feet in width shall be installed in the fence.
- (f) The Contractor shall furnish and install electrical service to the facility. The electrical service provided shall meet the requirements of the latest National Electric Code for providing electric service to the construction trailer. The service shall be adequate to address all anticipated electrical loads and meet the minimum voltage and amperage requirements indicated by the selected trailer and recommended by the trailer manufacturer. The Contractor shall be responsible for supply of power to the facility office throughout the contract period. If a portable generator is used to supply electrical power, the Contractor shall be responsible for the complete operation and maintenance of the generator. The generator shall remain in continuous operation 24 hours per day and shall be located a minimum of 100 feet from the facility and shielded so as to minimize the noise in the facility.
- (g) The facility and all utilities shall be in place at the worksite prior to the start of work requiring continuous inspection and no later than 15 days after receipt of the Notice to Proceed.
- (h) Recreational Facilities including but not limited to buildings, foot paths, playgrounds and fishing docks are located in the vicinity of the construction work area. Contractor shall protect Recreational Facilities and in case of damage restore them into as-new condition.

- (i) Contractor shall reconstruct fencing along Lehman Road to pre-construction existing condition.
- (3) The demobilization operation shall include but not be limited to the following items of work:
 - (a) All debris, trash, tires, equipment, equipment parts, chains, cables, and other such items resulting from the construction operation shall, at the Contractor's expense, be removed from the work site and be salvaged by the Contractor, or disposed of in an appropriate manner which meets all Federal, State and Local Regulations.
 - (b) All disturbed areas shall be bladed or smoothed to blend the area with the surrounding land surface. The bladed or smoothed surface shall be free of abrupt mounds, windrows, depressions or other irregularities that would prevent the safe operation of ordinary farm equipment thereon. The finished surface shall prevent diversion of surface runoff and shall prevent standing or ponding water.
 - (c) All traffic control devices, warning signs, barricades and any other material used for traffic control shall be removed.
 - (d) All buildings, trailers, chain link fence, storage sheds, sanitary facilities and other such items shall be removed from the worksite when construction work is completed.
 - (e) All utilities shall be removed from the site as required by the owner of the utility after construction work is completed.
 - (f) The access road shall be bladed to be smooth and shall be left in a rut- free condition. The road base/rock used on the access road it shall remain in place for use by the landowner and the CLO.
 - (g) Contractor shall restore any damaged Recreational Facilities into as-new condition.
 - (h) The Stabilized Construction Entrance shall be left in place at the end of construction with the exception of removing the riprap and smoothing and leveling the area disturbed.
- (4) The item of work subsidiary to this bid item is Traffic Control as specified in Construction Specification 9.

Construction Specification 9—Traffic Control

1. Scope

The work shall consist of establishing traffic control and maintaining safe, convenient use of public roads and rights-of-way.

2. Traffic and access

The contractor's operations shall cause no unnecessary inconvenience to the public. The public rights-of-way shall be maintained at all times unless interruption is authorized by proper local authority. Contractor's authorized closing or detour plans shall be provided to the engineer for approval.

Safe and adequate access shall be provided and maintained to all public protection devices and to all critical utility control locations. Facility access shall be continuous and unobstructed unless otherwise approved.

3. Storage of equipment and material in public streets

Construction materials and equipment shall not be stored or parked on public streets, roads, or highways. During any material or equipment loading or unloading activities that may temporarily interfere with traffic, an acceptable detour shall be provided for the duration of the activity. Any associated expense for this activity is the responsibility of the contractor.

Excavated material, including suitable material that is intended for adjacent trench backfill or other earth backfill as specified in section 5 of this specification, shall not be stored on public streets, roads, or highways that remain in service for the public. Any waiver of this requirement must be obtained from the proper local authority and approved by the engineer. All excess and unsuitable material shall be removed from the site as soon as possible. Any spillage shall be removed from roadways before they are used by the public.

4. Street closures, detours, and barricades

The contractor shall comply with the requirements of all applicable responsible units of government for closure of any street, road, or highway. The contractor shall provide the required barriers, guards, lights, signs, temporary bridges, and flaggers together with informing the public of any detours and construction hazards by the most suitable means available, such as local newspapers or radio stations. The contractor is also responsible for compliance with additional public safety requirements that may arise during construction. The contractor shall furnish, install, and, upon completion of the work, promptly remove all signs, warning devices, and other materials used in the performance of this work.

Unless otherwise specified, the contractor shall notify, in writing, the fire chief, police chief, county sheriff, state patrol, schools that operate school buses, or any other government official as may be appropriate no less than 7 days before closing, partly closing, or reopening any street, road, or highway.

Unless otherwise specified, the contractor shall furnish to the engineer a written plan showing the proposed method of signing, barricading for traffic control, and safety for street detours and closures.

All temporary detours will be maintained to ensure use of public rights-of-way is provided in a safe manner. This may include dust control, grading, and graveling as required in section 7 of this specification.

5. General and specific references

All signs, signals, barricades, use of flaggers, and other traffic control and public safety devices shall conform to the general requirements set forth in the *Manual of Uniform Traffic Control Devices* (MUTCD) and the latest edition of *Standard Highway Signs and Standard Alphabets for Highway Signs and/or OSHA Construction Industry Standards (29 CFR Part 1926)*, Subpart G, Signs, Signals, and Barricades unless otherwise specified in section 7 of this specification.

6. Measurement and payment

For items of work for which specific lump sum prices are established in the contract, payment for the work is made at the contract lump sum price. Progress payments will be made based upon the percentage of estimated total time that traffic control will be required unless otherwise specified in section 7 of this specification. Payment will constitute full compensation for all flaggers, labor, materials, equipment, and all other items necessary and incidental to completion of the work.

Compensation for any item of work described in the contract, but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and items to which they are made subsidiary are identified in section 7 of this specification.

7. Items of work and construction details

7. Items of Work and Construction Details

In Section 4, Street closures, detours, and barricades, the Contractor shall furnish a written plan showing the proposed method of signing, barricading for traffic control, use of flaggers, etc. to be approved by the appropriate governmental authority, as well as this contract's Engineer.

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Subsidiary Item, Traffic Control

- (1) This item shall consist of performing all items of work for traffic control as required by Sections 1 and 2 of this specification.
- (2) Separate payment will not be made for this item of work. Compensation for this item will be included in the payment for the bid item Mobilization and Demobilization.

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Construction Specification 11—Removal of Water

1. Scope

The work consists of the removal of surface water and ground water as necessary to perform the construction required by the contract in accordance with the specifications. It shall include: (1) constructing, installing, building, and maintaining all necessary temporary water containment facilities, channels, and diversions; (2) furnishing, installing, and operating all necessary pumps, piping, and other facilities and equipment; and (3) removing all such temporary works and equipment after their intended function is no longer required.

2. Diverting surface water

The contractor shall install, maintain, and operate all cofferdams, channels, flumes, sumps, and all other temporary diversion and protective works needed to divert streamflow and other surface water through or around the construction site. Control of surface water shall be continuous during the period that damage to construction work could occur. Unless otherwise specified and/or approved, the diversion outlet shall be into the same drainageway that the water would have reached before being diverted.

The contractor shall furnish the contracting officer, in writing, a proposed plan for diverting surface water before beginning any construction activities for which a diversion is required, unless waived in section 8 of this specification. Acceptance of this plan or the waiving of the plan requirement will not relieve the contractor of the responsibilities related to this activity during the process of completing the work as specified.

3. Dewatering the construction site

Foundations, cutoff trenches, and all other parts of the construction site shall be dewatered and kept free of standing water and muddy conditions as necessary for the proper execution of the work. The contractor shall furnish, install, operate, and maintain all drains, sumps, pumps, casings, well points, and all other equipment required to properly dewater the site as specified. Dewatering systems that cause a loss of soil fines from the foundation areas will not be permitted.

The contractor shall furnish the contracting officer, in writing, a proposed plan for dewatering before commencing with any construction activity for which dewatering may be required, unless waived in section 8 of this specification. Acceptance of this plan or the waiving of the plan requirement will not relieve the contractor of the responsibilities for completing the specified work.

4. Dewatering borrow areas

The contractor shall maintain all borrow areas free of surface water or otherwise provide for timely and effective removal of surface and subsurface water that accumulates within the borrow area, unless waived in section 8 of this specification. Borrow material shall be processed as necessary to achieve proper and uniform moisture content at the time of placement.

If pumping to dewater borrow areas is included as a bid item of work in the bid schedule, each pump discharge pipe shall be equipped with a water meter. The meter shall be such that the measured quantity of water is accurate within 3 percent of the true quantity. The contractor shall provide necessary support to perform accuracy tests of the water meter when requested by the contracting officer.

5. Erosion and pollution control

Removal of water from the construction site, including the borrow areas, shall be accomplished so that erosion and the transporting of sediment and other pollutants are minimized. Dewatering activities shall be accomplished in a manner that the water table water quality is not altered. Pollution control activities shall not conflict with the requirements of Construction Specification 5, Pollution Control, if it is a part of this contract.

6. Removal of temporary works

When temporary works are no longer needed, the contractor shall remove and return the area to a condition similar to that which existed before construction. Areas where temporary works were located shall be graded for slightly appearance with no obstruction to natural surface waterflows or the proper functioning and access to the works of improvement installed. The contractor shall exercise extreme care during the removal stages to minimize the loss of soil sediment and debris that was trapped during construction.

Pipes, casings, and any other material used to dewater the site shall be removed from temporary wells. The wells shall be filled to ground level with clean gravel or other suitable material approved by the contracting officer. The contractor shall exercise extreme care to prevent pollution of the ground water by these actions.

7. Measurement and payment

Method 1—Items of work listed in the bid schedule for removal of water, diverting surface water, and dewatering construction sites and borrow areas are paid for at the contract lump sum prices. Such payment will constitute full compensation for all labor, equipment, tools, and all other items necessary and incidental to the completion of the work.

Method 2—Items of work listed in the bid schedule for removal of water, diverting surface water, dewatering construction sites, and dewatering borrow areas are paid for at the contract lump sum prices. Such payment will constitute full compensation for furnishing, installing, operating, and maintaining the necessary trenches, drains, sumps, pumps, and piping and for all labor, equipment, tools, and all other items necessary and incidental to the completion of the work. The exception is that additional payment for pumping to dewater borrow areas and the removal of water will be made as described in the following paragraph.

If pumping to dewater borrow areas is a contract bid item, payment is made at the contract unit price, which shall be the price per 1,000 gallons shown in the bid schedule. Such payment will constitute full compensation for pumping only. Compensation for equipment and preparation and for other costs associated with pumping is included in the lump sum payment for removal of water or the lump sum payment for dewatering the borrow areas. Payment is made only for pumping that is necessary to dewater borrow areas that cannot be effectively drained by gravity or that must have the water table lowered to be usable as a suitable borrow source. Pumping for other purposes will not be included for payment under this item.

All Methods—The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed in the bid schedule is included in the payment for the contract line item to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 8 of this specification.

8. Items of work and construction details

8. Items of Work and Construction Details

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item 11, Removal of Water

- (1) This item shall consist of all operations necessary to accomplish the work defined in Section 1 of this specification, including that work required to control water from entering the new principal spillway.
- (2) The new principal spillway conduit installation area shall be protected from the entry of water from the reservoir until the dam is reconstructed to the full design cross-section over the conduit. Water will not be permitted to enter the new principal spillway conduit until the new principal spillway system, including inlet, conduit, impact basin, and outlet channel are constructed and fully operational.
- (3) A coffer dam shall be required to prevent transport of sediment from the reservoir and to protect the new principal spillway and RCC chute structure from reservoir water. It shall be designed complete with plans and specification, and sealed by a Professional Engineer licensed in Texas. The level of protection shall be the Contractor's choice and responsibility. The plans shall be submitted to the Engineer prior to start of construction operations.
- (4) Written sealed plans and specs for diverting surface waters and for dewatering the site are required. The Contractor's plans for diverting surface waters and dewatering the site shall be submitted to the Engineer prior to the start of construction operations. Use of a well-point system for dewatering the site shall be acceptable so long as the well-point system is designed and sealed by a Professional Engineer licensed in Texas.
- (5) Within the scope of this item, the contractor shall provide dewatering capacity sufficient to maintain a water level which allows excavation in the borrow area to the grades specified on the drawings during periods of low flow. Additional dewatering capacity to draw the water level down to this level within 10 days shall be provided in the event of flooding which inundates the borrow area.
 - (a) When accumulations of water in the borrow areas prevent the excavation, borrow operations from these areas will be suspended until suitable conditions again prevail.
- (6) Excavation for the installation of the RCC chute, concrete outlet structure, and rock riprap lined outlet shall be kept free of water during placement of RCC, concrete, rock, and/or backfilling. The water table at a concrete structure location shall be kept 2 feet below the subgrade of the concrete during and for a minimum of seven days after concrete placement or until backfilling around the concrete structure is complete, whichever is longer. The water table at a backfill or rock riprap location shall be maintained a minimum of 2 feet below the backfill/rock riprap surface until completion of fill placement activities in the area.
- (7) In Section 7, Measurement and payment, Method 1 shall apply. Payment will be made prorated into monthly amounts based on length of contract period.

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Construction Specification 21—Excavation

1. Scope

The work shall consist of the excavation required by the drawings and specifications and disposal of the excavated materials.

2. Classification

Excavation is classified as **common excavation**, **rock excavation**, or **unclassified excavation** in accordance with the following definitions.

Common excavation is defined as the excavation of all materials that can be excavated, transported, and unloaded using heavy ripping equipment and wheel tractor-scrapers with pusher tractors or that can be excavated and dumped into place or loaded onto hauling equipment by excavators having a rated capacity of one cubic yard or larger and equipped with attachments (shovel, bucket, backhoe, dragline, or clam shell) appropriate to the material type, character, and nature of the materials.

Rock excavation is defined as the excavation of all hard, compacted, or cemented materials that require blasting or the use of ripping and excavating equipment larger than defined for common excavation. The excavation and removal of isolated boulders or rock fragments larger than 1 cubic yard encountered in materials otherwise conforming to the definition of common excavation shall be classified as rock excavation. The presence of isolated boulders or rock fragments larger than 1 cubic yard is not in itself sufficient cause to change the classification of the surrounding material.

For the purpose of these classifications, the following definitions shall apply:

Heavy ripping equipment is a rear-mounted, heavy duty, single-tooth, ripping attachment mounted on a track type tractor having a power rating of at least 250 flywheel horsepower unless otherwise specified in section 10.

Wheel tractor-scraper is a self-loading (not elevating) and unloading scraper having a struck bowl capacity of at least 12 cubic yards.

Pusher tractor is a track type tractor having a power rating of at least 250 flywheel horsepower equipped with appropriate attachments.

Unclassified excavation is defined as the excavation of all materials encountered, including rock materials, regardless of their nature or the manner in which they are removed.

3. Blasting

The transportation, handling, storage, and use of dynamite and other explosives shall be directed and supervised by a person(s) of proven experience and ability who is authorized and qualified to conduct blasting operations.

Blasting shall be done in a manner as to prevent damage to the work or unnecessary fracturing of the underlying rock materials and shall conform to any special requirements in section 10 of this specification. When specified in section 10, the contractor shall furnish the engineer, in writing, a blasting plan before blasting operations begin.

4. Use of excavated material

Method 1—To the extent they are needed, all suitable material from the specified excavations shall be used in the construction of required permanent earthfill or rockfill. The suitability of material for specific purposes is determined by the engineer. The contractor shall not waste or otherwise dispose of suitable excavated material.

Method 2—Suitable material from the specified excavations may be used in the construction of required earthfill or rockfill. The suitability of material for specific purposes is determined by the engineer.

5. Disposal of waste materials

Method 1—All surplus or unsuitable excavated materials are designated as waste and shall be disposed of at the locations shown on the drawings.

Method 2—All surplus or unsuitable excavated materials are designated as waste and shall be disposed of by the contractor at sites of his own choosing away from the site of the work. The disposal shall be in an environmentally acceptable manner that does not violate local rules and regulations.

6. Excavation limits

Excavations shall comply with OSHA Construction Industry Standards (29CFR Part 1926) Subpart P, Excavations, Trenching, and Shoring. All excavations shall be completed and maintained in a safe and stable condition throughout the total construction phase. Structure and trench excavations shall be completed to the specified elevations and to the length and width required to safely install, adjust, and remove any forms, bracing, or supports necessary for the installation of the work. Excavations outside the lines and limits shown on the drawings or specified herein required to meet safety requirements shall be the responsibility of the contractor in constructing and maintaining a safe and stable excavation.

7. Borrow excavation

When the quantities of suitable material obtained from specified excavations are insufficient to construct the specified earthfills and earth backfills, additional material shall be obtained from the designated borrow areas. The extent and depth of borrow pits within the limits of the designated borrow areas shall be as specified in section 10 or as approved by the engineer.

Borrow pits shall be excavated and finally dressed to blend with the existing topography and sloped to prevent ponding and to provide drainage.

8. Overexcavation

Excavation in rock beyond the specified lines and grades shall be corrected by filling the resulting voids with portland cement concrete made of materials and mix proportions approved by the engineer. Concrete that will be exposed to the atmosphere when construction is completed shall meet the requirements of concrete selected for use under Construction Specification 31, Concrete for Major Structures, or 32, Structure Concrete, as appropriate.

Concrete that will be permanently covered shall contain not less than five bags of cement per cubic yard. The concrete shall be placed and cured as specified by the engineer.

Excavation in earth beyond the specified lines and grades shall be corrected by filling the resulting voids with approved, compacted earthfill. The exception to this is that if the earth is to become the subgrade for riprap, rockfill, sand or gravel bedding, or drainfill, the voids may be filled with material conforming to the specifications for the riprap, rockfill, bedding, or drainfill. Before correcting an overexcavation condition, the contractor shall review the planned corrective action with the engineer and obtain approval of the corrective measures.

9. Measurement and payment

For items of work for which specific unit prices are established in the contract, the volume of each type and class of excavation within the specified pay limits is measured and computed to the nearest cubic yard by the method of average cross-sectional end areas or by methods outlined in section 10 of this specification. Regardless of quantities excavated, the measurement for payment is made to the specified pay limits except that excavation outside the specified lines and grades directed by the engineer to remove unsuitable material is included. Excavation required because unsuitable conditions result from the contractor's improper construction operations, as determined by the engineer, is not included for measurement and payment.

Method 1—The pay limits shall be as designated on the drawings.

Method 2—The pay limits shall be defined as follows:

- a. The upper limit shall be the original ground surface as it existed before the start of construction operations except that where excavation is performed within areas designated for previous excavation or earthfill, the upper limit shall be the modified ground surface resulting from the specified previous excavation or earthfill.
- b. The lower and lateral limits shall be the neat lines and grades shown on the drawings.

Method 3 —The pay limits shall be defined as follows:

- a. The upper limit shall be the original ground surface as it existed before the start of construction operations except that where excavation is performed within areas designated for previous excavation or earthfill, the upper limit shall be the modified ground surface resulting from the specified previous excavation or earthfill.
- b. The lower and lateral limits shall be the true surface of the completed excavation as directed by the engineer.

Method 4—The pay limits shall be defined as follows:

- a. The upper limit shall be the original ground surface as it existed before the start of construction operations except that where excavation is performed within areas designated for previous excavation or earthfill, the upper limit shall be the modified ground surface resulting from the specified previous excavation or earthfill.
- b. The lower limit shall be at the bottom surface of the proposed structure.
- c. The lateral limits shall be 18 inches outside of the outside surface of the proposed structure or shall be vertical planes 18 inches outside of and parallel to the footings, whichever gives the larger pay quantity, except as provided in d below.
- d. For trapezoidal channel linings or similar structures that are to be supported upon the sides of the excavation without intervening forms, the lateral limits shall be at the underside of the proposed lining or structure.
- e. For the purposes of the definitions in b, c, and d, above, any specified bedding or drainfill directly beneath or beside the structure will be considered to be a part of the structure.

All methods—The following provisions apply to all methods of measurement and payment.

Payment for each type and class of excavation is made at the contract unit price for that type and class of excavation. Such payment will constitute full compensation for all labor, materials, equipment, and all other items necessary and incidental to the performance of the work except that extra payment for backfilling overexcavation will be made in accordance with the following provisions.

Payment for backfilling overexcavation, as specified in section 8 of this specification, is made only if the excavation outside specified lines and grades is directed by the engineer to remove unsuitable material and if the unsuitable condition is not a result of the contractor's improper construction operations as determined by the engineer.

Compensation for any item of work described in the contract, but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 10 of this specification.

10. Items of work and construction details

10. Items of Work and Construction Details

In Section 5, Use of excavated material, Method 1 shall apply. There is no guarantee that materials obtained from the specified excavations may be used directly in specified fill areas. Separate stockpiling of selected materials, based on their engineering properties, to ensure their availability for use in specific zones of fill areas may be required. Stockpiling shall be conducted within waste area and borrow area shown on the construction drawings or as approved by the Engineer. Additional compensation will not be made for stockpiling of excavated materials. Cost for stockpiling of excavated materials shall be included in the compensation for the bid item(s) for excavation.

In Section 6, Disposal of waste materials, Method 1 shall apply. The disposal of the excavated materials shall include transporting, depositing, and spreading the materials to and on the designated waste areas as shown on the drawings or as approved by the Engineer. The finished surface of the waste area(s) shall be uniform and conform to the topography. Additional compensation for disposal of excavated materials and dressing of the surface of waste areas will not be made. Costs will be included in the compensation for the bid item for excavation.

In Section 7, Excavation Limits, a qualified Representative of the Engineer will inspect all exposed subgrade surfaces upon which structures, drainfill, or embankment fill will be placed. The Representative shall conduct visual inspection and/or testing to confirm the subgrade is suitable for the intended design purpose, and if necessary, will direct the Contractor to perform additional overexcavation and replacement if conditions warrant. The Contractor shall facilitate access to subgrade areas and assist the Representative as necessary during the inspection. The Contractor shall be prepared to provide an excavator and operator to perform test excavations at the direction of the Representative, if requested, and provide heavy equipment to conduct proof rolling operations as required. Proof rolling will be performed in accordance with Item 216, "Proof Rolling" of the Texas Department of Transportation Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges (2014). In Section 9, Measurement and payment, Method 3 shall apply. The neat lines and grades shown on the drawings shall be considered the true surface of the completed excavation unless otherwise approved by the Engineer. After the limits of excavation shown on the drawings are complete, the Engineer will examine the completed surface and mark areas that need additional excavation to remove low density or unsuitable materials. The actual depths and extent of these excavations will be determined after examination of materials encountered.

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item 12, Excavation, Common

- (1) This item shall consist of all excavation required for reconstruction of the embankment, including all wet excavation along the upstream slope and inlet channel; and installation of the new principal spillway riser, 48-inch I.D. principal spillway pipe, RCC spillway, vegetated auxiliary spillway, rock riprap lined principal spillway and auxiliary spillway outlet, and outlet channels as shown on the drawings.
- (2) Prior to performing designated excavations, the ground surface shall be stripped of vegetation and topsoil. The depth of this stripping shall be sufficient to remove soil containing significant vegetative or organic matter. The depth of stripping is estimated to be 12 inches, on average. The upper limit for pay limit determination (Method 3) shall be the ground surface as it exists prior to stripping the surface vegetation and topsoil.

- (3) Suitable materials resulting from the required excavations shall be used to construct the specified fills except materials suitable for topsoil shall be stockpiled at the location designated by the Engineer. Unsuitable materials shall be placed in the waste area shown on the drawings.
- (4) Items of work subsidiary to this bid item are:
 - (a) Excavation, Common, Foundation Stripping as specified in Section 10.b. of this specification as it applies to this bid item.

b. Subsidiary Item, Excavation, Common, Foundation Stripping

- (1) This item shall consist of removing weeds, grass, roots and soils containing significant vegetative or organic material from the ground surface (including any waste areas) prior to placing earthfill in required areas. The depth of stripping shall be sufficient to remove the vegetative material and soil containing significant organic matter and is estimated to be 3 to 12 inches (on average). The total required volume of stripping shall not exceed that obtained by assuming a depth of 6 inches.
- (2) Separate payment will not be made for this item. Compensation for this item will be included in the payment for the respective bid item for Excavation, Common.

c. Subsidiary Item, Excavation Common, Borrow

- (1) This item shall consist of all excavation from within the borrow areas required to complete the specified earthfills as designated on the drawings.
- (2) All excavated slopes within the limits of borrow areas shall be maintained to be no steeper than five horizontal to one vertical.
- (3) All borrow areas shall be maintained to provide positive drainage to natural and constructed drainage ways. Dressing and grading of borrow areas to accomplish this drainage shall be accomplished as borrow excavation progresses. Additional compensation will not be made for this work as herein specified.
- (4) All borrow areas shall be maintained to be contiguous with no berms, ridges or mounds remaining that extend more than two feet above the lowest point in adjacent borrow areas. All berms, ridges, and mounds shall be removed to meet this height limitation. Additional compensation will not be made for this work as herein specified.
- (5) Separate payment will not be made for this item. Compensation for this item will be included in the payment for the respective bid items for Material Type C, Material Type D and Material Type E, as appropriate.

d. Subsidiary Item, Excavation, Common, Drainfill, Fine Filter

- (1) This item includes all excavation, outside the limits of other designated excavation, required for the installation of the drainage systems as shown on the drawings.
- (2) Separate payment will not be made for this item. Compensation for this item will be included in the payment for the bid item for Drainfill, Fine Filter.

e. Subsidiary Item, Excavation, Common, Drainfill, Coarse Filter

- (1) This item includes all excavation, outside the limits of other designated excavation, required for the installation of the drainage systems as shown on the drawings.
- (2) Separate payment will not be made for this item. Compensation for this item will be included in the payment for the bid item for Drainfill, Coarse Filter.

f. Subsidiary Item, Excavation, Common, Concrete Structures

- (1) This item includes all excavation, outside the limits of other designated excavation, required for the installation of the principal spillway system and appurtenances including the principal spillway outlet structure.
- (2) Separate payment will not be made for this item. Compensation for this item will be included in the payment for the respective bid items for Concrete, Structural and Concrete, Pipe Cradle, as appropriate.

g. Subsidiary Item, Excavation, Common, Rock Riprap and Riprap Bedding

- (1) This item shall consist of all excavation required for the installation of the rock riprap as shown on the drawings.
- (2) Separate payment will not be made for this item. Compensation for this item will be included in the payment for the bid items for Rock Riprap and Riprap Bedding.

h. Subsidiary Item, Excavation, Common, Structure Removal

- (1) This item shall consist of all excavation required for removing the existing principal spillway intake tower and portions of the existing principal spillway conduit designated for removal, as shown on the drawings.
- (2) Separate payment will not be made for this item. Compensation for this item will be included in the payment for the bid item for Structure Removal, Existing Principal Spillway.

i. Subsidiary Item, Excavation, Common, Flexbase

- (1) This item shall consist of all excavation required for the installation of the flexbase as shown on the drawings.
- (2) Separate payment will not be made for this item. Compensation for this item will be included in the payment for the bid item for Flexbase.

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Construction Specification 23—Earthfill

1. Scope

The work consists of the construction of earth embankments, other earthfills, and earth backfills required by the drawings and specifications.

Earthfill is composed of natural earth materials that can be placed and compacted by construction equipment operated in a conventional manner.

Earth backfill is composed of natural earth material placed and compacted in confined spaces or adjacent to structures (including pipes) by hand tamping, manually directed power tampers or vibrating plates, or their equivalent.

2. Material

All fill material shall be obtained from required excavations and designated borrow areas. The selection, blending, routing, and disposition of material in the various fills shall be subject to approval by the engineer.

Fill materials shall contain no frozen soil, sod, brush, roots, or other perishable material. Rock particles larger than the maximum size specified for each type of fill shall be removed prior to compaction of the fill.

The types of material used in the various fills shall be as listed and described in the specifications and drawings.

3. Foundation preparation

Foundations for earthfill shall be stripped to remove vegetation and other unsuitable material or shall be excavated as specified.

Except as otherwise specified, earth foundation surfaces shall be graded to remove surface irregularities and shall be scarified parallel to the axis of the fill or otherwise acceptably scored and loosened to a minimum depth of 2 inches. The moisture content of the loosened material shall be controlled as specified for the earthfill, and the surface material of the foundation shall be compacted and bonded with the first layer of earthfill as specified for subsequent layers of earthfill.

Earth abutment surfaces shall be free of loose, uncompacted earth in excess of 2 inches in depth normal to the slope and shall be at such a moisture content that the earthfill can be compacted against them to produce a good bond between the fill and the abutments.

Rock foundation and abutment surfaces shall be cleared of all loose material by hand or other effective means and shall be free of standing water when fill is placed upon them. Occasional rock outcrops in earth foundations for earthfill, except in dams and other structures designed to restrain the movement of water, shall not require special treatment if they do not interfere with compaction of the foundation and initial layers of the fill or the bond between the foundation and the fill.

Foundation and abutment surfaces shall be no steeper than one horizontal to one vertical unless otherwise specified. Test pits or other cavities shall be filled with compacted earthfill conforming to the specifications for the earthfill to be placed upon the foundation.

4. Placement

Earthfill shall not be placed until the required excavation and foundation preparation have been completed and the foundation has been inspected and approved by the engineer. Earthfill shall not be placed upon a frozen surface nor shall snow, ice, or frozen material be incorporated in the earthfill matrix.

Earthfill shall be placed in approximately horizontal layers. The thickness of each layer before compaction shall not exceed the maximum thickness specified in section 10 or shown on the drawings. Materials placed by dumping in piles or windrows shall be spread uniformly to not more than the specified thickness before being compacted.

Hand compacted earth backfill shall be placed in layers whose thickness before compaction does not exceed the maximum thickness specified for layers of earth backfill compacted by manually directed power tampers.

Earth backfill shall be placed in a manner that prevents damage to the structures and allows the structures to assume the loads from the earth backfill gradually and uniformly. The height of the earth backfill adjacent to a structure shall be increased at approximately the same rate on all sides of the structure.

Earthfill and earth backfill in dams, levees, and other structures designed to restrain the movement of water shall be placed to meet the following additional requirements:

- (a) The distribution of materials throughout each zone shall be essentially uniform, and the earthfill shall be free from lenses, pockets, streaks, or layers of material differing substantially in texture, moisture content, or gradation from the surrounding material. Zone earthfills shall be constructed concurrently unless otherwise specified.
- (b) The surface of each layer shall be scarified parallel to the axis of the fill to a depth of not less than 2 inches before the next layer is placed.
- (c) The top surface of embankments shall be maintained approximately level during construction with two exceptions: A crown or cross-slope of about 2 percent shall be maintained to ensure effective drainage, or as otherwise specified for drainfill or sectional zones.
- (d) Dam embankments shall be constructed in continuous layers from abutment to abutment except where openings to facilitate construction or to allow the passage of streamflow during construction are specifically authorized in the contract.
- (e) Embankments built at different levels as described under (c) or (d) above shall be constructed so that the slope of the bonding surfaces between embankment in place and embankment to be placed is not steeper than 3 feet horizontal to 1 foot vertical. The bonding surface of the embankment in place shall be stripped of all material not meeting the requirements of this specification and shall be scarified, moistened, and recompacted when the new earthfill is placed against it. This ensures a good bond with the new earthfill and obtains the specified moisture content and density at the contact of the in-place and new earthfills.

5. Control of moisture content

During placement and compaction of earthfill and earth backfill, the moisture content of the material being placed shall be maintained within the specified range.

The application of water to the earthfill material shall be accomplished at the borrow areas insofar as practicable. Water may be applied by sprinkling the material after placement on the earthfill, if necessary. Uniform moisture distribution shall be obtained by disking.

Material that is too wet when deposited on the earthfill shall either be removed or be dried to the specified moisture content prior to compaction.

If the top surface of the preceding layer of compacted earthfill or a foundation or abutment surface in the zone of contact with the earthfill becomes too dry to permit suitable bond, it shall either be removed or scarified and moistened by sprinkling to an acceptable moisture content before placement of the next layer of earthfill.

6. Compaction

Earthfill—Earthfill shall be compacted according to the following requirements for the class of compaction specified:

Class A compaction—Each layer of earthfill shall be compacted as necessary to provide the density of the earthfill matrix not less than the minimum density specified in Section 10 or identified on the drawings. The earthfill matrix is defined as the portion of the earthfill material finer than the maximum particle size allowed in the reference compaction test method specified (ASTM D698 or ASTM D1557).

Class B compaction—Each layer of earthfill shall be compacted to a mass density not less than the minimum density specified.

Class C compaction—Each layer of earthfill shall be compacted by the specified number of passes of the type and weight of roller or other equipment specified or by an approved equivalent method. Each pass shall consist of at least one passage of the roller wheel or drum over the entire surface of the layer.

Earth backfill—Earth backfill adjacent to structures shall be compacted to a density equivalent to that of the surrounding in-place earth material or adjacent required earthfill or earth backfill. Compaction shall be accomplished by hand tamping or manually directed power tampers, plate vibrators, walk-behind, miniature, or self-propelled rollers. Unless otherwise specified heavy equipment including backhoe mounted power tampers or vibrating compactors and manually directed vibrating rollers shall not be operated within 3 feet of any structure. Towed or self-propelled vibrating rollers shall not be operated within 5 feet of any structure. Compaction by means of drop weights operating from a crane or hoist is not permitted.

The passage of heavy equipment will not be allowed:

- Over cast-in-place conduits within 14-days after placement of the concrete
- Over cradled or bedded precast conduits within 7 days after placement of the concrete cradle or bedding
- Over any type of conduit until the backfill has been placed above the top surface of the structure to a height equal to one-half the clear span width of the structure or pipe or 3 feet, whichever is greater, except as may be specified in section 10.

Compacting of earth backfill adjacent to structures shall not be started until the concrete has attained the strength specified in section 10 for this purpose. The strength is determined by compression testing of test cylinders cast by the contractor's quality control personnel for this purpose and cured at the work site in the manner specified in ASTM C 31 for determining when a structure may be put into service.

When the required strength of the concrete is not specified as described above, compaction of earth backfill adjacent to structures shall not be started until the following time intervals have elapsed after placement of the concrete.

Structure	Time interval (days)
Vertical or near-vertical walls with earth loading on one side only	14
Walls backfilled on both sides simultaneously	7
Conduits and spillway risers, cast-in-place (with inside forms in place)	7
Conduits and spillway risers, cast-in-place (inside forms removed)	14
Conduits, pre-cast, cradled	2
Conduits, pre-cast, bedded	1
Cantilever outlet bents (backfilled both sides simultaneously)	3

7. Reworking or removal and replacement of defective earthfill

Earthfill placed at densities lower than the specified minimum density or at moisture contents outside the specified acceptable range of moisture content or otherwise not conforming to the requirements of the specifications shall be reworked to meet the requirements or removed and replaced by acceptable earthfill. The replacement earthfill and the foundation, abutment, and earthfill surfaces upon which it is placed shall conform to all requirements of this specification for foundation preparation, approval, placement, moisture control, and compaction.

8. Testing

During the course of the work, the contractor shall perform quality control tests, as applicable, to identify earthfill and earth backfill materials; determine the reference maximum density and optimum moisture content; and document that the moisture content of material at the time of compaction and the density of earthfill and earth backfill in place conform to the requirements of this specification.

Determining Reference Maximum Density and Optimum Moisture Content—For Class A compaction, the reference maximum density and optimum moisture content shall be determined in accordance with the compaction test and method specified on the drawings or in section 10.

Documenting Specification Conformance—In-place densities of earthfill and earth backfill requiring Class A compaction shall be measured in accordance with ASTM D1556, D2167, D2937, D6938 or D8167. Moisture contents of earthfill and earth backfill at the time of compaction shall be measured in accordance with ASTM D2216, D4643, or D6938. Values of moisture content determined by ASTM D2216 are considered the true value of the soil moisture. Values of moisture content determined by ASTM D4643 or D6938 shall be verified by comparison to values obtained by ASTM D2216. Values of in-place density and moisture content determined by these tests shall be compared to the minimum density and moisture content range specified on the drawings or in section 10.

Correction for Oversize Particles—If the materials to be used for earthfill or earth backfill contain more than 5 percent by dry weight of oversize rock particles (particles larger than those allowed in the specified compaction test and method), corrections for oversize particles shall be made using the appropriate procedures explained in ASTM D4718.

9. Measurement and payment

For items of work for which specific unit prices are established in the contract, the volume of each type and compaction class of earthfill and earth backfill within the specified zone boundaries and pay limits is measured and computed to the nearest cubic yard by the method of average cross-sectional end areas. Unless otherwise specified in section 10, no deduction in volume is made for embedded items, such as, but not limited to, conduits, inlet structures, outlet structures, embankment drains, sand diaphragm and outlet, and their appurtenances.

The pay limits shall be as defined below, with the further provision that earthfill required to fill voids resulting from overexcavation of the foundation, outside the specified lines and grades, will be included in the measurement for payment only under the following conditions:

- Where such overexcavation is directed by the engineer to remove unsuitable material, and
- Where the unsuitable condition is not a result of the contractor's improper construction operations as determined by the engineer.

Earthfill beyond the specified lines and grades to backfill excavation required for compliance with OSHA requirements will be considered subsidiary to the earthfill bid item(s).

Method 1—The pay limits shall be as designated on the drawings.

Method 2—The pay limits shall be the measured surface of the foundation when approved for placement of the earthfill and the specified neat lines of the earthfill surface.

Method 3—The pay limits shall be the measured surface of the foundation when approved for placement of the earthfill and the measured surface of the completed earthfill.

Method 4—The pay limits shall be the specified pay limits for excavation and the specified neat lines of the earthfill surface.

Method 5—The pay limits shall be the specified pay limits for excavation and the measured surface of the completed earthfill.

Method 6—Payment for each type and compaction class of earthfill and earth backfill is made at the contract unit price for that type and compaction class of earthfill. Such payment will constitute full compensation for all labor, material, equipment, and all other items necessary and incidental to the performance of the work.

Method 7—Payment for each type and compaction class of earthfill and earth backfill is made at the contract unit price for that type and compaction class of earthfill. Such payment will constitute full compensation for all labor, material, equipment, and all other items necessary and incidental to the performance of the work except furnishing, transporting, and applying water to the foundation and earthfill material. Water applied to the foundation and earthfill material is measured and payment made as specified in Construction Specification 10.

All methods—The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 10 of this specification.

10. Items of work and construction details

10. Items of Work and Construction Details

Where embankment fill is placed against excavated and constructed slopes which have a gradient equal to or steeper than 5 horizontal to 1 vertical (5H:1V), the slope shall be benched such that the vertical height of each bench shall be approximately 1 foot with a horizontal width of no less than 2 feet. Benching shall extend beyond the limits of previously completed foundation excavation. The benched material shall receive the same compaction effort as the lift of fill that is placed adjacent to each bench. Density testing of the benches will not be required when benching into natural slopes or previously constructed slopes which have already been tested for this Project. Natural slopes between 5H:1V and 10H:1V shall be raised horizontally. Temporary slopes shall conform to OSHA requirements.

Earthfill shall be compacted with kneading-type equipment capable of producing a homogenous compacted fill with good inter-lift bonding and free from adverse preferential planes.

The maximum layer thickness shall be 9 inches before compaction when compacted by heavy equipment, or 4 inches before compaction when compacted with manually-operated equipment. The maximum allowable equipment compacted particle size shall be 2 inches. Backfill adjacent to concrete works shall not contain particles larger than 1 inch in diameter.

Excavated subgrades shall be inspected as specified in Construction Specification 21, Excavation. Immediately prior to placement of the initial fill layer on earthen subgrade, the stripped subgrade shall be scarified to a depth of approximately 6 inches, moisture conditioned as necessary to within 0 to +4% of optimum moisture according to ASTM D698, and compacted to achieve a minimum relative compaction of 98% of maximum dry density under the footprint of structures and a minimum of 95% of maximum dry density in all other areas per ASTM D698.

After being deposited on the fill, each lift of fill material shall be spread, bladed and smoothed to the extent necessary to ensure that the surface is free of abrupt mounds, depressions or windrows to provide a smooth uniform surface for operation of plowing and compaction equipment.

Each lift of fill material shall then be disked, bladed and plowed to an acceptable degree and depth so as to thoroughly loosen, blend, and bond the material with the preceding lift before compaction is started.

The minimum disk blade size shall be 34 inches in diameter. An increase in the weight of the plow; an increase in disc size; a decrease in thickness of lifts being placed, or any combination of these may be required to accomplish the blending and bonding herein specified.

All surfaces to receive fill shall be closely examined immediately prior to the placement of all earthfills and backfills. All materials that exhibit drying cracks, slaking, or other evidences of being unstable or unsuitable, shall be removed or reworked by scarification, wetting, and compaction to the affected depths prior to the placement of fill. Additional compensation will not be made for removing or reworking the foundation or fill materials to meet the requirements herein specified.

In Section 9, Measurement and payment, Method 4 and 6 shall apply.

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item 13, Earthfill, Material Type A, Imported Fill

- (1) This item shall consist of all fill and backfill necessary for the completion of the embankment adjacent to RCC Spillway as shown on the drawings. This item shall include all costs required to locate off-site borrow source, to verify that material meets specifications and to supply material to the project site.
- (2) In Section 6, Compaction, Class A compaction shall apply. In-place dry density of materials being placed shall not be less than specified on the drawings during tests performed in accordance with the procedures contained in ASTM D698 (Laboratory Compaction Characteristics of Soil Using Standard Effort) using Method A or B, as appropriate. Moisture at the time of compaction shall be as shown on the drawings as determined from the above test. The moisture content of the materials being placed shall be adjusted as necessary to meet these requirements.
- (3) The foundation on which earthfill is to be placed that has not had previous excavation performed shall be properly prepared as outlined in Section 3 of this specification.

b. Bid Item 14, Earthfill, Material Type B, Imported Fill

- (1) This item shall consist of all fill and backfill necessary for the completion of the embankment under the RCC spillway as shown on the drawings. This item shall include all costs required to locate off-site borrow source, to verify that material meets specifications and to supply material to the project site.
- (2) In Section 6, Compaction, Class A compaction shall apply. In-place dry density of materials being placed shall not be less than specified on the drawings during tests performed in accordance with the procedures contained in ASTM D698 (Laboratory Compaction Characteristics of Soil Using Standard Effort) using Method A or B, as appropriate. Moisture at the time of compaction shall be as shown on the drawings as determined from the above test. The moisture content of the materials being placed shall be adjusted as necessary to meet these requirements.
- (3) The foundation on which earthfill is to be placed that has not had previous excavation performed shall be properly prepared as outlined in Section 3 of this specification.

c. Bid Item 15, Earthfill, Material Type C, On-site Fill

- (1) This item shall consist of all fill and backfill necessary for the completion of the interior zone of the embankment as shown on the drawings.
- (2) In Section 6, Compaction, Class A compaction shall apply. In-place dry density of materials being placed shall not be less than specified on the drawings during tests performed in accordance with the procedures contained in ASTM D698 (Laboratory Compaction Characteristics of Soil Using Standard Effort) using Method A or B, as appropriate. Moisture at the time of compaction shall be as shown on the drawings as determined from the above test. The moisture content of the materials being placed shall be adjusted as necessary to meet these requirements.

- (3) The foundation on which earthfill is to be placed that has not had previous excavation performed shall be properly prepared as outlined in Section 3 of this specification.
- (4) The Item of work subsidiary to this bid item is Excavation, Common, Borrow, as specified in Construction Specification 21.

d. Bid Item 16, Earthfill, Material Type D, On-site Fill

- (1) This item shall consist of all fill and backfill necessary for the completion of the outer zone of the embankment as shown on the drawings.
- (2) In Section 6, Compaction, Class A compaction shall apply. In-place dry density of materials being placed shall not be less than specified on the drawings during tests performed in accordance with the procedures contained in ASTM D698 (Laboratory Compaction Characteristics of Soil Using Standard Effort) using Method A or B, as appropriate. Moisture at the time of compaction shall be as shown on the drawings as determined from the above test. The moisture content of the materials being placed shall be adjusted as necessary to meet these requirements.
- (3) The foundation on which earthfill is to be placed that has not had previous excavation performed shall be properly prepared as outlined in Section 3 of this specification.
- (4) The Item of work subsidiary to this bid item is Excavation, Common, Borrow, as specified in Construction Specification 21.

e. Bid Item 17, Earthfill, Material Type E, On-site Fill

- (1) This item shall consist of all fill and backfill necessary for the completion of the vegetated auxiliary spillway as shown on the drawings.
- (2) In Section 6, Compaction, Class A compaction shall apply. In-place dry density of materials being placed shall not be less than specified on the drawings during tests performed in accordance with the procedures contained in ASTM D698 (Laboratory Compaction Characteristics of Soil Using Standard Effort) using Method A or B, as appropriate. Moisture at the time of compaction shall be as shown on the drawings as determined from the above test. The moisture content of the materials being placed shall be adjusted as necessary to meet these requirements.
- (3) The foundation on which earthfill is to be placed that has not had previous excavation performed shall be properly prepared as outlined in Section 3 of this specification.
- (4) The Item of work subsidiary to this bid item is Excavation, Common, Borrow, as specified in Construction Specification 21.

f. Subsidiary Item, Earthfill, Structure Removal

- (1) This item shall consist of earthfill as required to backfill to original or existing adjacent grades the overexcavations required for removing the existing principal spillway intake tower and portions of the existing principal spillway conduit designated for removal, as shown on the drawings.

- (2) Separate payment will not be made for this item. Compensation for this item will be included in the payment for the bid item for Structure Removal, Existing Principal Spillway.

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Construction Specification 24—Drainfill

1. Scope

The work consists of furnishing, placing, and compacting drainfill required in the construction of structure drainage systems.

2. Material

Method 1—Drainfill material shall conform to the requirements of Material Specification 521, Aggregates for Drainfill and Filters. A minimum of 30 days before delivery of materials to the site, the contractor shall inform the engineer in writing of the source(s) from which drainfill material will be obtained. The contractor shall provide the engineer free access to the source(s) for the purpose of obtaining samples for testing.

Method 2—Drainfill material shall be sand, gravel, or crushed stone, or mixtures thereof, obtained from the specified sources. The material shall be selected as necessary to avoid the inclusion of organic matter, clay balls, excessive fine particles, or other substances that would interfere with their free-draining properties.

3. Base preparation

Foundation surface and trenches shall be clean and free of organic matter, loose soil, foreign substance, and standing water when the drainfill is placed. Earth surfaces upon or against which drainfill will be placed shall not be scarified.

4. Placement

Drainfill shall not be placed until the subgrade has been inspected and approved by the engineer. Drainfill shall not be placed over or around pipe or drain tile until the installation of the pipe or tile has been inspected and approved.

Drainfill shall be placed uniformly in layers not to exceed 12 inches thick before compaction. When compaction is accomplished by manually controlled equipment, the layers shall not exceed 8 inches thick. The material shall be placed to avoid segregation of particle sizes and to ensure the continuity and integrity of all zones. No foreign material shall be allowed to become intermixed with or otherwise contaminate the drainfill.

Traffic shall not be permitted to cross over drains at random. Equipment cross-overs shall be maintained, and the number and location of such crossovers shall be established and approved before the beginning of drainfill placement. Each crossover shall be cleaned of all contaminating material and shall be inspected and approved by the engineer before the placement of additional drainfill material.

Any damage to the foundation surface or the trench sides or bottom occurring during placement of drainfill shall be repaired before drainfill placement is continued.

The upper surface of drainfill constructed concurrently with adjacent zones of earthfill shall be maintained at a minimum elevation of 1 foot above the upper surface of adjacent earthfill.

Drainfill over and/or around pipe or drain tile shall be placed to avoid any displacement in line or grade of the pipe or tile.

Drainfill shall not be placed adjacent to structures until the concrete has attained the strength specified in section 9 of this specification. The strength shall be determined by compression testing of concrete test cylinders cast

and field cured at the project site in accordance with ASTM Method C 31 for determining when a structure may be placed into service.

When the required strength of the concrete is not specified as described above, placement of drainfill adjacent to concrete structures shall not be commenced until the following item intervals have elapsed following placement of the concrete:

Structure type	Time interval (days)
Vertical or near-vertical wall with earth loading on one side only (retaining walls and counterforts)	14
Walls backfilled on both sides simultaneously	7
Conduits and galleries, cast-in-place (with inside forms in place)	7
(inside forms removed)	14
Conduits, precast, cradled	2
Conduits, precast, bedded	1
Cantilever outlet bents backfilled on both sides simultaneously	3

5. Control of moisture

The moisture content of drainfill material shall be controlled as specified in section 9 of this specification. When additional water is required, it shall be applied in a manner to avoid excessive wetting to adjacent earthfill. Except as specified in section 9 of this specification, control of moisture content will not be required.

6. Compaction

Drainfill shall be compacted according to the following requirements for the class of compaction specified:

Class A compaction—For drainfill materials with more than 70 percent passing the 3/4 inch sieve, each layer of drainfill shall be compacted to a minimum dry density of not less than the density specified in section 9 of this specification as determined by ASTM D 698. For drainfill materials with 70 percent or less passing the 3/4 inch sieve, each layer of drainfill shall be compacted to a relative density of not less than 70 percent as determined by ASTM D 4254.

Class I compaction—Each layer of drainfill shall be compacted by a minimum of two passes over the entire surface with a steel-drum vibrating roller weighing at least 5 tons and exerting a vertical vibrating force of not less than 20,000 pounds at a minimum frequency of 1,200 times per minute, or by an approved equivalent method.

Class II compaction—Each layer of drainfill shall be compacted by one of the following methods or by an approved equivalent method. (A pass is defined as at least one complete coverage of the roller wheel, tire, or drum over the entire surface for each layer.)

- A minimum of two passes over the entire surface with a pneumatic-tired roller exerting a minimum pressure of 75 pounds per square inch.
- A minimum of four passes over the entire surface with the track of a crawler-type tractor weighing at least 20 tons.
- Controlled movement of the hauling equipment so that the entire surface is traversed by not less than one tread track of the loaded hauling equipment.

Class III compaction—No compaction will be required beyond that resulting from the placing and spreading operations.

When compaction other than Class III compaction is specified, material placed in trenches or other locations inaccessible to heavy equipment shall be compacted by manually controlled pneumatic or vibrating tampers as specified in section 9 of this specification.

Heavy equipment shall not be operated within 2 feet of any structure. Vibrating rollers shall not be operated within 5 feet of any structure. Compaction by means of drop weights operating from cranes, hoists, or similar equipment will not be permitted.

7. Testing

The contractor shall conduct such tests as necessary to verify that the drainfill material and the inplace drainfill meets the specification requirements.

The engineer shall be granted access to perform such tests as are required to verify that the drainfill materials and the drainfill in place meets the requirements of the specifications. These tests are not intended to provide the contractor with information needed to assure that the materials and workmanship meet the specification requirements. These verification tests will not relieve the contractor of the responsibility of performing required tests for that purpose.

8. Measurement and payment

Method 1—For items of work for which specific unit prices are established in the contract, the volume of drainfill within the neat lines shown on the drawings are measured and computed to the nearest cubic yard. Where the engineer directs placement of drainfill outside the neat lines to replace unsuitable foundation material, the volume of such drainfill is included. The volume included is only to the extent that the unsuitable condition is not a result of the contractor's improper construction operation in the determination of the engineer.

Payment for drainfill is made at the contract unit price for each type of drainfill, complete in place. Except as otherwise specified in section 9 of this specification, such payment will constitute full compensation for all labor, equipment, material, and all other items necessary and incidental to the performance of the work.

Method 2—For items of work for which specific unit prices are established in the contract, the quantity of drainfill placed within the specified limits is computed to the nearest 0.1 ton by actual weight. Where the engineer directs placement of drainfill outside the neat lines to replace unsuitable foundation material, the weight of such drainfill is included. The weight included is only to the extent that the unsuitable condition is not a result of the contractor's improper construction operation in the determination of the engineer.

Payment for drainfill is made at the contract unit price for each type of drainfill, complete in place. Except as otherwise specified in section 9 of this specification, such payment will constitute full compensation for all labor, equipment, material, and all other items necessary and incidental to the performance of the work.

Compensation for any item of work described in the contract, but not included in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 9 of this specification.

9. Items of work and construction details

9. Items of Work and Construction Details

In Section 2, Material, Method 1 shall apply. The percentage of drainfill materials that is finer than the No. 200 U.S. Standard Sieve Size (0.074 millimeter) shall be as shown on the drawings when determined in accordance with the procedures contained in ASTM C117. Fines shall be non-plastic when tested in accordance with ASTM D4318.

In Section 5, Control of moisture, Fine Filter drainfill shall be in wet or near saturated condition when placed. Each layer of Fine Filter drainfill shall be saturated immediately prior to compaction. No control of moisture is required for Coarse Filter drainfill.

In Section 6, Compaction, for Fine Filter drainfill, Class A compaction with the following exceptions shall apply:

The compacted dry density shall be a minimum of 98% of the maximum dry density as determined by the method in ASTM D698.

The ASTM D698 test procedure shall be modified to consist of a 1-point test performed on a representative sample of oven-dried drainfill. The procedure shall be repeated three times to obtain an average value for the maximum dry density.

Compaction shall be achieved using a suitable vibratory compactor.

In Section 6, Compaction, for Coarse Filter drainfill, Class I compaction shall apply.

In Section 8, Measurement and payment, Method 1 shall apply. A deduction in volume will not be made for embedded conduits.

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item 18, Drainfill, Fine Filter

- (1) This item shall consist of furnishing and installing fine-graded filter material required for the principal spillway filter diaphragm, impact basin drain and filter, the filter blanket for the RCC auxiliary spillway and the filter diaphragm for the decommissioned existing principal spillway conduit.
- (2) Fine filter shall be placed in such a manner as to prevent segregation of particle sizes.
- (3) The item of work subsidiary to this bid item is Excavation, Common, Drainfill, Fine Filter as specified in Construction Specification 21.

b. Bid Item 19, Drainfill, Coarse Filter

- (1) This item shall consist of furnishing and installing coarse-graded filter material required for the impact basin drain and filter, and the filter blanket for the RCC auxiliary spillway.

- (2) Coarse filter gradation requirements are shown on the drawings. Coarse filter shall have $D_{15}/d_{85} \leq 4$, where D_{15} is the particle size corresponding to 15% finer by weight of the coarse filter and d_{85} is the particle size corresponding to 85% finer by weight of the fine filter.
- (3) Coarse filter shall be placed in such a manner as to prevent segregation of particle sizes.
- (4) The item of work subsidiary to this bid item is Excavation, Common, Drainfill, Coarse Filter as specified in Construction Specification 21.

c. Bid Item 29, Riprap Bedding

- (1) This item shall consist of furnishing and installing bedding material required beneath riprap as shown on the drawings.
- (2) Riprap Bedding shall be placed in such a manner as to prevent segregation of particle sizes.
- (3) The item of work subsidiary to this bid item is Excavation, Common, Rock Riprap and Riprap Bedding as specified in Construction Specification 21.

d. Bid Item 38, Flexbase

- (1) This item shall consist of furnishing and installing Flexbase (Flexible Base) material Texas Department of Transportation (TxDOT) Item 247 required beneath Principal Spillway Inlet and Impact Basin as shown on the drawings.
- (2) Flexbase aggregate shall be Type A, Grade 1-2 as per TxDOT Item 247 Table 1. Flexbase shall be placed in such a manner as to prevent segregation of particle sizes.
- (3) Flexbase shall be placed in maximum loose lift thickness of 9 inches.
- (4) Flexbase shall be compacted to a minimum of 100% of maximum dry density per ASTM D698. Compaction moisture shall be between -2% and +2% of optimum moisture per ASTM D698.
- (5) The item of work subsidiary to this bid item is Excavation, Common, Flexbase as specified in Construction Specification 21.

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Construction Specification 26—Topsoiling

1. Scope

The work consists of furnishing and spreading topsoil to specified depths at locations shown on the drawings.

2. Quality of topsoil

Topsoil shall consist of friable surface soil reasonably free of grass, roots, weeds, sticks, rocks, or other unsuitable material. Additional quality requirements, if any, are in section 7 of this specification.

3. Furnishing

Method 1—Topsoil shall be salvaged from designated earth surfaces that will be disturbed by construction activities. After designated sites have been cleared and grubbed, the topsoil shall be removed from the designated areas and stockpiled at locations shown on the drawings or acceptable to the engineer. Unsuitable material encountered during removal of topsoil shall be disposed of at locations shown on the drawings or approved by the engineer, or it will be otherwise hauled and disposed of at locations removed from the construction site. The contractor is responsible for complying with all local rules and regulations and the payment of any and all fees that may result from the disposal at locations outside the construction work limits.

Method 2—Topsoil shall be furnished from an offsite source designated by the contractor. The engineer shall be granted access to the source for inspection and acceptance before delivery to the site. Test results and samples shall be provided when specified in section 7 of this specification.

4. Stockpiling

Stockpiles of topsoil shall not conflict with the requirements of Construction Specification 5, Pollution Control, when made a part of this contract.

5. Spreading

Method 1—Spreading shall not be conducted when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to uniform spreading operations. Surfaces designated to receive a topsoil application shall be lightly scarified just before the spreading operation.

Following the spreading operation, the topsoil surface shall be left reasonably smooth and without ruts or surface irregularities that could contribute to concentrated waterflow downslope.

Method 2—Spreading shall not be performed when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to uniform spreading operations. Surfaces designated to receive a topsoil application shall be lightly scarified just before the spreading operation. Where compacted earthfills are designated to be topsoiled, the topsoil shall be placed concurrently with the earthfill and shall be bonded to the compacted fill with the compacting equipment.

Following the spreading operation, the topsoil surface shall be left reasonably smooth and without ruts or surface irregularities that could contribute to concentrated waterflow downslope.

6. Measurement and payment

Method 1—The total surface covered by topsoil is measured and the area(s) computed to the nearest square yard. Payment for furnishing and placing topsoil is made at the contract unit price.

Method 2—The total surface covered by topsoil, except the surface area of embankments, levees, dikes, and other earthfills not included for payment, is measured and the area(s) computed to the nearest square yard.

Payment for topsoil spread on the surface of embankments, levees, dikes, and other earthfills is included in the measurement and payment for that item of earthfill where topsoil application occurred.

Method 3—For items of work for which specific unit prices are established in the contract, the volume of topsoil furnished and spread is computed to the nearest cubic yard by the method of average cross-sectional end areas from surveys of the excavated topsoil stockpile or, if not stockpiled, cross-sectional surveys of the borrow area(s). Payment for furnishing and spreading topsoil is made at the contract unit price.

All methods—The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 7 of this specification.

All payment methods—Payment will constitute full compensation for all labor, equipment, material, and all other items necessary and incidental to the completion of the work. This includes excavating, stockpiling, hauling, spreading, and the wasting of unsuitable excavated material.

7. Items of work and construction details

7. Items of Work and Construction Details

In Section 3, Furnishing, Method 1 shall apply.

In Section 5, Spreading, Method 1 shall apply.

In Section 6, Measurement and payment, Method 1 shall apply.

Topsoil shall be processed by pulverizing and shall have the moisture content adjusted to optimum to facilitate uniform spreading to the specified thickness.

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item 20, Topsoiling

- (1) This item shall consist of salvaging of approved topsoil from required excavations; from the stripping operations; and from borrow areas and placing and spreading it on all designated earthfills, waste areas, and exposed excavated slopes as indicated on the drawings.
- (2) Topsoil shall be placed after the earthfill placement has been completed.
- (3) The depth of topsoil for the embankment earthfills, subsidiary earthfills, and waste areas shall be 12 inches normal to the slope.
- (4) The depth of topsoil for exposed cut slopes in the outlet channel, as well as exposed cut slopes for the embankment subgrade shall be 6 inches.

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Construction Specification 31—Concrete for Major Structures

1. Scope

The work consists of furnishing, forming, placing, finishing, and curing portland cement concrete as required to build the structures designated in section 25 of this specification.

The following BioPreferred® product category is applicable to this specification.

— Concrete release fluids (a.k.a., form-release agents)

2. Material

Aggregates must conform to the requirements of section 25 and Material Specification 522, Aggregates for Portland Cement Concrete, unless otherwise specified.

Portland cement must conform to the requirements of Material Specification 531, Portland Cement, for the specified type. One brand only of any type of cement may be used in any single structure as defined in section 25.

Fly ash must conform to the requirements of Material Specification 532, Supplementary Cementitious Materials.

Blast-furnace slag used as a partial substitution of portland cement in concrete must conform to the requirements of Material Specification 532, Supplementary Cementitious Materials.

Silica fume must conform to the requirements of Material Specification 532, Supplementary Cementitious Materials.

Air-entraining admixtures must conform to the requirements of Material Specification 533, Chemical Admixtures for Concrete. If air-entraining cement is used, any additional air-entraining admixture must be of the same type as that in the cement.

Plasticizing admixtures must conform to the requirements of Material Specification 533, Chemical Admixtures for Concrete.

Water-reducing or retarding admixtures must conform to the requirements of Material Specification 533, Chemical Admixtures for Concrete.

Accelerating and water-reducing and accelerating admixtures, if specified in section 25, must conform to the requirements of Material Specification 533, Chemical Admixtures for Concrete.

Curing compound must conform to the requirements of Material Specification 534, Concrete Curing Compound.

Preformed expansion joint filler must conform to the requirements of Material Specification 535, Preformed Expansion Joint Filler.

Sealing compound for joints must conform to the requirements of Material Specification 536, Sealing Compound for Joints in Concrete and Concrete Pipe.

Waterstops must conform to the requirements of Material Specifications 537, Nonmetallic Waterstops, and 538, Metal Waterstops, for the specified kinds.

Dowels must be a plain, round steel bar conforming to the requirements of Material Specification 539, Steel Reinforcement (for concrete).

Metal plates must conform to the requirements of Material Specification 581, Metal, for structural quality or commercial or merchant quality steel. Structural quality must be used only if specifically designated in the drawings or specifications.

Water used in mixing and curing concrete must be clean and free from injurious amounts of oil, salt, acid, alkali, organic matter, or other deleterious substances.

3. Concrete mix design

Method 1

Responsibilities—The contractor is responsible for the design and proportioning of the concrete. Job mixes must be prepared to meet the quality, consistency, and strength of concrete specified.

Submittals—At least 15 calendar days before the placement of any concrete, the contractor must provide the engineer with full documentation to support each job mix and any admixtures to be used in the work. The contractor must furnish test results to the engineer for each admixture showing that it meets the requirements of Material Specification 533, Chemical Admixtures for Concrete. Job mixes are reviewed and accepted or rejected by the engineer within 8 calendar days following the date of submittal. After a job mix has been accepted, neither the source, character, nor gradation of the aggregates nor the type or brand of cement or admixtures may be changed without prior notice to the engineer. Revisions or changes in a job mix that are determined to be significant by the engineer must follow the same submittal and acceptance process as that for the initial job mix.

Design criteria—The class of concrete must be as specified in section 25 and in accordance with the following specified compressive strength.

Class of concrete	Specified compressive strength (f'_c) at 28 days (lb/in ²)
5000	5,000
4000	4,000
3000	3,000
2500	2,500

Maximum water-cement ratio must be 0.50, unless otherwise specified.

Unless otherwise specified the air content (by volume) of the concrete at the time of placement must be:

Maximum size aggregate	Air content (%)
3/8 inch to 1 inch	5 to 7
Over 1 inch	4 to 6

The consistency of all concrete must allow it to be placed without segregation or excessive laitance. Unless otherwise specified, the slump must be:

Type of structural section	Slump (inches)
Massive sections, pavements, footings	2 ± 1
Heavy beams, thick slabs, thick walls (>12 inches)	3 ± 1
Columns, light beams, thin slabs, thin walls (12 inches or less)	4 ± 1

Superplasticized concrete must contain either a water-reducing, high range admixture (ASTM C494, Type F or G) or a plasticizing admixture (ASTM C1017) at a dosage rate that reduces the quantity of water required to produce a concrete mix within the above slump range by 12 percent or more or produces an increase in the slump of at least 2 inches above the slump of the design mix containing no water reducer or plasticizing admixture.

A water-reducing admixture (ASTM C494, Type F or G), a plasticizing admixture (ASTM C1017), or both may be added to an approved job mix without resubmittal and reapproval of the job mix if the following requirements are met:

- a. The admixture must be introduced into the concrete mix as specified by the manufacturer and be compatible with other admixtures in the job mix.
- b. The water content must be equal to or less than that required in the job mix without the admixture.
- c. The cement content must be the same as that required in the job mix without the admixture.
- d. The air content must be within the specified range.
- e. The slump must not exceed 7.5 inches unless the contractor demonstrates before placement that the job mix can be placed without segregation or excessive laitance at a slump greater than 7.5 inches. The concrete must retain the increased slump for not less than 30 minutes.
- f. If the admixture is added at the job site, the slump of the concrete before the addition of the admixture must not exceed the slump specified above for concrete that does not contain the admixture.

Calcium chloride or other corrosive accelerators may not be used unless otherwise specified.

Fly ash may be used as a partial substitution for portland cement in an amount not greater than 25 percent (by weight) of cement in the concrete mix unless otherwise specified.

Ground granulated blast-furnace slag may be used as a partial substitution for portland cement in amounts between 25 to 70 percent (by weight) of cement in the concrete mix unless otherwise specified.

Silica fume may be used as a partial substitution for portland cement in an amount ranging from 5 to 10 percent (by weight) of cement in the concrete mix unless otherwise specified.

Job mix criteria—Proportioning of concrete for job mixes must be based on the standard deviation computed from compressive strength tests of previous batch records or established by laboratory trial mixes. Unless otherwise specified, a compressive strength test is the average of the compressive strengths of two standard cured cylinders prepared and tested in accordance with section 4.

For a job mix based upon the standard deviation computed from compressive strength tests of previous batch records, the previous batches must represent similar material and conditions to those expected for the job mix and have a strength within 1,000 pounds per square inch of the specified compressive strength (f'_c) at 28 days for the class of concrete specified. The contractor must provide to the engineer copies of the facility's previous batching records that show the compressive strength results and the batch mix design used.

For a job mix based upon a laboratory trial mix, the trial mix must contain the actual material to be used in the final job mix, have a slump within 0.75 inches of the maximum allowable slump, and have an air content within 0.5 percent of the maximum allowable air content. The contractor must provide the engineer with copies of the actual compressive strength test records for the trial mix from the testing facility performing the test.

The trial job mix or previous batch records must include the water-reducing admixture when a water-reducing admixture is used in a concrete mix specifically to improve the physical properties of the hardened concrete or change portions of the mix components.

In meeting strength requirements, the selected job mix proportions must produce an average strength, f_{cr} , exceeding the specified compressive strength, f'_c , by the amount specified.

n	s_{30}	f_{cr}
>30	1.00 s	The larger of these
25	1.03 s	two equations:
20	1.08 s	$f'_c + 1.34 s_{30}$
15	1.16 s	$f'_c + 2.33 s_{30} - 500$
<15		$f'_c + 1,000$ for $f'_c < 3,000$
		$f'_c + 1,200$ for $3,000 \leq f'_c \leq 5,000$
		$1.10 f'_c + 700$ for $f'_c > 5,000$

Where—

- n = number of consecutive compressive strength tests
 s_{30} = standard deviation adjusted to 30 tests, lb/in²
 f_{cr} = required average compressive strength, lb/in²
 f'_c = specified compressive strength of concrete, lb/in²
 s = standard deviation (lb/in²) computed as $\{[\sum(X_i - \bar{X})^2]/[n-1]\}^{1/2}$
 where:
 X_i = individual strength test result, lb/in²
 \bar{X} = average of n strength test results, lb/in²

Method 2

Responsibilities—The engineer is responsible for the design and proportioning of the job mix. The initial job mix must be as specified in section 25. The engineer may adjust the initial job mix proportions to establish the designated job mix. The engineer will provide the contractor with a copy of each job mix as soon as the material and proportions have been determined. After the job mix has been designated, neither the source, character, nor gradation of the aggregates nor the type or brand of cement or admixtures may be changed without prior approval of the engineer. During the course of the work, the engineer may adjust the job mix proportions and batch weights whenever necessary to meet special job conditions.

The contractor, for each class of concrete, is responsible for—

- a. Taking the following actions and furnishing the engineer with the following information at least 35 calendar days before any placement of concrete, unless otherwise designated:
 - (1) Select the source of aggregates and sample and test the gradations of aggregates available.
 - (2) Select the brand and type of cement.
 - (3) Select the brand of admixtures and obtain manufacturer's test data and recommendation of use.
 - (4) Identify the concrete production facility, the type of mixer, and the mixing methods that will be used.
 - (5) Provide from the concrete production facility consecutive compressive strength test records and batching records for concrete mixes that have material, proportions, and compressive strengths within 1 000 pounds per square inch of the proposed design mix.
- b. Batching at least 3 cubic yards of the initial job mix, in the presence of the engineer, for testing and evaluation not less than 30 calendar days before any placement of concrete.

4. Inspecting and testing

During the course of the work, the engineer performs quality assurance testing as required to verify the concrete meets the contract requirements. The engineer must have free entry to the plant and equipment furnishing concrete under the contract. Proper facilities must be provided for the engineer to inspect material, equipment, and processes and to obtain samples of the concrete. All tests and inspections are conducted so as not to interfere unnecessarily with the manufacture, delivery, and placement of the concrete.

Any portion of a batch may be tested by the engineer for any of the purposes shown below. Samples taken for testing must be representative of that part of the batch.

- a. Determining uniformity of the batch.
- b. Checking compliance with requirements for slump and air content when the batch is discharged over an extended period.
- c. Checking compliance of the concrete with the specifications when the whole amount being placed in a small structure, or a distinct part of a larger structure, is less than full batch.

If concrete is conveyed to the placement location by pumping or conveyor belts, the samples must be collected at the discharge end.

When a plasticizing admixture is added to the concrete mix at the job site, slump tests are made both before the addition of the admixture to the concrete mix and after the admixture has been incorporated into the concrete mix.

The tests on concrete are performed by the following methods unless otherwise specified:

Type of test	Test method (ASTM designation)
Sampling	C172
Slump test	C143
Air content	C231 or C173
Compression test specimens	C31 or C42
Compressive strength testing	C39
Unit weight	C138
Temperature	C1064

A strength test for concrete is the average of two standard cured concrete cylinders prepared in accordance with ASTM C31 from the same sample of concrete and tested in accordance with ASTM C39 at 28 days, unless otherwise specified. If one cylinder shows manifest evidence of improper sampling, molding, curing, or testing, it must be discarded and the strength of the remaining cylinder must then be considered the compressive strength of the concrete. Should both cylinders show such defects, the entire test must be discarded.

If both cylinders are discarded or in-place concrete that was not sampled is in question, the in-place concrete may be sampled by coring in accordance with ASTM C42. For core tests, these requirements must be followed:

- a. At least three representative cores must be taken from each area of concrete in question. If one or more of the cores shows signs of being damaged before testing, it must be replaced by a new one.
- b. Test cores must be prepared for testing in accordance with moisture conditioning in ASTM C42 unless the engineer determines that the concrete in the structure will be dry under service conditions. If the concrete is determined to be dry under service conditions, the cores must be air dried (temperature 60°F to 80°F and relative humidity less than 60%) for 7 days before testing and must be tested dry.

5. Handling and measurement of material

Aggregates must be stored or stockpiled in such a manner that separation of coarse and fine particles of each size is avoided and that various sizes do not become intermixed before proportioning. Methods of handling and transporting aggregates must avoid contamination, excessive breakage, segregation, degradation, or intermingling of various sizes.

Unless otherwise specified, scales must be beam type or spring-less dial type. They must be accurate when static load tested to plus 0.4 percent of the total capacity of the scales. All exposed fulcrums, clevises, and similar working parts of scales must be kept clean.

Measuring tanks for mixing water must be of adequate capacity to furnish the maximum amount of mixing water required per batch. Tanks must be equipped with outside taps and valves to verify their calibration unless other means are provided for readily and accurately determining the amount of water in the tank.

The quantities of each component of the concrete mix must be measured by the following methods and to the accuracy indicated below:

Cement, fly ash, slag—Cement, except as otherwise specifically permitted, must be measured by weight or in bags on which the weight is plainly marked. When cement, fly ash, and slag are supplied in bulk and are measured by weight, they must be weighed on a scale separate from that used for other material and in a hopper entirely free and independent of the hopper used for weighing the aggregate. When fly ash or slag is used in the job mix, the cement and the fly ash or slag may be weighed separately or cumulatively by weighing the cement first and then adding the fly ash or slag to arrive at the composite weight. The weight of the cement and the combined weight of the cement and fly ash or slag must be within plus or minus 1 percent of the required weight of the cementitious material. When cement is measured in bags, no fraction of a bag may be used unless weighed.

Aggregates—Aggregates must be measured by weight unless otherwise specifically permitted. Mix proportions must be based on saturated, surface-dry weights. The batch weight of each aggregate is the required saturated, surface-dry weight corrected by the weight of surface moisture it contains. The weight of each of the specified aggregates must be within plus or minus 2 percent of the required weight.

Mixing water—Mixing water consists of water added to the batch, ice added to the batch, water occurring as surface moisture on the aggregates, and water introduced in the form of admixtures. The added water must be measured by weight or volume to an accuracy of 1 percent of the required total mixing water. Added ice must be measured by weight. Wash water must not be used as part of the mixing water for succeeding batches.

Admixtures—Dry admixtures must be measured by weight. Paste or liquid admixtures must be measured by weight or volume. The admixtures must be within plus or minus 3 percent of the required weight or volume for each specific admixture.

6. Mixers and mixing

Mixers are either stationary parts of a central mixing plant or portable equipment, such as revolving drum truck mixers and volumetric batching/continuous mixing truck mixers. Mixers must be capable of thoroughly mixing the concrete ingredients into a uniform mass within the specified mixing time and of discharging the mix without segregation. Each mixer or agitator must bear a manufacturer's rating plate indicating the gross volume of the drum, the capacity of the drum or container in terms of the volume of mixed concrete, and the minimum and maximum mixing speeds of rotation of the drum, blades, or paddles. When the truck mixer is used for truck-mixed concrete as described in section 6a(2) or for shrink-mixed concrete as described in section 6a(3), the capacity of the drum or container in terms of the volume of mixed concrete must not exceed 63 percent of the gross volume of the drum. When the truck mixer is used to transport central-mixed concrete as described in section 6a(1), the capacity of the drum or container in terms of the volume of mixed concrete must not exceed 80 percent of the gross volume of the drum. The mixer must be operated in accordance with these recommendations.

Concrete must be uniform and thoroughly mixed when delivered to the forms in a freshly mixed and unhardened state. Variations in slump of more than 1 inch within a batch is considered evidence of inadequate mixing and must be corrected by changing batching procedures, increasing mixing time, changing mixers, or other means. Mixing time must be within the limits specified below unless the contractor demonstrates by mixer performance tests that adequate uniformity is obtained by different times of mixing.

No mixing water in excess of the amount called for by the job mix may be added to the concrete during mixing or hauling or after arrival at the delivery point. Water to compensate for up to a 1-inch loss in slump may be added, not to exceed the design maximum water cement ratio. Withholding some of the mixing water until the concrete arrives on the job, then adding the remaining water and turning the mixer 30 revolutions at mixing speed is allowed to overcome transporting conditions. When loss of slump or workability cannot be offset by these measures, complete mixing must be performed by onsite batching and mixing or by using a combination of centrally batching and transporting material to the site and adding remainder of material onsite.

Concrete may be furnished by ready-mix methods, by volumetric batching and continuous mixing at the site, or by batch mixing at the site.

a. Ready-mixed concrete

Ready-mixed concrete must be mixed, transported, and placed in a freshly mixed and unhardened state. The contractor must furnish the engineer a batch ticket showing amount of concrete in cubic yards, the time of loading, the time the load was discharged, the revolution counter reading at the time of loading and discharge, and the type and actual quantity of each material including all admixtures used in each batch of concrete. The batch ticket must include information necessary to calculate the water-cementitious materials ratio.

Truck mixers and truck agitators must be equipped with revolution counters by which the number of revolutions of the drum or blades may be readily verified. Ready-mixed concrete must be mixed and delivered by one of the following methods:

- (1) Central-mixed concrete—Central-mixed concrete is mixed completely in a stationary mixer and transported to the point of delivery either in a truck agitator, a truck mixer operating at agitating speed, or non-agitating equipment.

When a truck agitator or a truck mixer is used as an agitator and transports concrete that has been completely mixed in a stationary mixer, mixing during transportation must be at the speed designated by the manufacturer of the equipment as agitating speed. When concrete is transported in a truck mixer or truck agitator, the volume of the mixed concrete must not exceed 80 percent of the gross volume of the drum. The total number of revolutions of the truck mixer or truck agitator must not exceed 200 before discharge of the concrete, unless otherwise specified.

The use of non-agitating equipment to transport concrete to the site of the work is permitted only if the consistency and uniformity of the concrete as discharged at the point of delivery meet the requirements of this specification. Bodies of non-agitating hauling equipment must be constructed so that leakage of the concrete mix, or any part thereof, does not occur. Concrete hauled in open-top vehicles must be protected from rain and from more than 20 minutes exposure to the sun and wind when the air temperature is above 75 degrees Fahrenheit.

- (2) Truck-mixed concrete—Truck-mixed concrete is completely mixed in a truck mixer. The total volume of all ingredients to be mixed in a revolving drum truck mixer must not exceed 63 percent of the gross volume of the drum. The concrete ingredients must be mixed between 70 and 100 revolutions of the drum or blades at the speed designated by the manufacturer as mixing speed. Mixing in excess of 100 revolutions must be at the speed designated by the manufacturer of the equipment as agitating speed.
- (3) Shrink-mixed concrete—Shrink-mixed concrete is partly mixed at a central plant and the mixing is completed in a truck mixer. The mixing time in the central plant mixer is the minimum required to intermingle the ingredients. The volume of the mixed concrete in a truck mixer must not exceed 63 percent of the gross volume of the truck drum. The mixing must be completed in a truck mixer. The number of revolutions of the truck mixer drum or blades must be between 50 and 100 revolutions at the speed designated by the manufacturer as mixing speed. Mixing in excess of 100 revolutions must be at the speed designated by the manufacturer of the equipment as agitating speed.

b. Volumetric batching and continuous mixing at the site

Equipment used for volumetric batching and continuous mixing at the site is commonly referred to as mobile concrete mixers. Unless otherwise specified, volumetric batching and continuous mixing at the construction site is permitted. The batching and mixing equipment must conform to the requirements of ASTM C685 and must be demonstrated before placement of concrete by tests with the job mix to produce concrete meeting the specified proportioning and uniformity requirements. Concrete made by this method must be produced, inspected, and documented in conformance with ASTM C685.

c. Batch mixing at the site

This method of batching and mixing concrete is either by batching and mixing all material onsite using paving mixers or stationary construction mixers or by using a combination of centrally batching part of the mix, transporting it to the site, and adding the rest of the material and mixing onsite.

Paving mixers or stationary construction mixers and associated transport vehicles must be in accordance with recommended practices described in method 1 for central mixed concrete. The time for mixing a batch of concrete in the mixer drum must be according to manufacturer's recommendations, but not less than 1 minute plus 0.25 minute for each cubic yard of concrete being mixed (8 yd³ batch = 3 minutes).

When a combination of centrally batching and transporting material to the site and adding rest of material onsite is used, the contractor must prepare a written plan detailing how the batching and mixing of the concrete material will be accomplished and controlled. This written batching and mixing plan must be submitted to the engineer for review and approval not less than 10 working days before the placement of concrete. The volume of the mixed concrete in a truck mixer must not exceed 63 percent of the gross volume of the drum.

The contractor must furnish the engineer a batching ticket for each batch of fresh concrete. The ticket shows the type, brand, and amount of cement; the type, name, and amount of each admixture; total water added to the batch, which includes free water on the aggregate; maximum size of aggregate; the type and dry weight of fine aggregate; the type and dry weight of coarse aggregate; the time of loading (the time that water was introduced to the cement); and the time the load was discharged.

7. Forms

Forms must be of good quality wood, plywood, steel, or other approved material and must be mortar tight. The forms and associated falsework must be substantial and unyielding and must be constructed so that the finished concrete conforms to the specified dimensions and contours. Form surfaces must be smooth and free from holes, dents, sags, or other irregularities and must be maintained in this condition throughout the work. Forms must be coated with a non-staining form release agent before being set into place. Acceptable tolerances for formed structure members are specified in section 23.

When a superplasticized concrete mix is used, forms must be designed to withstand the increased pressures of the superplasticized concrete and the increased impact forces resulting from larger drop heights used in placing the superplasticized concrete. Form release agents must be specifically formulated, when specified, for use with plasticized concrete or documentation from the release agent manufacturer must be provided stating that formed concrete surfaces made using the form release agent with plasticized concrete have not varied significantly from nonplasticized concrete surfaces made using the same form release agent. If the form release agent is not specifically formulated for use with plasticized concrete and, after observing its performance, it is suspected the release agent is responsible for causing increased surface imperfections (bug-holes), a release agent specifically formulated for use with plasticized concrete must be used for all formed concrete to be subsequently placed.

Metal ties or anchorages that will be embedded in the concrete must be equipped with cones, she-bolts, or other devices that permit their removal to a depth of at least 1 inch without injury to the concrete. Ties designed to break off below the surface of the concrete must not be used without cones. If approved fiberglass or plastic form ties are used, the tie ends must be cut flush with the finished concrete and ground smooth.

All edges that will be exposed must be chamfered unless finished with molding tools as specified in section 18.

8. Preparation of forms and subgrade

Before placement of concrete, the forms, embedments, and subgrade must be free of chips, sawdust, debris, water, ice, snow, extraneous oil, mortar, or other harmful substances or coatings. Any form release agent on the reinforcing steel or other surfaces required to be bonded to the concrete must be removed.

Rock surfaces must be cleaned by high pressure air-water cutting, sandblasting, or wire brush scrubbing, as necessary, and must be wetted immediately before placement of concrete. The earth surface must be firm and damp. Placement of concrete on mud, dried earth, non-compacted fill, or frozen subgrade is not permitted. All ice, snow, and frost must be removed, and the temperature of all surfaces, including the reinforcing steel and other steel inclusions, to be in contact with the new concrete must be no colder than 40 degrees Fahrenheit.

Items to be embedded in the concrete must be positioned accurately and anchored firmly.

Weep holes in walls or slabs must be formed with nonferrous material.

9. Conveying

Concrete must be delivered to the site and discharged completely into the forms within 1.5 hours after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates. In hot weather or under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85 degrees Fahrenheit or above, the time between the introduction of the cement to the aggregates and discharge must not exceed 45 minutes.

Superplasticized concrete may be conveyed and placed when the temperature of the concrete is below 95 degrees Fahrenheit and the slump of the concrete remains within the allowable slump range.

The engineer may allow an appropriate extension of time when the setting time of the concrete is increased a corresponding amount by the addition of an approved admixture. In any case, concrete must be conveyed from the mixer to the forms as rapidly as practicable by methods that prevent segregation of the aggregates or loss of mortar.

10. Placing

Concrete must not be placed until the subgrade, forms, steel reinforcement, and other embedments are inspected and approved by the engineer. For walls and columns, subsequent higher placements of concrete must not be placed until the concrete below the new placement has gained sufficient strength to support the concrete dead load and any superimposed loads without distress. Placement sequences and timing must consider form removal timing covered in section 16.

If a placement plan is required in section 25, concrete must not be placed until the placement plan has been reviewed and approved by the engineer. The contractor must have all equipment and material required for curing available at the site ready for use before placement of concrete begins.

Concrete must be placed only in the presence of the engineer. The contractor must give reasonable notice to the engineer before each placement. Such notice must be far enough in advance to give the engineer adequate time to verify that the subgrade, forms, steel reinforcement, and other preparations comply with specifications. Other preparations include, but are not limited to, the concrete batching plant, mixing and delivery equipment and system, placing and finishing equipment and system, schedule of work, workforce, and heating or cooling facilities, as applicable. All deficiencies are to be corrected before concrete is delivered for placing.

Concrete must be placed and consolidated to prevent segregation of the mix components. The concrete must be deposited as closely as possible to its final position in the forms. It must be worked into the corners and angles of the forms and around all reinforcement and embedded items to prevent segregation of aggregates or excessive laitance. The depositing of concrete must be regulated so that the concrete can be consolidated with a minimum of lateral movement. Concrete placement against a sloping surface must start at the lowest elevation and work upwards to the highest elevation.

Concrete other than architectural concrete must not be dropped more than 5 feet vertically unless suitable equipment is used to prevent segregation. Architectural concrete must not be dropped more than 3 feet vertically unless suitable equipment is used to prevent segregation. When a superplasticized concrete mix is used, concrete other than architectural concrete must not be dropped more than 12 feet vertically and architectural concrete must not be dropped more than 10 feet vertically unless suitable equipment is used to prevent segregation.

11. Layers

Slab concrete must be placed to design thickness in one continuous layer unless otherwise specified. Formed concrete must be placed in horizontal layers not more than 20 inches deep. Where a superplasticized concrete mix is used, formed concrete may be placed in horizontal layers not more than 5 feet deep.

Successive layers of fresh concrete between construction joints must be placed at a rate fast enough that the preceding layer is still plastic and can be easily mixed with the fresh concrete such that seams (cold joints) or plane of weakness do not occur. If the surface of a previously placed layer of concrete has taken a set to the degree that it will not flow and mix with the succeeding layer when vibrated, the contractor must discontinue placing concrete and must make a construction joint according to the procedure specified in section 13. If placing is discontinued when a layer is incomplete, the ends of the incomplete layer must be formed by a vertical bulkhead.

12. Consolidating

All concrete must be consolidated with internal type mechanical vibrators capable of transmitting vibration to the concrete at frequencies not less than 8,000 impulses per minute, unless otherwise specified or approved before placement. Vibration must be supplemented by spading, rodding, and hand tamping as necessary to ensure smooth and dense concrete along the form surface, in corners, and around embedded items. The contractor must provide a sufficient number of vibrators to properly consolidate the concrete immediately after it is placed. A sufficient number of standby vibrators must be kept onsite during the placement of concrete.

Vibration must compact the concrete and bring it into intimate contact with the forms, reinforcing steel, and other embedded items while removing voids and pockets of entrapped air. The location, insertion, duration, and removal of the vibrators must be such that maximum consolidation of the concrete is achieved without causing segregation of the mortar and coarse aggregate or causing water or cement paste to flush to the surface. Vibration must be applied to the freshly deposited concrete by rapidly inserting the vibrator and slowly, in an up and down motion, removing the vibrator at points uniformly spaced at not more than 1.5 times the radius of the area visibly effected by vibration. Generally, this is at 5 to 10 seconds per foot on 14-inch spacings or less. The area visibly effected by the vibrator must overlap the adjacent, just vibrated area. The vibrator must extend vertically into the previously placed layer of fresh concrete by at least 6 inches at all points. This ensures effective bond between layers. In thin slabs the vibrator(s) should be sloped toward the horizontal to allow operations in a fully embedded position.

Vibration must not be applied directly to the reinforcement steel, the forms, or other embedded items unless otherwise specified. Vibration must not be applied to concrete that has hardened to the degree that it does not become plastic when vibrated. If surface vibrators are used, they may contact forms when consolidating thin slabs.

The use of vibrators to transport concrete in the forms or conveying equipment is not permitted.

Surface vibrators may be used to consolidate slabs 8 inches and less in thickness. Slabs more than 8 inches thick must be consolidated with internal vibration and may be augmented through use of surface vibrator, such as vibrating screeds, plate or grid vibratory tampers, or vibratory roller screeds. If concrete is to be consolidated using surface vibration methods, the contractor must detail how this work is to be performed in writing to the engineer for review and approval. This report must be submitted no less than 30 calendar days before placing concrete by this method. It includes equipment selection and specifications.

13. Construction joints

Construction joints must be made at the locations shown on the drawings unless otherwise specified or approved by the engineer. If construction joints are needed that are not shown on the drawings, they must be placed in locations approved by the engineer.

Where a feather edge would be produced at a construction joint, as in the top surface of a sloping wall, an insert form must be used so that the resulting edge thickness on either side of the joint is not less than twice the maximum aggregate diameter used in the concrete mix.

Non-vertical construction joints in structural elements, such as walls and columns, must be consolidated and screeded to grade unless otherwise specified. Construction joints must be covered and wet cured for 7 days or until concrete placement resumes unless otherwise specified.

Steel tying and form construction next to concrete in place must not be started until the concrete has cured at least 12 hours. Before new concrete is deposited on or against concrete that has hardened, the forms must be retightened. New concrete must not be placed until the hardened concrete has cured at least 12 hours.

Method 1—The surface of construction joints must be cleaned of all unsatisfactory concrete, laitance, coatings, stains, or debris by sandblasting or high-pressure air-water cutting, or both. Sandblasting can be used after the concrete has gained sufficient strength to resist excessive cutting, and high-pressure air-water cutting can be used as soon as the concrete has hardened sufficiently to prevent the jet from displacing the coarse aggregates. The surface of the concrete in place must be cut to expose clean, sound aggregate, but not so deep as to undercut the edges of larger particles of the aggregate. After cutting, the surface must be thoroughly washed to remove all loose material. If the surface is congested by reinforcing steel, is relatively inaccessible, has cured beyond the ability to cut with air-water blasting, or disturbing the concrete before it is hardened is considered undesirable, cleaning of the joint by air or water jets is not permitted. The sandblasting method is required after the concrete has hardened.

Immediately before new concrete is placed, all construction joints must be wetted and standing water removed.

Method 2—The surface of construction joints must be cleaned of all unsatisfactory concrete, laitance, coatings, stains, or debris by washing and scrubbing with a wire brush or wire broom, or by other means approved by the engineer. Immediately before new concrete is placed, all construction joints must be wetted and standing water removed.

14. Expansion and contraction joints

Expansion and contraction joints must be made only at locations shown on the drawings. Exposed concrete edges at expansion and contraction joints must be carefully tooled or chamfered, and the joints must be free of mortar and concrete. Joint filler must be fully exposed for its entire length with clean and true edges.

Where open joints or weakened plane “dummy” joints are specified, joints formed in fresh concrete must be constructed by the insertion and subsequent removal of a wood strip, metal plate, or other suitable template. This must be done so that the corners of the concrete do not chip or break. The edges of the fresh concrete at the joints must be finished with an edging tool before the joint strips are removed. Open joints or weakened plane dummy joints may also be saw-cut joints conforming to the depth and extent specified.

Preformed expansion joint filler must be held firmly in the correct position as the concrete is placed.

15. Waterstops

Waterstops must be held firmly in the correct position as the concrete is placed. Joints in metal waterstops must be brazed or welded. Joints in rubber or plastic waterstops must be cemented, welded, or vulcanized as recommended by the manufacturer. Joints must be watertight and of a strength equivalent to that specified in Material Specification 537. Intersecting waterstop joints must be prefabricated and supplied by the same manufacturer providing the waterstop.

16. Removal of forms, supports, and protective coverings

Forms, supports, and protective coverings must be removed as soon as practical after the concrete has gained sufficient strength to support its own weight and superimposed loads. Removal must be done so that the concrete surface is not damaged and sudden or excessive stresses are not induced. The minimum period from completion of the concrete placement to the removal of the forms must be based on either strength tests or cumulative times.

Strength tests—The strength of the in-place concrete is determined by testing concrete cylinders specifically cast for this purpose and cured adjacent to the member in accordance with the ASTM C31 method for determining removal time. Unless otherwise specified, forms supporting the weight of the concrete member may be removed after the concrete strength is 70 percent of that specified for the class of concrete. Forms not supporting the weight of the concrete member or other superimposed loads may be removed after the concrete strength has reached the strength specified in section 25.

Cumulative time—The total accumulated time, not necessarily continuous, that the air adjacent to the concrete is above 50 degrees Fahrenheit and the specified concrete curing has occurred concurrently will be determined. Forms may be removed after the total accumulated time shown:

Accumulated form removal times

Forms		Time ^{1/}
Sides of slabs or beams		12 hours
Undersides of slabs or beams	Clear span	^{2/}
	< 10 ft.	4 days
	10 - 20 ft.	7 days
	> 20 ft.	14 days
Sides of walls or columns	Height above form	^{3/ 4/}

	< 10 ft.	12 hours
	< 20 ft.	24 hours
	> 20 ft.	72 hours

- 1/ Table values apply to normal concrete. Values for concrete that contains cements or admixtures that significantly retard or accelerate strength gain will be determined by the engineer and based on actual design mix data.
- 2/ Values apply to members designed to support significant superimposed loads. Values for members designed for only self-weight when placed in service must be 50 percent greater.
- 3/ Values apply to members not subject to significant horizontal loads. Additional time or re-bracing is needed for members subject to significant wind or other horizontal loads.
- 4/ Subsequent higher lifts may be placed after 12 hours.

17. Finishing formed surfaces

All formed concrete surfaces must be true and even, and must be free from over-tolerance depressions, holes, projections, bulges, or other defects in the specified surface finish or alignment, unless otherwise specified in section 25. Depressions are measured as the distance from the bottom of a 5-foot-long template or straight edge.

A surface to be backfilled or otherwise concealed when construction is completed must have the following surface treatment unless otherwise specified:

- Repair defective concrete.
- Fill all form tie holes.
- Correct surface depressions deeper than 1 inch.
- Remove or smooth fins and abrupt projections that exceed 0.75 inch.

A surface to be permanently exposed, where other finishes are not specified, must have the following treatment:

- Repair defective concrete.
- Fill all form tie holes.
- Remove or smooth all abrupt irregularities greater than 0.25 inch in depth or projection.
- Treat all depressions and irregularities so that they do not exceed 0.5 inch in depth.

Form bolt and tie holes and other holes of similar size and depth must be repaired and filled as specified in section 20.

18. Finishing unformed surfaces

All exposed surfaces of the concrete must be accurately screeded to grade and then float finished unless otherwise specified. The float finish must result in a surface that has no irregularities of more than 0.25 inch when checked with a template or straight edge that is 10 feet long.

All exposed surfaces of concrete must be accurately struck off to grade after placement and consolidation are completed. Following strikeoff, the surface must be immediately smoothed by darbying or bull floating before any free water has bled to the surface. The concrete must then be allowed to rest until the bleed water and water sheen have left the surface and the concrete has stiffened to where it will sustain foot pressure with only about 0.25-inch indentation. At this time all joints and edges that are exposed to view and are not chamfered must be finished with edging tools. After edging and hand jointing is complete, all exposed surfaces must be floated with wood or magnesium floats. The floating should work the concrete no more than necessary to remove screed, edger, and jointer marks and to produce a compact surface uniform in texture.

Water must not be sprinkled or added to the surface of the concrete during the darbying, bull floating, floating, or other finishing operations to facilitate finishing.

19. Curing

Freshly placed concrete must be cured a minimum of 7 days in accordance with the recommended practices set forth in this section. A curing process must be started as soon as the concrete has hardened sufficiently to prevent surface damage. Curing concrete, including exposed surfaces of formed concrete and concrete in forms, must be maintained at a satisfactory moisture content for at least 7 days following placement. If forms are removed before the end of the 7-day curing period, the interrupted curing process must be reestablished and maintained until a full 7-day curing period is achieved. A satisfactory moisture condition is—

- Continuous or frequent application of water or use of a saturated cover material, such as canvas, cloth, burlap, earth, or sand.
- Prevention of excessive water loss from the concrete by use of an impermeable coating (curing compound) or covering (plastic, paper).

The application of water or covering must not erode, mar, or otherwise damage the concrete. Plastic film or paper must meet the requirements of ASTM C171. Black covering must not be used when concreting in hot weather.

Except as otherwise specified in section 25, curing compound may be used for exposed surfaces or formed surfaces after patching and repair are completed. Curing compounds must not be used on a surface that is to receive additional concrete, paint, tile, or other coatings unless the contractor demonstrates that the membrane can be satisfactorily removed or can serve as a base for the later application.

Curing compound must be thoroughly mixed before applying and be agitated during application. Except as otherwise specified in section 25, the compound must be applied at a pressure of 75 to 100 pounds per square inch. A continuously agitating pressure sprayer is used for application at a uniform rate of not less than 1 gallon per 175 square feet of surface. Manual hand pump sprayers must not be used for curing concrete surfaces exceeding 400 square feet unless otherwise specified. For individual concrete placements or repairs having a surface area of 400 square feet or less, curing compound may be applied with a soft-bristled brush, paint roller, or hand sprayer. The compound must form a uniform, continuous, adherent film that must not check, crack, or peel and must be free from pinholes or other imperfections.

All surfaces covered with curing compound must be continuously protected from damage to the protective film during the required curing period.

A surface subjected to heavy rainfall or running water within 3 hours after the compound has been applied or that is damaged by subsequent construction operations during the curing period must be resprayed in the same manner as for the original application.

Water for curing must be clean and free from any substances that cause discoloration of the concrete.

20. Concrete patching, repair or replacement

Patching—All form bolts, metal ties, and similar forming restraints must be removed to a depth of 1 inch below the surface of the concrete and their cavities repaired unless otherwise specifically permitted or specified. Small cavities, large air holes, minor honeycombed areas, and other superficial imperfections that require patching to meet the specified finish requirements must be thoroughly cleaned and filled. Holes left by bolts or straps that pass through the concrete section must be filled solid with a dense, well-bonded, non-shrink patching material. Dry-pack mortar and replacement concrete must follow the appropriate procedure detailed in the “Repair and Maintenance” chapter of the Concrete Manual, Bureau of Reclamation, U.S. Department of the Interior. Proprietary patching material must be appropriate for the type of repair, used within the manufacturer's recommended limits, and applied according to the manufacturer's recommendations.

Repair or replacement—The contractor must repair or replace concrete that does not meet the requirements of this specification. Before starting any repair or replacement work, the contractor must prepare a written plan for the repair or replacement. The primary reference for material and repair methods for the plan must be the appropriate sections of the “Repair and Maintenance” chapter of the Concrete Manual, Bureau of Reclamation, U.S. Department of the Interior. The repair plan must be submitted to the engineer for review at least 10 days before any repair or replacement work. Approval of the plan will be authorized in writing by the contracting officer.

When proprietary patching material is proposed in the plan, the manufacturer's data sheets and written recommendations must be included in the plan.

Repair material or replacement concrete must have properties, color, and texture similar to and compatible with the concrete being repaired or replaced. Repair or replacement concrete work may only be performed when the engineer is present.

Curing of repaired or replaced concrete must be started immediately after finish work is completed and as specified in section 19 or as specified by the manufacturer of proprietary compounds.

21. Concreting in cold weather

Methods for concreting in cold weather must be performed when, for more than 3 consecutive days, the following conditions exist:

- The average daily air temperature at the job site is less than 40 degrees Fahrenheit. (The average daily air temperature is the average of the highest and lowest temperatures occurring during the period from midnight to midnight.)
- The air temperature at the job site is less than, or equal to, 50 degrees Fahrenheit for more than half of any 24-hour period.

Concrete must be protected against freezing during the first 24 hours after placement whether or not the average weather conditions specified above for cold weather concreting exist. The following provisions also apply unless otherwise specified:

- a. When the cement is added to the mix, the temperature of the mixing water must not exceed 140 degrees Fahrenheit nor the temperature of the aggregate exceed 150 degrees Fahrenheit.
- b. The temperature of the concrete at the time of placing must be within the placement temperature range shown below, unless otherwise specified.

Least dimension of section, inches	Placement temperature, °F
Less than 12	55 – 75
12 to 36	50 – 70
36 to 72	45 – 65
Greater than 72	40 – 60

- c. The minimum temperature of the concrete for the first 72 hours after placement must not be less than the minimum temperature shown above. Concrete structures must be immediately protected after concrete placement by covering, housing, insulating, or heating concrete structures sufficiently to maintain the minimum temperature adjacent to the concrete surface. If the minimum temperature requirements are not met and the concrete did not freeze, the protection time will be extended a period equal to twice the number of hours the temperature was below the minimum temperature.
- d. Exhaust flue gases from combustion heaters must be vented to the outside of the enclosure. The heat from heaters and ducts must be directed in such a manner as to not overheat or dry the concrete in localized areas or to dry the exposed concrete surface.
- e. At the end of the protection period, the concrete must be allowed to cool gradually. The maximum decrease at the concrete surface in a 24-hour period must not exceed 40 degrees Fahrenheit.

22. Concreting in hot weather

Methods for concreting in hot weather must be in accordance with the requirements set forth below.

For the purpose of this specification, hot weather is defined as the weather condition at the jobsite that causes acceleration in the rate of moisture loss or rate of cement hydration of freshly mixed concrete, including an ambient temperature of 80 degrees Fahrenheit or higher, and an evaporation rate that exceeds 0.2 pounds per square foot per hour. The rate of moisture loss and rate of cement hydration may be accelerated if one or a combination of the following conditions exists:

- High ambient temperature
- High concrete temperature
- Low relative humidity
- Wind velocity
- Solar radiation

Whenever the above conditions exist or when climatic conditions are such that the temperature of the concrete may reasonably be expected to exceed 90 degrees Fahrenheit at the time of delivery to the worksite or during the placement operations, the following provisions apply:

- a. The contractor must maintain the temperature of the concrete below 90 degrees Fahrenheit during mixing, conveying, and placing.
- b. Exposed concrete surfaces that tend to dry or set too rapidly must be continuously moistened using fog sprays or other means to maintain adequate moisture during the time between placement and finishing. Water must not be sprinkled or added directly to the surface of the concrete before finishing.
- c. Finishing of slabs and other exposed surfaces must be started as soon as the condition of the concrete allows and must be completed without delay. Water must not be sprinkled or added to the surface of the concrete during the darbying, bull floating, floating, or other finishing operations to facilitate finishing.
- d. Formed surfaces must be kept completely and continuously wet from the time the concrete takes initial set to when the forms are removed. After the forms are removed, the concrete surfaces must be kept completely and continuously wet for the duration of the curing period or until curing compound is applied in accordance to section 21.
- e. Exposed and unformed concrete surfaces, especially flat work placed with large areas of surface, must be kept completely and continuously wet for the duration of the curing period or until curing compound is applied in accordance to section 19. The concrete must be protected against thermal shock from rapid cooling (5°F per hour or more than 40°F per 24-hour period) of the concrete by application of curing water or temperature changes during the first 24 hours of the curing period.
- f. When any single or combination of conditions might result in very rapid setting or drying of the concrete, extreme conditions exist. For flat work and slab construction, extreme conditions exist when the evaporation rate exceeds 0.2 pound per square foot per hour. The engineer may—
 - (1) Restrict placement to the most favorable time of the day.
 - (2) Restrict the depth of layers to assure coverage of the previous layer while it will still respond readily to vibration.
 - (3) Suspend placement until conditions improve.
 - (4) Restrict the removal of forms, repair, and patching to small areas that can be protected with curing compound immediately.

The evaporation rate for flat work and slab construction may be determined by calculating the evaporation rate from a cake pan having a surface area of at least 1 square foot or by other methods approved by the engineer or designated in section 25.

23. Acceptance of the concrete work

Acceptance of the concrete work will be a cumulative acceptance process based upon progressively meeting the requirements of the specifications and drawings for—

- Fresh concrete.
- Concrete strength and durability.
- Structure dimensions.
- Structure appearance.

Fresh concrete—Fresh concrete conforming to the mix proportions and quality requirements of the approved job mix and the handling and placement requirements of previous sections will be satisfactory.

Concrete strength—A strength test is the average of the compressive strengths of two standard cured cylinders prepared and tested in accordance with section 4, unless otherwise specified. The strength of the hardened concrete is satisfactory if the following requirements are met:

- a. If method 1 from section 3 is specified and the concrete work is less than 75 total cubic yards for the class of concrete specified, the compressive strength of the concrete is satisfactory if no individual strength test falls more than 500 pounds per square inch below the specified compressive strength (f'_c) for the respective class of concrete.
- b. If method 1 from section 3 is specified and the concrete work is 75 total cubic yards or more for the class of concrete specified, the compressive strength of the concrete is satisfactory if both of the following requirements are met:
 - (1) No individual strength test falls more than 500 pounds per square inch below the specified compressive strength (f'_c) for the class of concrete specified.
 - (2) The average of any three consecutive strength tests is not less than the specified compressive strength (f'_c) for the class of concrete specified.

The contractor must take steps to increase the average of subsequent strength tests when the average of any three consecutive strength tests falls below the specified concrete strength (f'_c).

- c. The engineer determines the structural adequacy and evaluates the durability of the in-place concrete when the concrete strength based on the standard cured concrete cylinders is unsatisfactory. The engineer determines the need for additional quality assurance testing.
- d. The contractor may core the concrete, have the cores tested by a certified testing laboratory at the contractor's expense, and submit test results to the engineer for consideration and evaluation of concrete strength adequacy when the concrete strength based on the standard cured concrete cylinders is unsatisfactory.
- e. Sampling and testing concrete by coring must conform to section 4. The strength of the concrete based upon concrete cores is satisfactory if both of the following requirements are met:
 - (1) The average compressive strength of the three cores equal or exceed 85 percent of the specified compressive strength (f'_c).
 - (2) The compressive strength of any individual core does not fall below 75 percent of the specified compressive strength (f'_c).
- f. If method 2 from section 3 is specified, the engineer is responsible for the concrete job mix design and the quality concrete that results from the job mix.

The hardened concrete is satisfactory if the required batch tickets or other documentation acceptable to the engineer clearly show that the batch ingredients and weights of each ingredient including all admixtures conforms to the job mix provided by the engineer. Random periodic inspection of the batching operations may be made by the engineer to verify that ingredients and ingredient proportions conform to the batching documentation.

If the concrete ingredients, proportions, or admixtures varies from the job mix provided by the engineer, the concrete may be rejected if, in the judgment of the engineer, the variance will significantly affect the strength or durability of the concrete or will adversely affect the life expectancy or other components of the structure.

Structure dimensions and appearance

The appearance of the concrete must meet the requirements of sections 17 and 18.

The dimensions of formed members, unless otherwise specified, are satisfactory if they conform to the requirements of the specifications, the locations shown on the drawings, and are within acceptable tolerances:

- a. Variation from plumb for walls and column must be no more than 0.2 percent of the total wall or column height.
- b. Variation from specified elevations for slabs, floors, or other horizontal members must be no more than 0.2 percent of the length of the member in the direction of grade.
- c. Variations in the cross-sectional dimensions of columns and beams and in the thickness of walls and above-grade slabs must be no more than minus 0.25 inch or plus 0.5 inch from the shown dimensions.

24. Measurement and payment

For items of work for which specific unit prices are established in the contract, concrete is measured to the neat lines or pay limits shown on the drawings, and the volume of concrete is computed to the nearest 0.1 cubic yard. No deduction in volume is made for chamfers, rounded or beveled edges, or for any void or embedded item that is less than 5 cubic feet in volume. Where concrete is

placed against the sides or bottom of an excavation without intervening forms, drainfill, or bedding, the volume of concrete required to fill voids resulting from over-excavation outside the neat lines or pay limits is included in the measurement for payment where such over-excavation is directed by the engineer to remove unsuitable foundation material. However, this payment is only to the extent that the unsuitable condition is not a result of the contractor's improper construction operations, as determined by the engineer.

Method 1—Payment for each item of concrete is made at the contract unit price for that item. The payment for concrete will constitute full compensation for completion of the concrete work, including joint fillers, waterstops, dowels or dowel assemblies, and metal plates, but not including reinforcing steel or other items listed for payment elsewhere in the contract.

Method 2—Payment for each item of concrete is made at the contract unit price for that item. The payment for concrete constitutes full compensation for completion of the concrete work, including joint fillers, waterstops, metal plates, dowels, and other assemblies. It does not include furnishing and placing reinforcing steel or furnishing and handling cement or other items listed for payment elsewhere in the contract.

Cement is measured by dividing the volume of concrete accepted for payment by the yield of the applicable job mix. The yield is determined by the procedure specified in ASTM C138. If the amount of cement actually used per batch exceeds the amount in the job mix specified by the engineer, the measurement is based on the amount of cement specified by the engineer for the job mix. Unless otherwise stated in section 25, a bag of cement is considered 94 pounds. Payment for each type of cement will be made at the contract unit price for furnishing and handling that type of cement and such payment will constitute full compensation for furnishing and handling the cement.

All methods—The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed in the bid schedule, will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 25 of this specification.

25. Items of work and construction details

25. Items of Work and Construction Details

Concrete items installed in conformance with this specification shall be of concrete made with Type II or V cement. Class 2 coarse aggregate shall be Size No. 7, 57, 67, or 467. Bituminous preformed expansion joint filler shall be according to ASTM D994. Sponge rubber expansion joint filler shall be according to ASTM D1752. The slump range for all concrete shall be 4 inches plus or minus 1 inch.

In Section 3, Concrete mix design, Method 1 shall apply. All concrete shall equal or exceed Class 4000.

In Section 13, Construction joints, Method 1 shall apply.

In Section 24, Measurement and payment, Method 1 shall apply.

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item 21, Concrete, Structural

- (1) This item shall consist of furnishing and placing all concrete required for construction of the concrete principal spillway inlet and outlet structure, and the auxiliary spillway concrete baffle blocks, stilling basin end sill, and upstream and downstream cut off walls, as shown on the drawings.
- (2) In addition to the finishing of all formed concrete surfaces and slabs in conformance with Section 17 of this specification, all concrete surfaces that will be exposed to air and water, shall be finished by (1) a complete carborundum stone rubbing or (2) by treatment with a cement-based heavy-duty coating such as "MasterSeal 581" manufactured by Master Builder Solutions. A product of equal quality may be used. The coating material to be used shall be approved by the Engineer.
 - (a) The cement-based coating shall be in powder form, free from lumps or aggregates, and easily dispersed in water to a smooth and homogeneous consistency. The coating shall be suitable for application to wetted masonry or concrete surfaces with a fiber brush, roller, or special spray equipment.
 - (b) The coating materials shall be heavy-bodied with ability to fill and seal pores and voids and provide a waterproof finish. The coating material shall be applied in such a manner that all cavities or surface pits, pockmarks, or holes not filled as otherwise specified are completely filled with the surface finish of coating materials.
 - (c) Products applied as surface finish shall be applied in conformance with the manufacturer's recommendations with the additional requirement that all concrete surfaces shall be cleaned by wet or dry sandblasting, steam cleaning, or other approved method that insures a clean surface to which the surface finish product readily adheres and which is free of all unsatisfactory concrete, laitance, coatings, stains, and debris that would prevent the coating from adhering tightly to the prepared concrete surfaces.
 - (d) The surface finish shall present a uniform appearance and shall be free of check marks, blisters, cracking, and other evidence of non-uniformity, inconsistencies, and

imperfections. Such area(s) of non-uniformities, checks, blisters, cracks, and other imperfections shall be removed, and the surface finish reapplied to present uniform appearance in accordance with the requirements of this section.

- (e) The color of the final cured coating shall conform to the MasterSeal color “Gray”.
- (f) The coating shall meet the following specifications:
 - 1) Compressive Strength – 4,200 psi in 7 days, 6030 psi in 28 days (Test Method ASTM C109).
 - 2) Tensile Strength -- 250 psi in 7 days, 440 psi in 28 days (Test Method ASTM C190).
 - 3) Flexural Strength -- 360 psi in 7 days, 1027 psi in 28 days (Test Method ASTM C348).
 - 4) The coating shall dry to the touch in 4 hours and hard-dry within 48 hours (ASTM C1640).
 - 5) Freeze-Thaw Cycling -- No cracking or delamination after 200 cycles (Test Method ASTM C666, Method B).
 - 6) Weatherometer -- After 5000 hours of weatherometer exposure, there shall be no checking, cracking, or loss of adhesion, and the degree of chalking shall be No. 8 (ASTM D822 and ASTM G26).
 - 7) Resistance to wind-driven rain – after 8 hours exposure rated as excellent as per Federal Specification (TT-P-0035).
- (3) The item of work subsidiary to this bid item is Excavation, Common, Concrete Structures as specified in Construction Specification 21 as it applies to this bid item.

b. Bid Item 22, Concrete, Pipe Cradle

- (1) This item shall consist of furnishing and placing all concrete required for the construction of the principal spillway conduit cradle as shown in the construction drawings.
- (2) The item of work subsidiary to this bid item is Excavation, Common, Concrete Structures as specified in Construction Specification 21 as it applies to this bid item.

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Construction Specification 34—Steel Reinforcement

1. Scope

The work consists of furnishing and placing steel reinforcement for reinforced concrete or pneumatically applied mortar.

2. Material

Steel reinforcement must conform to the requirements of Material Specification 539, Steel Reinforcement (for concrete). Before reinforcement is placed, the surface of the bars and fabric and any metal supports must be cleaned to remove any loose, flaky rust, mill scale, oil, grease, or other undesirable coatings or foreign substances. Epoxy-coated steel reinforcement must be free of surface damage. After placement, the reinforcement must be maintained in a clean and serviceable condition until it is completely embedded within the concrete.

3. Bar schedule, lists and diagrams

Any supplemental bar schedules, bar lists or bar-bending diagrams required in section 10 of this specification to accomplish the fabrication and placement of steel reinforcement must be provided by the contractor. Before reinforcement is placed, the contractor must furnish four copies of any such lists or diagrams to the contracting officer for approval. Acceptance of the reinforcement is not based on approval of these lists or diagrams, but on inspection of the steel reinforcement after it has been placed, tied, and supported and is ready to receive concrete.

4. Bending

Reinforcement must be cut and bent in compliance with the requirements of the American Concrete Institute Standard 315. Bars must not be bent or straightened in a manner that will injure or weaken the material. Bars with kinks, cracks, or improper bends must be rejected.

5. Splicing bar reinforcement

Method 1—Splices of reinforcement may only be made at locations shown on the drawings and provided by the steel schedule. Placement of bars at the lap splice locations shown, when not in contact, must not be farther apart than one-fifth the shown lap length and in any case no greater than 6 inches.

Method 2—Splices of reinforcement must be limited to those locations shown on the drawings. Splice lengths must be determined before fabrication and meet the requirements of ACI Standard 318, Building Code Requirements for Reinforced Concrete, based upon design information in section 10 of this specification. Bar placement drawings and schedules must be provided for approval before fabrication. The drawings must show all splice locations, layouts, and lap dimensions.

6. Splicing welded wire reinforcement

Unless otherwise specified, welded wire reinforcement must be spliced in the following manner:

End-to-end—Adjacent sections must be spliced end-to-end (longitudinal lap) by overlapping a minimum of one full mesh plus 2 inches plus the length of the two end overhangs. The splice length is measured from the end of the longitudinal wires in one piece of fabric to the end of the longitudinal wire in the lapped piece of fabric.

Side-to-side—Adjacent sections must be spliced side to side (transverse lap) a minimum of one full mesh plus 2 inches. The splice length must be measured from the centerline of the first longitudinal wire in one piece of fabric to the centerline of the first longitudinal wire in the lapped piece of fabric.

7. Placing

Reinforcement must be accurately placed and secured in position to prevent its displacement during the placement of concrete. Tack welding of bars is not permitted. Metal chairs, metal hangers, metal spacers, and concrete chairs may be used to support the reinforcement. Metal hangers, spacers, and ties must be placed in such a manner that they are not exposed in the finished concrete surface. The legs of metal chairs or side form spacers that may be exposed on any face of slabs, walls, beams, or other concrete surfaces must have a protective coating or finish. The coating or finish must be hot dip galvanized, epoxy coated, plastic coated, or stainless steel. Metal chairs and spacers not fully covered by a protective coating or finish must have a minimum cover of 0.75 inch of concrete over the unprotected metal part. The exception is that those with plastic coatings may have a minimum cover of 0.5 inch

of concrete over the unprotected metal part. Precast concrete chairs must be manufactured of the same class of concrete as specified for the structure and must have the tie wires securely anchored in the chair or a V-shaped groove at least 0.75 inch in depth molded into the upper surface to receive the steel bar at the point of support. Precast concrete chairs must be clean and moist at the time concrete is placed.

High-density or structural plastic rebar accessories designed to ensure maximum concrete bond may be substituted for metal or concrete accessories in spacer applications as approved by the contracting officer. Exposure of plastic rebar accessories at the finished concrete surface must be kept to a minimum. Plastic rebar accessories, when used, must be staggered along adjacent parallel bars and must be placed at intervals no closer than 12 inches. Plastic rebar accessories must not be used in concrete sections 6 inches or less in thickness.

Reinforcement must not be placed until the prepared site has been inspected and approved. After placement of the reinforcement, concrete must not be placed until the reinforcement has been inspected and approved by the responsible engineer.

8. Storage

Steel reinforcement stored at the work site must be placed on platforms, skids, or other supports. This is done so that contact with the ground is avoided and the material is protected from mechanical damage and/or corrosion.

9. Measurement and payment

Method 1—For items of work for which specific unit prices are established in the contract, the weight of steel reinforcement placed in the concrete in accordance with the drawings is determined to the nearest pound by computation from the placing drawings. Measurement of hooks and bends is based on the requirements of ACI Standard 315. Computation of weights of reinforcement is based on the unit weights established in tables 34–1 and 34–2 of this specification. Computation of weights for welded wire reinforcement not shown in table 34–2 must be based on ACI Standard 315. The area of welded wire reinforcement placed in the concrete in accordance with the drawings is determined to the nearest square foot by computation from the placing drawings with no allowance for required laps. The weight of steel reinforcing in extra splices or extra-length splices approved for the convenience of the contractor or the weight of supports and ties is not included in the measurement for payment.

Payment for furnishing and placing reinforcing steel is made at the contract unit price. Such payment constitutes full compensation for all labor, material, equipment, and all other items necessary and incidental to the completion of the work including preparing and furnishing bar schedules, lists, or diagrams; furnishing and attaching ties and supports; and furnishing, transporting, storing, cutting, bending, cleaning, and securing all reinforcements.

Method 2—For items of work for which specific unit prices are established in the contract, the weight of bar reinforcement placed in the concrete in accordance with the drawings is determined to the nearest pound by computation from the placing drawings. Measurement of hooks and bends is based on the requirements of ACI Standard 315. Computation of weights of bar reinforcement is based on the unit weights established in table 34–1 of this specification. The weight of steel reinforcing in extra splices or extra length splices approved for the convenience of the contractor or the weight of supports and ties is not included in the measurement for payment.

The area of welded wire reinforcement placed in the concrete in accordance with the drawings is determined to the nearest square foot by computation from the placing drawings with no allowance for required laps.

Payment for furnishing and placing bar reinforcing steel is made at the contract unit price for bar reinforcement. Payment for furnishing and placing welded wire reinforcing steel is made at the contract unit price for welded wire reinforcement. Such payment constitutes full compensation for all labor, material, equipment, and all other items necessary and incidental to the completion of the work including preparing and furnishing bar schedules, lists, or diagrams; furnishing and attaching ties and supports; and furnishing, transporting, cutting, bending, cleaning, and securing all reinforcement.

All Methods—The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed in the bid schedule, is included in the payment for the item of work to which it is made subsidiary. Such items to which they are made subsidiary are identified in section 10 of this specification.

Table 34–1 Standard reinforcing bars

- - Bar size designations - -		Weight (lb/ft)
English	Metric	
3	10	0.376
4	13	0.668
5	16	1.043
6	19	1.502
7	22	2.044
8	25	2.670
9	29	3.400
10	32	4.303
11	36	5.313
14	43	7.650
18	57	13.600

1/ The bar diameter (inches) equals the bar size number divided by eight. For example, the diameter of a #4 bar is $4 \div 8 = 0.5$ inch.

2/ The metric bar size has been rounded to a whole number that represents the approximate diameter of the bar in millimeters.

Table 34–2 Rectangular welded wire reinforcement

----- Style designation ^{1/} -----		Weight
by W-number	by steel wire gauge (former designation)	(lb/100 ft ²)
6 × 6 – W1.4 × W1.4	6 × 6 – 10 × 10	21
6 × 6 – W2.1 × W2.1	6 × 6 – 8 × 8	30
6 × 6 – W2.9 × W2.9	6 × 6 – 6 × 6	42
6 × 6 – W4.0 × W4.0	6 × 6 – 4 × 4	58
4 × 4 – W1.4 × W1.4	4 × 4 – 10 × 10	31
4 × 4 – W2.1 × W2.1	4 × 4 – 8 × 8	44
4 × 4 – W2.9 × W2.9	4 × 4 – 6 × 6	62
4 × 4 – W4.0 × W4.0	4 × 4 – 4 × 4	85
4 × 12 – W2.1 × W0.9 ^{2/}	4 × 12 – 8 × 12	25
4 × 12 – W2.5 × W1.1 ^{2/}	4 × 12 – 7 × 11	31

1/ Style designation is defined in ACI Standard 315 of the American Concrete Institute.

2/ Welded smooth wire reinforcement with wires smaller than size W1.4 is manufactured from galvanized wire.

10. Items of work and construction details

10. Items of Work and Construction Details

In Section 5, Splicing bar reinforcement, Method 1 shall apply.

In Section 7, Placing, if during the placement of the concrete any reinforcement is displaced more than ½ inch from its designated position, that reinforcement shall be entirely removed and placed in proper position. Inspection and approval of the reinforcement by the Engineer will not relieve the Contractor of the responsibility of ensuring the reinforcement is held in place and is not displaced during the placement of the concrete.

In Section 9, Measurement and payment, Method 1 shall apply.

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item 23, Reinforcing Steel

- (1) This item shall consist of furnishing and placing all steel reinforcement required for the construction of all reinforced concrete works under this contract.

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Construction Specification 36—Roller Compacted Concrete

1. Scope

The work consists of furnishing all materials, tools, equipment, and mixing plant and performing all labor for the mixing, transporting, forming, placing, compacting, and curing of roller compacted concrete (RCC) as required to install the structure(s) as shown on the drawings and designated in section 22 of this specification and the test section designated in the same section.

The following BioPreferred® product category is applicable to this specification:

— Concrete release fluids (a.k.a., form-release agents)

2. Material

Portland cement must conform to the requirements of Material Specification 531, portland cement. Type-III portland cement must not be used.

Pozzolan must conform to the requirements of Material Specification 532, Supplementary Cementitious Materials. Fly ash must be class F unless otherwise specified. The source of pozzolan must consistently supply material with similar chemical and physical properties.

Combined aggregates must conform to the requirements of Material Specification 524, Aggregates for Roller Compacted Concrete, unless otherwise specified.

Water incorporated into the mix or used for curing RCC must be clean and free from injurious amounts of oil, salt, acid, alkali, organic matter, turbidity, or other deleterious substances. Water must conform to the requirements of ASTM C 94 except that wash water may not be used for mixing RCC.

Water-reducing, set-retarding admixture must conform to ASTM C494, type D.

Curing compound must conform to the requirements of Material Specification 534, Concrete Curing Compound. Curing compound must be furnished in containers that have not been previously opened and that have the original manufacturer's labels attached.

Bonding mortar must consist of cement, sand, water, and a water-reducing, set-retarding admixture to retard the set and control the consistency of the mortar. The cement, water, and admixture must be as specified. Sand must comply with ASTM C33 for fine aggregate. The mortar must be mixed in the proportions 1 part cement to 2.5 parts sand, by weight. Water content must be sufficient to provide a spreadable consistency. In combination with the admixture, the maximum water-to-cementitious materials ratio must be 0.45. The mortar slump must be 7 to 9 inches when tested in accordance with ASTM C143. The admixture must be included at the manufacturer's recommended dosage so that the initial set time is retarded at least 3 hours when the ambient air temperature is 95 degrees Fahrenheit.

Material testing—The contractor must test materials or provide certified test results to ensure all materials conform to the specified requirements. All nonconforming materials must be promptly removed from the job site, including those that have been incorporated into the work.

Aggregate sampling must be in accordance with ASTM D75.

Aggregate samples must be taken from stockpiles, belt feeders from bins, the mix plant feed conveyor belts, the mixer feed conveyer belt, or from the pug mill discharge while only aggregate is discharged from the pugmill.

When obtaining aggregate samples from stockpiles, samples must be obtained from various parts of the stockpiles, but never from the perimeter of the lower third of the pile.

The contractor must provide access for material sampling and performance of quality assurance testing activities at material storage sites.

Sampling—The contractor must provide suitable platforms, tools, equipment, and labor necessary for obtaining representative samples of materials to be used for the contractor's quality control testing and for the Government's quality assurance testing. Samples may be taken from stockpiles, aggregate bins and feed belts, entrance to the mixer, mixer discharge, gob hopper discharge, points in transit, or the placement area.

Material handling and processing—Transportation of cement and pozzolan to the batching plant must be accomplished in weather-tight trucks, conveyors, or other means that will completely and thoroughly protect the cementitious materials from exposure to moisture and contaminants.

The temperature of cement and pozzolan when delivered to the job site must not exceed 160 degrees Fahrenheit. The temperature of the cement and pozzolan must be determined by direct insertion of a thermometer into the material in the delivery truck. The temperature of air to transport cement into storage containers or silos must not exceed 180 degrees Fahrenheit. It may be assumed that the temperature of the air in the transfer pipe is the same as the temperature on the outside surface of the transport pipe. The temperature of the air must be determined by measuring the temperature on the outside of the transport pipe with a surface thermometer.

Immediately upon receipt at the job site, cement and pozzolan must be stored in dry, weather-tight, ventilated structures. All storage facilities must permit easy access for inspection and identification. Sufficient cement and pozzolan must be stored onsite at all times to complete a minimum of 24 hours of placement at the planned average production rate, unless otherwise specified. Cement and pozzolan that have been stored at the site for the longest period must be used first, unless otherwise specified.

Aggregates must be transported to the site in two or more components that will be combined in the mix plant to meet the overall aggregate gradation. Aggregate components must be of a gradation that will minimize segregation prior to introduction into the mixer. Aggregates must be stored in stockpiles in the designated contractor use area. Aggregate components must be stockpiled separately. Aggregates must be handled and stockpiled in a manner to prevent intermixing between dissimilar aggregates and to prevent contamination of the aggregate. Coarse and fine aggregates must remain separated until they are introduced into the mixing plant. For plants that mix in discrete batches, the coarse and fine aggregates must be fed separately into the batch hopper. For mix plants that mix continuously, the coarse and fine aggregates must remain separated until they are dropped onto the belt that delivers the aggregates to the mixing compartment. The contractor must develop and utilize methods that reliably and consistently withdraw and transport the aggregates from the stockpile without contamination or segregation. Segregated or contaminated aggregates must not be used in production of the RCC and must be disposed of in locations specified in section 22.

A 2-week supply of aggregates, based on the average planned weekly production rate, must be stockpiled at the mixing plant location or other approved location, prior to RCC production unless otherwise specified.

Sufficient water must be available for mixing and curing to complete a minimum of 24 hours of placement at the average planned production rate.

3. Submittals

Manufacturer's certifications and test reports in no way relieve the contractor of the responsibility for furnishing materials that meet the specified requirements. Manufacturer's certifications and test reports must be produced and dated within the 6 months preceding the delivery of the submittal. The test method used must be noted on all test reports. Any deviation from standard test methods must be detailed in the test report and the reason for the deviation must be given.

Trial mix production submittals—The submittals listed below must be provided, in writing, for approval no later than 30 days before trial mix production, unless otherwise specified. Trial mix production must not proceed before approval of these submittals.

- a. The name and qualifications of the laboratory that will perform the mix design.
- b. The sources from which the cementitious materials will be obtained along with a certified mill test report for each type of cement, pozzolan, and blended cement that will be used to produce RCC. The certified mill test report must verify that the cement, pozzolan, or blended cement conforms to the applicable material specification.
- c. The source from which the aggregate will be obtained and certified test results showing that all aggregates conform to the specification.

- d. The source from which the water will be obtained and the certified test results showing that water to be used in the mix conforms to ASTM C 94.
- e. The source of the admixture along with certified test results showing that the admixture conforms to the specification.

RCC preproduction submittals—The submittals listed below must be provided, in writing, to the engineer for approval. The submittal for the job mix and bonding mortar must be furnished 30 days before delivery of any RCC or bonding mortar component materials to the site. The submittal for the plant and equipment, personnel, and test section plan must be provided no later than 30 days before delivery of the plant or equipment to the site. RCC materials or equipment must not be delivered to the site before approval of these submittals.

Job mix

- a. A certified statement of materials, mix proportions (reported for saturated surface dry aggregate), theoretical air-free density (TAFD), moisture/density curves (wet density only), Vebe time, air content, unit weight of mix in air pot just prior to testing air content, and all compressive strength test results for each of the three mixes required in the development of the RCC job mix.
- b. Gradation of each of the aggregate component and combined aggregates used in each mix developed in the mix design program.
- c. The compacted bulk density and voids in each of the aggregate components and combined aggregates used in each mix developed in the mix design program.
- d. A statement of materials and mix proportions used in each mix developed in the mix design program.
- e. A statement of materials and mix proportions proposed to be used in manufacturing the RCC job mix.

Bonding mortar

- a. A statement of materials and mix proportions to be used in manufacturing the bonding mortar.

Plant and equipment

- a. The planned RCC component material production, transportation, and storage and temperature control procedures. Anticipated peak production capacity, normal production capacity, and onsite storage volumes must be included in the plan.
- b. Mixing plant manufacturer's data and operating instructions and the plant layout to include a schematic drawing of the plant and materials storage with a narrative description providing its peak capacity, normal anticipated production rate, and results of the most recent uniformity tests conducted within the previous 12 months. The proposed location of the mixing plant relative to the placement site must be provided.
- c. A narrative description and a layout of the equipment and methods to be used for delivering and depositing RCC at the placement site.
- d. The type and expected number of pieces of equipment required for all placing, spreading, and compaction of the RCC.
- e. The plan for obtaining the specified vertical surfaces.
- f. The method and procedure for curing of the in-place RCC, including the type of curing compound if used.
- g. The method and procedure that will be implemented to provide protection of RCC from temperature extremes, including the type of external heating equipment and insulating materials to be used.

Personnel

- a. The names and qualifications of the onsite quality control person, supervisor, and plant operator who will direct the batching, mixing, and placing of RCC.

Test section plan

- a. The contractor's proposed location for the test section and equipment, materials, personnel, and methods to construct the test section as specified. The submittal must include plans for the pre- and post-test section briefings.

Test section submittals—Within 24-hours of completing the tests or test section, the following information must be transmitted to the engineer in writing:

- a. Results of moisture and density tests used to compute the apparent maximum density (AMD). Include the results of all density tests made of RCC in the test section.
- b. Lift maps of the test section.
- c. Results of compressive strength tests.
- d. Air content and unit weight of RCC.
- e. Production plan that includes RCC production methods, materials, plant, equipment, and personnel as modified based on the results from the performance of the test section that have been documented to produce RCC that meets the requirements of the specification.

Unless otherwise specified, 7 days prior to beginning RCC production, submit a final written plan for RCC production methods, materials, plant, equipment, and personnel that will produce RCC that meets the requirements of this specification.

RCC production submittals—The following submittals must be provided in writing within 24 hours after delivery tickets, records, or test results are produced, unless otherwise specified:

- a. Delivery tickets for cement and pozzolan must include the source, date manufactured or produced, type or class, contractor's name, project name, and a certification that the material meets the specification requirements.
- b. Delivery tickets for aggregates must include the source, material description, date, and certification that the material meets the specification requirements.
- c. Delivery tickets for bonding mortar must include name and location of batch plant, ticket number, load and truck number, date, destination, class of cementitious materials, mix proportions, quantity of bonding mortar, time mixer drum charged with cement, and recording of revolution counter (transit-mixed concrete). If bonding mortar is produced on site, the above required information must be provided as applicable.
- d. Records of climatic conditions must be collected on a daily basis and reported on a weekly basis.
- e. Mix plant production records and summary of daily material use and RCC produced must be submitted before the start of the next production shift. Production records must include a comparison of actual materials used to the approved job mix.
- f. Results of RCC moisture and wet density tests.
- g. Results of uniformity tests.
- h. Results of compressive strength tests.
- i. Results of RCC temperature tests.
- j. Lift maps must be submitted before the start of the next production shift.

4. Personnel

There must be a supervisor who is responsible for all aspects of the RCC operation and a plant operator who is solely responsible for batching and mixing. There must be an onsite quality control inspector dedicated to RCC quality control. The supervisor, plant operator, and quality control inspector must have responsible experience on at least one previous RCC job in the same position for which they are being considered for the current job.

There must be at least one person whose sole responsibility is the oversight of the RCC curing activities.

5. RCC mix design

The contractor is responsible for the mix design and selection of all materials to be used in the design mix. The materials and proportions so stated, when approved, constitute the job mix. The job mix must be prepared to meet the quality, consistency, and strength of the RCC specified.

The contractor must conduct the mix design program at a materials testing laboratory staffed by American Concrete Institute (ACI) Certified Grade II Concrete Laboratory Testing Technicians.

Trial mix design parameters—The aggregate gradation must be as specified. The bulk density and voids in each of the aggregate components and the combined aggregate must be determined according to ASTM C 29.

The density, relative density, and absorption must be determined according to ASTM C 127 for coarse aggregate and ASTM C 128 for fine aggregate.

The air content of each mix must be determined according to ASTM C 231. The volume and tare weight of the air pot must be determined according to ASTM C 138. After consolidating the RCC in the air pot and just prior to testing to determine the air content, the weight of the RCC and pot must be determined according to ASTM C 138. The density of the RCC that is consolidated in the pot at the time of testing must be computed.

The minimum compressive strength for the RCC job mix must be as specified in section 22 of this specification.

Unless otherwise specified in section 22—

- A minimum of three separate mixes must be developed in the laboratory.
- Pozzolans must comprise at least 20 percent (by volume) but must not exceed 50 percent (by volume) of the cementitious materials.
- The remainder of the cementitious materials must be comprised of portland cement.
- A compaction curve (wet density only) must be developed for each mix to determine the water content that corresponds to the maximum wet density of each mix. Compaction tests must be performed in accordance with ASTM D 1557, adapted as follows:
 - o The mold specified for Method C must be used.
 - o All mix components must be included.
 - o When the maximum size aggregate in the mix is larger than 3/4 inch, place the material in three layers into the mold and compact each layer with 94 blows of the hammer.
- A Vebe test must be performed on each trial mix design to determine the Vebe consistency time in seconds and the wet density in pounds per cubic foot. The Vebe test must be performed according to ASTM C 1170. The Vebe consistency time must range from a minimum of 15 seconds to a maximum of 30 seconds.

Theoretical air free density—The theoretical air free density (TAFD) must be computed for each of the three laboratory mixes in the mix design program. The TAFD is the maximum wet density that can be attained for a specific mix assuming there is no air (entrapped or entrained) in the mix. The TAFD must be computed by dividing the sum of the individual weights of the mix components by the sum of the individual absolute volumes of the mix components. The absolute volume is the volume of the solid matter in the particles, exclusive of the volume of voids between the particles. The absolute volume of each mix component is determined as per ACI 211. The saturated surface dry weight and density of the aggregate must be used when computing the TAFD.

Laboratory compressive strength—Fifteen compressive strength cylinders from each RCC mixture must be prepared in accordance with ASTM C 1176 or C 1435 and weighed to determine the density of the RCC within each cylinder. Any cylinder that weighs less than 98 percent of the weight of the heaviest cylinder must be discarded and another cylinder prepared and weighed until all 15 cylinders have a weight that is at least 98 percent of that of the heaviest cylinder. The water content of each mixture, from which cylinders are made, must be within 0.5 percent of the water content that corresponds to the maximum wet density determined in accordance with ASTM D 1557. Three cylinders from each RCC mixture must be tested at 7, 14, 28, 90, and 180 days for compressive strength in accordance with ASTM C 39.

The average of the two closest 28-day strength values represent the 28-day compressive strength of the mix. The 28-day compressive strength of at least one of the mix designs must be 75 percent to 100 percent of the specified strength. The 28-day compressive strength of at least one of the mix designs must be 100 percent to 125 percent of the specified strength. The 28-day compressive strength of the remaining mix design must approximate the specified strength.

The cementitious materials content that will be used for the job mix will be based on the results of the 28-day compressive strengths of the three laboratory mix designs. The 28-day compressive strengths of each of the three laboratory mix designs will be plotted to form a curve showing the relationship of the cementitious materials content to the 28-day compressive strength of the laboratory mix designs. A cementitious material content must be selected from this curve corresponding to the 28-day compressive strength specified in section 22. The proposed job mix must be proportioned to contain the selected cementitious materials content and must be submitted for approval.

After the job mix has been approved, neither the source, character, or grading of the aggregates; nor the source mill, type, brand, or quantity of the cement; nor the source, type, or quantity of the pozzolan; nor the type, brand, or quantity of the chemical admixtures used may be changed without approval. Changes to the approved job mix require submittal and approval of a new job mix that complies with the requirements of this specification.

6. Test section

Prior to RCC production, the contractor must construct a test section as part of the RCC placement operations. RCC production is defined as the mixing of RCC to be incorporated into the work and the placing and compacting of RCC, to the specified density, within the specified lines and grades of the structure. Unless otherwise specified in section 22, the test section must be installed at an approved location proposed by the contractor. If the contractor constructs the test section in a location that will be incorporated into the RCC structure, it must be located in a noncritical part of the structure, and it must be removed if it fails to meet the requirements of this specification. If the contractor constructs the test section in a location that will not be incorporated into the structure, the contractor must remove and dispose of the test section upon completion of the testing requirements unless otherwise specified.

All RCC that is incorporated into the structure and placed prior to determining the AMD must be compacted to a density that is at least 96 percent of the TAFD. All RCC incorporated into the structure after the AMD is determined must be compacted to specification requirements.

The test section must be used to demonstrate all techniques, materials, plant and equipment, and personnel to be used for RCC construction and quality control. Additional techniques, materials, equipment, and personnel must be demonstrated in the test section as specified in section 22. Information gained will be used to evaluate the practical effectiveness of all techniques, materials, plant and equipment, and personnel to make minor adjustments to the mix and to determine the AMD of the approved job mix. The contractor must allow for numerous stops and starts to facilitate the testing that is required to determine the AMD.

The test section must be of sufficient size to allow the complete RCC placement and compaction operation to be conducted with the equipment operating at normal operating speeds.

When the test section is placed on soil, a minimum of two 12-inch lifts must be placed, and tests for determining the AMD must be conducted on the uppermost lift.

A section must be constructed to determine the adequacy of the procedures implemented to construct vertical surfaces. Any surface that is not horizontal is, within this specification, considered to be a vertical surface. Unless otherwise specified in section 22, the tolerance of vertical surfaces must conform to the requirements of section 18. The finish and appearance of formed and unformed vertical surfaces must comply with the requirements specified in section 17.

The contractor and engineer must conduct the pre-test section briefing to review the field status related to the preparedness, capability, and readiness of the contractor to construct the test section according to the approved plan. After test section construction and before RCC production, the contractor and engineer must conduct the post-test section briefing to discuss adjustments to the techniques, materials, plant, equipment, and personnel that will be used in RCC production. The contractor must submit in writing a final plan for RCC production methods, materials, plant, equipment, and personnel that will produce RCC that meets the requirements of this specification. Unless otherwise specified, the plan must be submitted no later than 7 days prior to beginning RCC production. Written approval of the plan must be required prior to beginning RCC production.

Apparent maximum density—AMD is the maximum RCC density of the approved job mix that can be attained by compacting the RCC with the production roller defined in section 13 of this specification. The AMD must be greater than or equal to 98 percent of the TAFD. The AMD of the RCC must be determined from the test section.

To determine the AMD, the RCC lift must be compacted by successive passes of the production roller over the entire lift surface. (Note: The act of rolling forward past a point and then rolling in reverse past the same point is considered two passes.) Between passes of the production roller, in-place wet density tests (ASTM C 1040) must be made at a depth of 12 inches. Density tests must be initiated after the second pass of the production roller. A minimum of two density tests must be performed at a depth of 12 inches and at approved locations. Successive passes of the production roller, followed by density tests at the 12-inch depth, must be made until the density of the lift no longer increases. When it appears that continued compaction will not increase the density, make two more passes of the production roller, each followed by a density test to document that the density is no longer increasing. Once it has been determined that the density measurement at the 12-inch depth is no longer increasing, density tests must be taken in two locations at depths of 2, 4, 6, 8, 10, and 12 inches. If the maximum and minimum density values obtained in one test hole vary more than 2 percent of the maximum value obtained at that test hole, the contractor must modify operations until this variation is no more than 2 percent.

When the density of the lift no longer increases and the density measurements taken at the specified depths vary no more than 2 percent of the highest value measured at one location, the density must be measured at the 10-inch depth at six approved locations. If more than one of these density measurements results in values less than 96 percent of the TAFD, the contractor must modify operations and repeat the process for determining the AMD. The AMD is the average of the in-place density test values that are greater than or equal to 96 percent of the TAFD of the job mix. If the AMD is less than 98 percent of the TAFD of the job mix, the contractor must modify operations to attain an AMD that is at least 98 percent of the TAFD.

If a new job mix is approved during production of RCC, a new TAFD will be computed and a new AMD will be determined as previously specified.

Air content and density—The air content of the mix must be determined according to ASTM C231 modified to use an impact hammer and tamping plate for compacting the AERCC in two equal lifts. The compaction of AERCC must be performed as described in ASTM C1435, taking care not to compact each layer more than necessary for the complete mortar ring formation. The tamping plate must have a diameter that is equal to the diameter of the inside of the air pot minus 3/8 to 5/8 inches. The volume and tare weight of the air pot must be determined according to ASTM C138. After consolidating the RCC in the air pot and just prior to testing to determine the air content, the weight of the RCC and pot must be determined according to ASTM C138. The density of the RCC that is consolidated in the pot at the time of testing must be computed.

Compressive strength tests—Fifteen compressive strength cylinders must be prepared from the mix in accordance with ASTM C1176 or C1435 and weighed to determine the density of the RCC within each cylinder. Any cylinder that weighs less than 98 percent of the weight of the heaviest cylinder must be discarded and another cylinder prepared and weighed until all 15 cylinders have a weight that is at least 98 percent of that of the heaviest cylinder. Three cylinders must be tested at 7, 14, 28, 90, and 180 days, respectively, for compressive strength in accordance with ASTM C39.

Unless otherwise specified in section 22 of this specification, the contractor must extract 10 intact vertical core samples, in accordance with ASTM C42, from a portion of the test section that has been placed to the specified density and cured in accordance with this specification. Core specimens must be taken 13 days after the RCC is placed. The contractor must test two samples at 14, 28, 56, 90, and 180 days, respectively, for compressive strength in accordance with ASTM C42. Cores must have a minimum length equal to one lift thickness and a nominal diameter of 6 inches.

7. Mix plant

The plant must either be a batch-type pugmill or a continuous-flow pugmill. The pugmill must be a twin shaft paddle-type mixer and must have adequate capacity to produce a uniform RCC mix at a rate that will conform to the production schedule. The plant must have a minimum capacity of 100 tons per hour.

The plant must have demonstrated satisfactory reliable performance on similar mixes on other RCC projects with little or no down time because of mixer breakdown or other production-related problems, excluding normal maintenance. Satisfactory reliable performance of the proposed plant must be documented by mixer uniformity tests from recent production work showing that the plant produced a mix of similar proportions that met the requirements for production rate and uniformity set forth in this specification.

The results of uniformity tests that are conducted after the plant is set up and calibrated may be substituted for documentation of reliable past plant performance provided the results of the uniformity testing are in compliance with the requirements of table 36–2. RCC produced during uniformity tests required herein must not be incorporated into the test section or any permanent structure.

The contractor must perform trial runs of the mixing and proportioning equipment, including uniformity tests if required.

Accuracy. Facilities must be provided for the accurate measurement and control of each of the materials entering the RCC mix. Delivery of materials as they are discharged from the mixer and from any gob hoppers must be within the tolerances shown in table 36–1.

Table 36–1 Tolerances in proportioning the various ingredients

Material	Tolerance
Pozzolan, mass	± 2 %
Cement, mass	± 2 %
Aggregate, mass	± 3 %
Water, mass or volume	± 2 %
Chemical admixture, mass or volume	± 3 %

Component monitoring systems. The systems that meter individual mix components must be interlocked with the plant control and must warn the operator and shut down the plant if any component is not feeding into the mixing chamber.

Aggregate bins. A separate bin must be provided for each gradation of aggregate supplied for the RCC job mix. The bins and associated conveyors must be capable of discharging and conveying the aggregates at a uniform rate without clogging, under all conditions.

Portland cement and pozzolan silos. All onsite storage facilities and connection hoses must be properly labeled with readily visible signage. The storage silos must be weather tight to prevent moisture and contaminants from accessing the portland cement and pozzolan. Blended cement/pozzolan products mixed by the cement manufacturer are permitted. Silos must be capable of dispensing at a uniform rate without clogging or bridging of the materials.

Portland cement, pozzolan, and aggregate feed. For a continuous-flow pugmill, the portland cement, pozzolan, and aggregates must be uniformly, continuously, and simultaneously fed into the mixing mechanism at the appropriate ratios. Each bin opening must be provided with a gate that can be maintained at the necessary opening size to consistently provide the correct feed rate. The bins must be of sufficient size to ensure a uniform flow of aggregate at a constant rate. Portland cement and pozzolan must be fed continuously by a feed device that is adjustable to ensure a uniform flow of cement and pozzolan at a constant rate for proportions established by the approved job mix. Feed devices must be capable of gradual adjustment while in operation.

Water dispenser. A suitable water facility must be provided that is capable of metering and dispensing the mix water within the specified tolerances. The mechanism for delivering water to the mixers must be free from leakage. The meter must measure the weight of water being added in pounds per unit time for continuous-flow pugmills, and weight per batch for batch-type pugmills. The valve must be capable of gradual adjustment during the mixing process to compensate for varying moisture contents in the aggregates.

Admixture dispenser. The liquid admixture dispensing system must be capable of metering and dispensing within the specified tolerances. The dispenser must be designed and installed in such a manner that will permit convenient checking of its accuracy and will assure uniform distribution of the liquid admixture with water to the materials entering the mixer. The system must be leak-free and designed and installed to prevent backflow or siphoning.

Mixing mechanism. The mixing mechanism must be capable of combining the materials into a uniform mixture and discharging this mixture without segregation. The mixing mechanism must produce a mix that meets the uniformity requirements listed in table 36–2.

Uniformity tests. When a continuous-flow pugmill is used, the three samples for obtaining uniformity tests must be taken from RCC produced near the beginning, the middle, and the end of a production run lasting a minimum of 1 minute. When a batch-type pugmill is used, the samples must be taken from RCC produced from three separate batches. Each batch must be similar in size, be produced by charging the mixer in a similar manner, be mixed at the same mixing speed and mix retention time as the other two batches, and be representative of a normal production run.

Table 36–2 Requirements for uniformity

Test	Allowable max. difference ^{1/}	ASTM standard
Water content of full mix (% by weight) (Select one of the ASTM standard tests listed)	10%	C566 D2216 D3017 D4643 D4959
Coarse aggregate content (% by weight)	10%	C685 (annex)
Density (lb/ft ³) of full mix	2%	C1170
Compressive strength at 14 days (lb/in ²)	15%	C39 ^{2/}

1/ The allowable maximum difference = 100 multiplied by the (maximum value – minimum value) divided by the average of three tests.

2/ Cylinders must be made in accordance with ASTM Standard C1176 or C1435.

Mix record. The mix plant must be capable of continually producing an RCC mix record. The record must show the weight of portland cement, pozzolan, water, aggregate, and weight or volume of chemical admixture that is processed through the plant during a specific time interval. The time interval must not exceed 30 minutes. The aggregate must be reported in terms of saturated surface dry weight processed through the plant during a specific time interval. The RCC mix record must be produced at all times when the plant is producing a mix. The aggregate moisture must be tested daily whenever RCC is being produced. The mix plant record must include the aggregate moisture content tests upon which the batch proportions are based.

A summary shift record must be provided. The record must include the total quantity of each constituent in the mix, total quantity of RCC produced, and a comparison of the quantity of each constituent mixed per cubic yard to that of the job mix.

Noise pollution. The plant must be operated to comply with all applicable regulations pertaining to noise pollution.

Pollution control. The plant must be operated to comply with all applicable regulations pertaining to air and water quality.

8. Mixing

The plant must be operated according to the manufacturer's recommendations. The mixing mechanism must be maintained in satisfactory operating condition and must be cleaned after each production run. All supply bins and silos must be kept sufficiently full to ensure a uniform and constant flow of all materials.

All RCC produced from the beginning of startup must be disposed of at the location or locations specified in section 22 of this specification until a uniform mix of the required proportions is consistently being discharged from the mixer.

After a batch-type pugmill has been calibrated and has produced the job mix with the specified uniformity, the mix retention time must not be reduced.

Uniformity—RCC uniformity must be monitored by continuous visual inspection by the plant operator and by periodic visual inspection by contractor quality control personnel. The mix must be visually inspected for uniformity by contractor quality control personnel at the beginning of each production run and at least once each hour during the production run. If it becomes apparent that

the mixer is not producing a uniform mix of the proportions specified, RCC production must be promptly discontinued until the problems that caused the uniformity problem are discovered and corrected.

If a uniformity problem is suspected, the contractor must conduct the tests listed in table 36–2, determine the maximum difference and compare to the allowable maximum difference, and take appropriate corrective measures.

Adjustments must be made to the mixing plant as necessary to obtain the required uniformity and consistency of the RCC mix when uniformity test results indicate that the requirements for uniformity are not being met. The production and placement of RCC may proceed without waiting for the compressive strength results if the results of the other three tests listed in table 36–2 are within the allowable maximum difference and the issues that caused a uniformity problem are resolved.

9. Conveying

The RCC mix must be conveyed from mixer to placement area as rapidly as practicable by methods that prevent segregation, contamination, and loss of water. The total length of time from the end of mixing until the RCC has been placed, spread, and compacted must not exceed 45 minutes.

The contractor must provide baffles to limit free fall of mixed RCC to a maximum of 5 feet at the discharge end of conveyors, within hoppers, and at other locations where the potential for segregation may occur. Chutes that tend to cause segregation, such as an inclined chute, will not be permitted.

Communications—Telephone, radio, or other voice communication must be provided between all interim storage hoppers, the batch plant control, and the placement locations. The contractor must provide the Government inspector the same form of communication.

Temporary storage containers—Gob hoppers must be used for storage wherever the mixed RCC is temporarily accumulated prior to being loaded into hauling equipment and when direct conveyor systems do not otherwise provide continuous delivery to the final placement location. Gob hoppers must be configured to allow free flow of RCC without segregation or choking.

Conveyor belts—The conveyor system design and layout must provide for adequate capacity, speed, reach, and pivot points to convey RCC to all placement areas.

Conveyor belts must be designed, erected, operated, and maintained in a manner that meets production requirements and does not segregate materials. RCC must not be exposed on any belt for a period exceeding 5 minutes without being protected from the drying elements of wind and sun. RCC must not be exposed on any belt during rainfall unless it is protected from the rain.

Hauling equipment—Equipment must be maintained in good operating condition and must not be permitted onto the RCC surface when vehicle fluids are leaking or when there is a potential for contamination to the RCC.

RCC may be hauled using trucks, front-end loaders, or scrapers. Hauling equipment that ruts, scores, mars, or indents the RCC surface must not be operated directly on previously compacted RCC surfaces. Hauling equipment must not track mud or other contaminants onto previously placed RCC and must not be operated directly on uncompacted RCC. All hauling vehicles must be operated in a manner that prevents tight turns, sudden stops, or other actions that cause damage or displacement to previously compacted RCC. The contractor must implement necessary measures to prevent contamination or damage of the previously compacted RCC.

10. Weather

Adverse weather—In adverse weather (heavy rain, severe cold, heavy snow, and hot temperature) where the conditions specified herein for RCC construction cannot be maintained, an interruption in placing operations is required.

Weather station—The contractor must install and maintain a weather station onsite at all times during performance of the test section and the production and placement of RCC. The weather station must be located at an approved location near the RCC structure. The weather station must record wind speed, ambient temperature, humidity, and the rate and cumulative volume of rainfall. A record of climatic conditions at the designated location including wind speed, ambient temperature, humidity, and rainfall rate and volume must be recorded daily.

Wet weather placement—RCC must be protected from rainfall-induced erosion and must not be placed during rainfall events at a rate equal to or greater than 0.1 inch in 20 minutes. Placement during a light mist may continue when covered belt conveyors rather than hauling vehicles are used to convey the mix. Placement of RCC will not be permitted when rainwater accumulates on compacted RCC surfaces.

Cold weather placement—RCC must not be placed when the ambient air temperature drops below 35 degrees Fahrenheit or the temperature of the RCC mix is less than 40 degrees Fahrenheit.

Hot weather placement—The maximum temperature of the RCC at time of placement must be as specified in section 22. After placing, but prior to compaction, the temperature of the mix must be determined according to ASTM C 1064. When the RCC temperature is within 2 degrees of the specified limit, it must be measured every hour. Introduction of chilled water and/or ice, shading and/or cooling of the aggregates, or other measures may be required in the production of RCC to maintain the RCC temperature within the specified requirements. If the RCC temperature exceeds the maximum specified temperature, RCC placement must be suspended until cooler weather or additional measures to reduce the RCC temperature results in a reduction of the placement temperature of the RCC to or below the specified maximum temperature.

11. Foundation preparation

Prior to the start of RCC placement, the foundation must be excavated or filled to the specified lines and grades as shown on the drawings. The foundation must be free of standing water and any organic or loose materials. All surfaces where RCC installation is specified must be damp and have a surface temperature not less than 35 degrees Fahrenheit at time of placement. Placement of RCC on mud, dried earth, uncompacted fill, standing water, or frozen subgrade is not permitted.

Earthen foundations—Earthen foundation surfaces must be prepared by adjusting the moisture content and compacting the foundation. The moisture content, depth, and degree of compaction required must be as specified in section 22. If the earthen foundation is allowed to dry after compaction, it must be moistened prior to placing RCC. The foundation surface must be firm and damp.

Rock foundations—Rock foundations must be cleaned and prepared as specified in Construction Specification 63, Treatment of Rock Surfaces. The slope of the finished foundation surface must not be steeper than one horizontal to one vertical. Rock surfaces must be damp at the time of RCC placement.

12. Placing and spreading

The placement of RCC into the structure must be such that once placement begins, it is performed without interruption until RCC placement and compaction complies with specification requirements within the geometric limits planned for that placement period. The contractor must obtain the concurrence of the engineer when establishing the geometric limits of RCC to be placed and compacted in any placement period.

All equipment used on the RCC fill must be maintained in good operating condition at all times. Equipment must not drip or spill oil or other contaminants onto the RCC. Any equipment that contaminates the RCC mixture must be promptly removed from contact with the RCC and repaired or replaced. Any contaminated RCC mixture must be removed and replaced.

Placing and spreading must be performed with equipment that does not mar or contaminate the surface of the compacted RCC. Track-type equipment must not operate directly on compacted RCC unless the tracks are equipped with rubber pads. Equipment used to deposit, spread, or compact must not turn on previously compacted RCC.

Layout of the placement area—The RCC must be spread in level lifts across the entire area of the structure. The direction of RCC placement must be parallel to the long axis of the structure so that the number of lanes and the number of edge joints are minimized. Transverse joints of adjacent lanes must be offset by no less than 20 feet horizontally.

Placing—RCC mix, bonding mortar, portland cement, neat cement grout, or concrete must not be placed on previously placed layers that have not been compacted to the specified density.

Roller compacted concrete mix must be deposited as near to its final location as possible. When haul vehicle delivery is used, depositing must be accomplished with a dump-spread action while the placing vehicle is moving. Belt placement must discharge with a spreading action that does not segregate the material. RCC must not be deposited directly against formwork or other vertical surfaces. Piles that form when placing RCC must not contact forms or vertical surfaces. Neither the discharge height nor the pile height of RCC must exceed 5 feet.

Spreading—Spreading of the RCC must be completed within 10 minutes following depositing. RCC must be spread into an uncompacted, uniform lift thickness that can be compacted to produce a lift of the specified thickness and density. In areas requiring special compaction, it may be necessary to deposit, spread, and compact the RCC in several layers to produce a lift of the specified thickness and density.

Equipment must not operate directly on any surface that has been cleaned and prepared to receive a subsequent lift of RCC.

Spreading of RCC material must be performed with a track-type bulldozer in a manner that will not cause damage to previously compacted RCC.

With RCC placement at or near its final location, spreading will typically be limited to leveling the RCC into uniform lifts. In isolated or confined placement locations, the RCC may be deposited and spread up to a maximum distance of 50 feet provided segregation does not occur, specified spreading time is not exceeded and the time specified between mixing and a completion of compaction is not exceeded. The contractor must conduct placing and spreading operations in a manner that will prevent segregation of RCC.

If segregation of RCC occurs during the spreading operation, it must be corrected by immediately reworking the RCC. Reworking must be performed using techniques that do not damage previously compacted RCC. This may require removing the RCC from the lift surface to accomplish reworking, then transporting the mix back onto the surface after mix uniformity has been achieved. If reworking the RCC does not produce a uniform mix, or if the specified time between mixing and compaction is exceeded, the segregated RCC must be wasted and replaced.

If a uniformity problem is suspected, uniformity tests must be performed from material taken from the placement area following spreading of the material and/or other points in the RCC production process as required to identify the source of the problem. Three individual samples of the material must be taken at the sample location at intervals of 5 minutes or more. Uniformity tests must be conducted in accordance with table 36–2. The maximum difference between the resulting values must be compared to the allowable maximum difference and appropriate corrective measures be employed.

13. Compaction

The entire surface area of each RCC lift must be compacted to the specified density, as determined from the apparent maximum density (AMD) specified in section 6, with adequate compaction overlap to ensure complete compaction of the RCC.

The in-place wet density of the compacted RCC measured at a depth of 10 inches must not be less than 98 percent of the AMD.

Uniformity of density must be achieved within each lift. The difference between density measurements at any two depths must not exceed 2 percent of the greater of the two values.

The wet density of the compacted RCC must be tested in accordance with ASTM C1040. The moisture content of the compacted RCC must be tested in accordance with ASTM D3017. Unless otherwise specified in section 22, a minimum of three moisture and density tests will be performed on each lift of RCC with no less than one density measurement and moisture measurement for each 100 cubic yards of RCC compacted.

Production compaction must be performed with production rollers as defined in this section. RCC compacted with production rollers must be compacted in single lifts that are 12 inches thick (plus or minus 1 inch) after the specified density has been achieved.

Production rollers must be single or double drum, large, self-propelled vibratory rollers. The rollers transmit a centrifugal force to the surface through smooth steel drum or drums by means of revolving weights, eccentric shafts, or other equivalent methods. Production rollers must impart a centrifugal force of at least 450 pounds per inch of drum width at the operating frequency during compaction. Production rollers must operate at a vibrating frequency of at least 1,500 vibrations per minute and have a drum diameter of 4 to 6 feet and a drum width of 5 to 8 feet. The amplitude of vibration of the roller must be between 0.03 and 0.07 inch. The roller must not travel at greater than 2 feet per second during the compaction operation.

Production rollers must be used in open areas where they can compact RCC to the specified density within the specified time and without damage to the structure, forms, foundation, or appurtenances.

Rollers may only be operated in the vibratory mode while actively compacting the RCC. After the RCC has been deposited and spread, rollers may be operated in static mode to smooth and/or firm up the surface, but must operate in the vibratory mode to compact the RCC to the specified density. Compaction must be completed with the roller operated in the static mode, as necessary, to achieve the specified density near the surface of the lift.

The contractor must select the combination of frequency of vibration, amplitude of vibration, and speed of operation that result in the specified density at the fastest production rate while meeting all other requirements.

Placement and compaction of RCC must be completed without damaging the structure, other structures, forms, foundation, or other embedded appurtenances. Any appurtenance damaged by the compaction process must be repaired or removed and replaced at the contractor's expense.

Special compaction techniques must be performed using special compaction rollers and power tampers in areas where production rollers cannot maneuver or will cause damage to the structure, forms, foundation, or appurtenances. RCC must be deposited, spread, and compacted in 4- or 6-inch-thick layers as required to obtain uniform specified density throughout the 12-inch lift with limited compaction to avoid drying the surface.

The individual layers that compose one lift must be deposited, spread, and compacted within 1 hour from the time the first layer within that lift is placed.

Special compaction rollers must be vibratory rollers that are capable of operating in confined areas and adjacent to forms, foundation, or appurtenances without damage to the RCC structure or appurtenances. Special compaction rollers must produce a centrifugal force of at least 150 pounds per linear inch of drum width for each drum of a double drum unit and 300 pounds per linear inch of drum width for a single drum unit. Special compaction rollers must be operated at a speed less than 2 feet per second during the compaction operation.

Power tampers must develop a force per blow of at least 3,500 pounds per square foot. The maximum layer thickness to be compacted by power tampers must be plus or minus 6 inches after the specified density has been achieved.

The contractor must maintain at least one special compaction roller and two tampers in operating condition at the site during RCC placement.

Manually directed vibratory plate compactors may be used to shape, smooth, and level the surface, but must not be used as a substitute for vibratory rollers and power tampers.

14. Record testing

Unless otherwise specified in section 22, one set of RCC cylinders for compressive strength tests must be obtained for each 1,000 cubic yards of RCC placed to be used for compressive strength testing.

Each set must consist of 15 compressive strength cylinders prepared in accordance with ASTM C 1176 or C 1435 and weighed to determine the density of the RCC within each cylinder. Any cylinder that weighs less than 98 percent of the weight of the heaviest cylinder must be discarded and another cylinder prepared and weighed until all 15 cylinders have a weight that is at least 98 percent of that of the heaviest cylinder. Three cylinders must be tested for compressive strength in accordance with ASTM C 39 at 7, 14, 28, 90, and 180 days, respectively, after the specimens are molded.

Unless otherwise specified in section 22 of this specification, the contractor must extract two sets of vertical core RCC samples in accordance with ASTM C 42. Each set must be sampled from RCC that has been placed in the structure at no less than 1 week apart. Each set must contain eight intact cores taken from the structure at approved locations. Cores must have a minimum length equal to one lift thickness and a nominal diameter of 6 inches. Core specimens must be obtained no earlier than 20 days after placement. The contractor must test two samples at 28, 56, 90, and 180 days, respectively, after placement for compressive strength in accordance with ASTM C 42.

15. Lift joints

The term joint, as used in this specification, applies to all surfaces that will eventually be covered by RCC mix, bonding mortar, portland cement, neat cement grout, or conventional concrete.

The joint treatment method must be as specified in section 22.

Joint condition—Three potential joint conditions will exist during construction: fresh joint, intermediate joint, and cold joint. The condition of a joint is defined on the basis of joint maturity or time of exposure. Joint maturity is defined as the product of the average RCC surface temperature (AST) in degrees Fahrenheit and the time of exposure (TE) in hours. Joint maturity is expressed in degree-hours (deg F-hr) and is calculated as—

$$\text{Joint maturity in deg F-hr} = (\text{AST}) \times (\text{TE}).$$

The TE is the period, expressed to the nearest quarter hour, beginning when the compaction of RCC is completed and ending when covered by the subsequent placement of RCC, bonding mortar, portland cement, neat cement grout, or conventional concrete.

Whenever the joint condition is defined on the basis of joint maturity, the AST must be determined hourly during the exposure period by measuring the RCC surface temperature at various locations with a surface thermometer. The temperature must be measured in degrees Fahrenheit and the temperature readings averaged to determine the AST.

A **fresh joint** is defined as a joint having maturity of 400 deg F-hr or less. In lieu of determining the joint maturity, a fresh joint may be defined as a joint with a TE of 4 hours or less.

An **intermediate joint** is defined as a joint having a maturity greater than 400 deg F-hr, but less than or equal to 1,600 deg F-hr. In lieu of determining the joint maturity, an intermediate joint may be defined as a joint with a TE of more than 4 hours, but less than 16 hours.

A **cold joint** is defined as a joint having a maturity of over 1,600 deg F-hr. In lieu of determining the joint maturity, a cold joint may be defined as a joint with a TE of 16 hours or more.

Joint treatment—All joint surfaces must be kept continuously moist, clean, and uncontaminated until placement of succeeding RCC lifts. Water that ponds on a finished surface must be removed prior to placing RCC.

The surface of previously placed RCC must be free of soil, dust, or other contaminants prior to being covered with joint treatment material or another layer or lift of RCC. Cleaning of previously placed RCC lifts must be accomplished by pressurized water and/or air or other methods provided that the surface of the in-place layer is not damaged by the cleaning operation.

The contractor must have a pressure washer and a blowpipe onsite capable of delivering a combined air-water mixture, with the ability to adjust the pressure, volume, and proportion of air and water.

Edge joints that are exposed for more than 30 minutes must be trimmed back no less than 9 inches to an RCC surface, that has been compacted to the specified density and beveled at a slope of one horizontal to one vertical. Immediately before placing RCC against a trimmed surface, the joint condition must be determined and the specified joint treatment must be applied.

Any surface to be covered with RCC, a bonding material or conventional concrete that is damaged to the extent that over 25 percent of the exposed coarse aggregate is undercut must be treated as a cold joint. Coarse aggregate with less than half of its surface area remaining embedded and bonded to the RCC is considered undercut.

All RCC materials removed by cleaning, brooming, smoothing, beveling, or trimming layers must be collected and removed from the structure.

Treatment Method I. Remove any loose materials and contaminants from the lift joint surface. The lift joint surface must be cleaned using moderate-pressure air immediately before spreading the next RCC lift. Maintain the surface in a moistened condition.

Treatment Method II. Perform Treatment Method I. Before the placement of RCC on the joint surface, uniformly distribute a layer of dry portland cement over the surface. The portland cement must be applied at a rate of 0.5 to 1 pound per square foot of surface. The amount of water applied to the lift surface before, during, or after distributing the cement must be of sufficient quantity to dampen all of the cement. The ratio of water to cement must be limited to that which will produce a tacky paste. Water applied after the cement is distributed must be applied in a fine mist to prevent the displacement of cement. The cement must be applied immediately ahead of placing the next layer or lift of RCC. The cement must not be exposed on the surface more than 10 minutes before being

covered with RCC. Portland cement paste that does not meet these requirements must be removed from the structure and disposed of, and the treatment method must be repeated.

Treatment Method III. Perform Treatment Method I. Before the placement of RCC, the joint surface must be covered with a layer of the bonding mortar specified in section 2. The thickness of the bonding mortar must be 0.25 to 0.5 inch. The bonding mortar must be covered with the next layer or lift of RCC while the mortar is still fluid. In no case may the bonding mortar remain uncovered for more than 30 minutes. Bonding mortar must be placed in a manner that will avoid segregation. Bonding mortar that does not meet these requirements must be removed from the structure and disposed of, and the treatment method must be repeated.

16. Curing and protection

Curing—Curing of RCC must begin immediately after compaction. All exposed and completed RCC surfaces must be cured for a minimum of 14 days at or above 40 degrees Fahrenheit following placement. All repairs, including those required to fill holes associated with form anchorages and coring, must be cured for a minimum of 7 days at or above 40 degrees Fahrenheit following repair.

If the RCC is wet cured, the RCC must be maintained in a continuously damp condition for the entire curing period. The continuous application of water supplemented by the use of a saturated cover material or an impermeable covering must be required to obtain the continuously damp condition. The application of water or cover material must not erode, mar, or otherwise damage the RCC. Plastic or paper covering must meet the requirements of ASTM C 171. Only white or reflective coverings may be used during hot weather as defined by ACI 305.

In lieu of wet curing, RCC that will not be covered with subsequent joint treatment, RCC, or conventional concrete may be treated with a curing compound as specified in section 2, unless otherwise specified in section 22. Areas to be cured with curing compound must be kept continuously moist until curing compound is applied. Curing compound must be thoroughly mixed before applying and must be agitated during application. A continuously agitating pressure sprayer must be used to apply the curing compound at a uniform rate of not less than double the curing compound manufacturer's recommended rate for conventional concrete curing. Manual hand pump sprayers may not be used. A brush or paint roller must be used in areas that are near unmasked surfaces that will be covered with subsequent joint treatment, RCC, or conventional concrete. The curing compound must form a uniform, continuous, adherent film that will not check, crack, or peel and be free from pinholes or other imperfections. Multiple applications of curing compound may be necessary to achieve the specified coverage. When multiple applications are required, the second application must be applied at a 90 degree angle to the first application. During the curing period, curing compound must be reapplied 7 days after the initial application. In areas where the curing compound is damaged, it must be reapplied immediately.

Curing compound must not be applied to areas that are to be repaired or patched. Areas to be repaired or patched must be kept continuously moist until the repair is made. Curing compound or wet curing must then be implemented to conform to curing requirements specified herein. Any curing compound applied to areas that are to be repaired or patched must be removed prior to applying the repair material.

Regardless of the curing method used, curing activities must not be discontinued or interrupted until the RCC has remained at or above 40 degrees Fahrenheit for a total of 14 days. This will require extending the curing period by the number of days that the RCC temperature drops below 40 degrees Fahrenheit during the curing period.

Protection—The temperature of RCC must be maintained at or above 35 degrees Fahrenheit from the time the RCC is placed until 7 days after the curing period. When ambient temperatures are expected to be below 32 degrees Fahrenheit, measures must be implemented to protect the RCC from freezing. The protection must remain in place until ambient temperatures remain continuously above 35 degrees Fahrenheit for 24 hours. Protective measures must not hinder the specified curing of the RCC.

RCC must be protected from damage by precipitation, vehicular traffic, or other causes.

17. Vertical surfaces

Unless otherwise specified in section 22, all formed RCC vertical surfaces that are subject to exposure must be finished to ensure a minimum of 80 percent of the surface area is free from honeycomb or other voids and is uniform in appearance. Forms must remain in place for a minimum 12 hours after the RCC is installed and until they can be removed without damage to the RCC.

Forming is not required for vertical RCC surfaces that are not subject to permanent exposure.

The finish and appearance of unformed vertical surfaces must comply with the requirements specified in section 22.

18. Tolerances

Any variation in the face or surface of the finished RCC must be within the tolerances stated herein.

The structures must be constructed to the lines and grades depicted on the drawings.

The thickness of compacted lifts of RCC must be 12 inches plus or minus 1 inch.

The allowable tolerance of all exposed formed surfaces must be plus or minus 0.1 foot from specified line. Abrupt changes must not exceed 0.05 foot in any exposed formed surface.

Limit gradual overbuild of exposed unformed RCC faces to 0.5 foot. Under build will not be allowed.

Do not exceed 0.1 foot in 10 feet variation in an unformed, exposed RCC face as measured in a straight line along the length and height of the face, or 0.5 foot over the entire length of the structure. Abrupt changes must be less than 0.1 foot.

The elevation of any horizontal RCC surface must be plus or minus 0.1 foot of the specified grade except that the elevation of a finished top of dam or spillway crest must be no more than 0.1 foot above the specified elevation.

19. Repair of RCC

Repair or replacement—The contractor must repair or replace RCC that does not meet the requirements of this specification. Before starting any repair or replacement work, the contractor must prepare a written plan for the repair or replacement. The primary reference for material and repair methods for the plan must be the appropriate sections of the American Concrete Institute's Manual of Concrete Inspection. The repair plan must be submitted for review and approval at least 10 days before any repair or replacement work.

Patching—All form bolts, metal ties, and similar forming restraints must be removed to a depth of 1 inch below the surface of the RCC and their cavities repaired unless otherwise specifically permitted or specified in section 22. Small cavities, large air holes, minor honeycombed areas, holes created from test coring, and other superficial imperfections that require patching to meet the specified finish requirement must be thoroughly cleaned and filled. Holes left by bolts or straps that passes through the RCC must be filled solid with a dense, well-bonded nonshrink patching material. Dry-pack mortar and replacement concrete must follow the appropriate procedure detailed in the Repair and Maintenance chapter of the Concrete Manual, Bureau of Reclamation, U.S. Department of the Interior. Proprietary patching material must be appropriate for the type of repair used within the manufacturer's recommended limits and applied according to the manufacturer's recommendations.

When proprietary patching material is proposed in the plan, the manufacturer's data sheets and written recommendations must be included in the plan.

Repair material or replacement concrete must have properties, color, and texture similar to and compatible with the concrete being repaired or replaced.

Curing of repaired or replaced concrete must be started immediately after finish work is completed as specified in section 16 or as specified by the manufacturer of proprietary compounds.

20. Cleanup of spillage

All loose gravel and uncompacted RCC material must be removed from the structure for disposal in approved locations or as specified in section 22 and must not be recycled into the RCC mix.

21. Measurement and payment

For items of work for which specific unit prices are established in the contract, the volume of RCC is measured and computed to the nearest cubic yard by the method of average cross-sectional end areas. Unless otherwise specified in section 22, no deduction in volume is made for embedded items, such as (but not limited to) conduits, inlet structures, outlet structures, embankment drains, sand diaphragm and outlet, and their appurtenances.

The volume of RCC must be determined by measuring from the surface of the foundation when approved for RCC placement to the specified neatlines of the completed RCC structures, unless otherwise specified in section 22.

If the test section is not incorporated into the RCC structure, the volume of RCC placed into the construction of the test section will be added to the volume computation of the completed RCC structure to determine the total volume of RCC for payment. If the test section is incorporated into the RCC structure, no addition volume of RCC must be included for payment.

When the test section is paid for under a separate bid item, the test section will not be measured for payment. Payment will be made at the contract lump sum price for the test section and will constitute full compensation for the completion of the test section including any removal and disposal as applicable.

Payment for the RCC, for which a specific unit price is established in the contract, will be computed to the nearest cubic yard. Payment constitutes full compensation for furnishing all labor, materials (except cementitious materials), equipment, tools transportation, and all other items necessary and incidental to the construction and removal of the test section and construction of the RCC structure, including joint treatment, trimming and removal, repair, replacement, patching, curing, protection, site cleanup, and disposal of spillage and waste materials. Payment for treatment of rock foundation surfaces, if any, will not be included in the payment for RCC. Payment will not be made for RCC material that is wasted or rejected for failure to comply with this specification.

Payment for each cementitious component of the RCC, for which a separate bid item is included in the contract, includes the quantity incorporated into the RCC structure and test section. This quantity is computed based on statement of delivery tickets. Payment will not be made for any cementitious materials not incorporated into the structure or test section.

Payment for the cementitious materials for which specific unit prices are established in the contract will be to the nearest 0.1 ton of cementitious materials.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 22.

22. Items of work and construction details

22. Items of Work and Construction Details

In Section 5, RCC mix design, the minimum compressive strength shall be 3000 psi at 28 days.

In Section 6, Test section, the location of the test section shall be the floor of the stilling basin as shown in the drawings.

In Section 10, Weather, Hot weather placement, the maximum temperature of the RCC at time of placement shall be 85°F.

In Section 11, Foundation preparation, the earthen foundation upon which RCC will be placed and has not been previously compacted shall be compacted with four (4) complete passes of the compacting equipment. The final excavated surface of the foundation area shall be examined and approved by the Engineer prior to placement of any RCC. All earthen surfaces on which RCC is placed shall be damp and at a surface temperature in excess of 35°F.

In Section 15, Lift joints, Treatment Method I shall be used for fresh joints, intermediate joints and cold joints throughout the entire structure.

In Section 17, Vertical surfaces, the Contractor shall provide a written plan for constructing the specified vertical surfaces to the Contracting Officer for approval 60 days prior to start of construction of Vertical surfaces.

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item 24, Roller Compacted Concrete (RCC)

- (1) This item shall consist of furnishing and placing all roller compacted concrete (RCC) required for the construction of the RCC auxiliary spillway as shown on the drawings.
- (2) The Contractor shall provide a drawing showing the layout of the mixing plant for the RCC. The layout shall be located on-site within the work limits designated on the drawings. The drawing shall designate a temporary disposal area(s) for segregated or contaminated aggregates; non-uniform, initial batch mixes; and/or rejected RCC materials as required in Section 2, Section 8, and Section 20. Prior to construction completion, the materials in these temporary area(s) shall be removed and disposed of at an off site location in compliance with state and local laws. All state and local laws pertaining to mixing or batching plants shall be adhered to.
- (3) The RCC auxiliary spillway shall be constructed in 12-inch-thick lifts (after compaction).
- (4) The Contractor shall remove and replace damaged or defective RCC. The Engineer will determine the required extent of removal, replacement or repair and advise the Contractor, in writing, of this determination. Approval of the Contractor's repair shall not be considered a waiver of Engineer's right to require complete removal of defective work if the completed work does not produce RCC of the required quality and appearance.
- (5) Cranes and heavy equipment shall not be allowed on the RCC after placement unless approved by the Engineer.

b. Bid Item 25, Cementitious Material

- (1) This item shall consist of furnishing and handling the cement and pozzolan required for the production of RCC required for the auxiliary spillway.

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Construction Specification 41—Reinforced Concrete Pressure Pipe Conduits

1. Scope

The work shall consist of furnishing and installing reinforced concrete pressure pipe conduits, fittings, and accessories as shown on the drawings and/or specified herein.

2. Material

Reinforced concrete pressure pipe, fittings, and accessories shall conform to the requirements of Material Specification 541, Reinforced Concrete Pressure Pipe.

Portland cement concrete for bedding and cradles shall conform to the requirements of Construction Specification 31 for the specified class of concrete.

Joint sealing compound shall conform to the requirements of Material Specification 536, Sealing Compound for Joints in Concrete and Concrete Pipe.

Preformed expansion joint filler shall conform to the requirements of Material Specification 535, Preformed Expansion Joint Filler.

Filter fabric shall conform to Material Specification 592, Geotextile.

3. Laying the pipe

The pipe shall be set to the specified line and grade and temporarily supported on precast concrete blocks or wedges. Concrete blocks and wedges used to temporarily support the pipe during placement of concrete bedding or cradle, or both, shall be a class of concrete equal to or stronger than the concrete used to construct the bedding or cradle. Bell and spigot pipe shall be laid with the bells or grooves facing upstream unless otherwise specified in section 7 or shown on the drawings. Pipe may be installed by initially placing the upstream section of pipe and progressing with placement of the remaining sections of pipe in the downstream direction; however, care must be taken to avoid contaminating the joint with soil or bedding as the bell end is slid over the spigot of the adjoining pipe.

Just before each joint is connected, the connecting surface of the bell and spigot or spigots and sleeve shall be thoroughly cleaned and dried. Also, the rubber gasket and the inside surface of the bell or sleeve shall be lubricated with a light film of soft vegetable soap compound (flax soap). The rubber gasket shall be stretched uniformly as it is placed in the spigot groove to ensure a uniform volume of rubber around the circumference of the pipe.

Method 1—The joint shall be connected by sliding the bell over the spigot or by sliding the spigot into the bell and applying a pulling or jacking force in a manner that will allow the spigot to enter squarely into the bell.

Method 2—The joint shall be connected in accordance with the manufacturer's instructions.

Use with either method—When the spigot has been seated to within 0.5 inch of its final position, the position of the gasket in the joint shall be checked around the entire circumference of the pipe by means of a metal feeler gauge. In any case where the gasket is found to be displaced, the joint shall be disengaged and properly reconnected. After the position of the gasket has been checked, the spigot shall be completely pulled into the bell and the section of pipe shall be adjusted to line and grade.

4. Filling joints

Before the placement of the bedding or cradle, the exterior annular space between the ends of the pipe sections shall be cleaned and completely filled with joint sealing compound. Before the compound is applied, the surface against which it is to be placed shall be cleaned of all dust, lubricant, and other substances that would interfere with a bond between the compound and the pipe. If recommended by the manufacturer of the compound, the con-

crete surface shall be coated with a primer in accordance with the manufacturer's recommendations. Primers shall be applied to the concrete surface only and shall not come in contact with the gasket or gasket sealing surface. Unless the compound or primer is specifically recommended for use on moist concrete, the surface shall be dry when the compound or primer is applied.

The joint sealing compound shall be allowed to cure until it is sufficiently firm to prevent the entry of concrete or earth into the joint. Unless otherwise specified in section 7 of this specification, before placing bedding or earth backfill (excluding concrete) containing particles larger than 0.25 inch in maximum dimension within 6 inches of the joint sealing compound, the compound shall be covered with a strip of 16-gauge to 24-gauge metal at least 2-inches wider than the space between the ends of the pipe sections. Instead of metal strips, the joints shall be covered by a minimum of 2-foot-wide, 4-ply thick filter fabric. Filter fabric shall be wrapped completely around the joint and overlapped a minimum of 12 inches at the top of the pipe. Lap shall be securely fastened to ensure filter fabric fits snugly during backfill operations. Filter fabric is centered on the joint. It shall conform to Material Specification 592, table 2, Nonwoven, class II.

5. Pressure testing

Method 1—Pressure testing of the completed conduit is not required.

Method 2—Before placing any concrete or earthfill around the conduit or filling the pipe joints, the conduit shall be tested for leaks in the following manner:

The ends of the conduits shall be plugged and a standpipe with a minimum diameter of 2 inches shall be attached to the upstream plug. The conduit shall be braced at each end to prevent slippage. The conduit and the standpipe shall be filled with water. The water level in the standpipe shall be maintained at least 10 feet above the invert of the upstream end of the conduit for at least 2 hours. Any leaks shall be repaired, and the conduit shall be tested again as described. The procedure shall be repeated until the conduit is watertight.

The pipe joints shall show no leakage. Damp spots developing on the surface of the pipe are not considered as leakage.

Method 3—Before placing any concrete or earthfill around the conduit or filling the pipe joints, the conduit shall be air tested in accordance with ASTM C924. The conduit shall be braced on each end to prevent slippage. All end plugs used for the air test shall be capable of resisting the internal pressure and must be securely braced.

All testing equipment to be used shall be furnished by the contractor and shall be inspected and approved by the engineer. The pressure gauges used shall be graduated to read in increments of 0.1 pounds per square inch and calibrated to provide accuracy within 10 percent plus or minus of the standard gauge. The contractor has the option of prewetting the conduit or line before testing. Any conduit that fails to pass this test must be repaired by a method satisfactory to the engineer. After the repairs are made, the conduit shall be retested until it passes the test requirements.

Method 4—Before placing concrete or earth backfill around the conduit joint to be tested or filling the pipe joints, the joint shall be tested in accordance to ASTM C 1103, Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Sewer Line. The test pressure shall be as specified in section 7 of this specification. Any joints showing leaks shall be relaid or repaired, and the joint shall be retested. The procedure shall be repeated until the joint passes the test.

6. Measurement and payment

Method 1—For items of work for which specific unit prices are established in the contract, the quantity of each size, type, and class of pipe is determined to the nearest 0.1 foot by measurement of the laid length of pipe along the invert centerline of the conduit. Payment for each size, type, and class of reinforced concrete pressure pipe is made at the contract unit price for that size, type, and class of pipe. Such payment constitutes full compensation for furnishing, transporting, and installing the pipe complete in place. This includes accessories, such as wall fittings, joint gaskets, coupling bands, sleeves, or collars, and all other items necessary and incidental to the completion of the work except the special fittings and appurtenances listed separately in the bid schedule. Payment for each special fitting and appurtenance is made at the contract price for that type and size of fitting or appurtenance.

Method 2—For items of work for which specific unit prices are established in the contract, the quantity of each size, type, and class of pipe is determined as the sum of the nominal laying lengths of the pipe sections used. Payment for each size, type, and class of reinforced concrete pressure pipe is made at the contract unit price for that size, type, and class of pipe. Such payment constitutes full compensation for furnishing, transporting, and installing the pipe complete in place. This includes accessories, such as wall fittings, joint gaskets, coupling bands, sleeves or collars, and all other items necessary and incidental to the completion of the work except the special fittings and appurtenances listed separately in the bid schedule. Payment for each special fitting and appurtenance is made at the contract price for that type and size of fitting and appurtenance.

All Methods—The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed in the bid schedule, is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 7 of this specification.

7. Items of work and construction details

7. Items of Work and Construction Details

In Section 3, Laying the pipe, Method 1 shall apply.

In Section 5, Pressure testing, Method 1 shall apply.

In Section 6, Measurement and payment, Method 2 shall apply.

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item 26, Concrete Pressure Pipe, C301, 48" ID

- (1) This item shall consist of furnishing and installing the 48-inch I.D. conduit for the new principal spillway as shown on the drawings.
- (2) The drawings are presented for conduit assembly consisting of basic pipe sections, 10 feet in length. Pipe sections of other lengths shall not be used unless approved by the Engineer. Where the length of the pipe section furnished differs from the basic 10 feet length, the resulting total length of the principal spillway conduit shall not be less than that specified on the drawings.
- (3) Each section of pipe shall be supported at minimum of two locations along its length. The supports should be located no further than 2 feet from each end of a section. Methods of support which allow the weight of the pipe to bear on the pipe joint will not be permitted. Supports shall be support blocks or opposing wedges as shown on the drawings.

Construction Specification 45—Plastic Pipe

1. Scope

The work consists of furnishing and installing plastic pipe (except corrugated polyethylene pipe) and the necessary fittings and appurtenances as shown on the drawings or as specified herein.

2. Material

Pipe, fittings, and gaskets shall conform to the requirements of Material Specification 547, Plastic Pipe, and as specified in section 14 of this specification or as shown on the drawings.

Perforated pipe shall conform to the requirements of Material Specification 547, Plastic Pipe, and as specified in section 14 of this specification or as shown on the drawings.

Unless otherwise specified, concrete shall conform to the requirements of Construction Specification 32, Structure Concrete, and section 8 of this specification.

Unless otherwise specified, earth backfill shall conform to the requirements of Construction Specification 23, Earthfill.

Unless otherwise specified, drainfill shall conform to the requirements of Construction Specification 24, Drainfill.

3. Handling and storage

Pipe shall be delivered to the job site and handled by means that provide adequate support to the pipe and do not subject it to undue stresses or damage. When handling and placing plastic pipe, care shall be taken to prevent impact blows, abrasion damage, and gouging or cutting (by metal edges and/or surface or rocks). The manufacturer's special handling requirements shall be strictly observed. Special care shall be taken to avoid impact when the pipe must be handled at a temperature of 40 degrees Fahrenheit or less.

Pipe shall be stored on a relatively flat surface so that the barrels are evenly supported. Unless the pipe is specifically manufactured to withstand exposure to ultraviolet radiation, it shall be covered with an opaque material when stored outdoors for 15 days or longer.

4. Excavation

Excavation shall be in accordance with Construction Specification 21, Excavation, and section 14 of this specification or as shown on the drawings.

The pipe foundation shall be excavated a minimum of 4 inches lower than the pipe grade shown on the drawings or staked in the field whenever bedrock, boulders, cobbles, or other material that may cause pipe damage is encountered at planned pipe grade.

5. Laying the pipe

Plastic pipe conduits complete with fittings and other related appurtenances shall be installed to the lines and grades shown on the drawings or specified in section 14 of this specification. The pipe shall be installed so that there is no reversal of grade between joints unless otherwise shown on the drawings. The pipe shall not be dropped or dumped on the bedding or into the pipe trench. The ground surface near the pipe trench shall be free of loose rocks and stones greater than 1 inch in diameter. This ensures that rock will not be displaced and impact the pipe.

Just before placement, each pipe section shall be inspected to ensure that all foreign material is removed from inside the pipe. The pipe ends and the couplings shall be free of foreign material when assembled. At the completion of a work shift, all open ends of the pipeline shall be temporarily closed off using a suitable cover or plug.

Care shall be taken to prevent distortion and damage during hot or cold weather. During unusually hot weather (daytime high temperature of more than 90 °F), the pipe assembled in the trench shall be lightly backfilled or shaded to keep it as near to ground temperature as possible until final backfill is placed. Backfill operations should be performed during daily construction periods when the ground temperature and the temperature of the pipe do not vary more than 40 degrees Fahrenheit.

Perforated pipe shall be installed with the perforations down and oriented symmetrically about the vertical centerline. Perforations shall be clear of any obstructions on the inside and outside of the pipe when the pipe is approved by the engineer for backfill.

During installation, the pipe shall be firmly and uniformly bedded throughout its entire length, to the depth and in the manner specified in section 14 of this specification or as shown on the drawings. Bell-holes shall be placed in bedding material under bells, couplings, and other fittings to assure the pipe is uniformly supported throughout its entire length. Blocking or mounding beneath the pipe to bring the pipe to final grade is not permitted.

6. Pipe embedment

Earth bedding—The pipe shall be firmly and uniformly placed on compacted earthfill bedding or an inplace earth material bedding of ample bearing strength to support the pipe without noticeable settlement. The earth material on which the pipe is placed shall be of uniform density to prevent differential settlement.

Unless otherwise specified, a groove that closely conforms to the outside surface of the pipe shall be formed in the bedding. The depth of the groove shall be equal to or greater than 0.3 of the pipe diameter.

Earth bedding shall be compacted to a density not less than adjacent undisturbed inplace earth material or be compacted earth backfill. Earthfill material used for compacted earth bedding shall be free of rocks or stones greater than 1 inch in diameter and earth clods greater than 2 inches in diameter. The pipe shall be loaded sufficiently during the compaction of bedding under the haunches and around the sides of the pipe to prevent displacement from its final approved placement.

Sand, gravel, or crushed rock bedding—When sand, gravel, or crushed rock bedding is specified, the pipe shall be firmly and uniformly placed on the bedding material. Material for bedding shall not exceed 1 inch in diameter. Unless otherwise specified in section 14 of this specification or shown on the drawings, the coarse-grained bedding material shall be carefully placed and compacted to a depth equal to or greater than 0.3 of the diameter of the pipe above the bottom of the pipe. The pipe shall be loaded sufficiently during backfilling and compaction around the sides to prevent displacement of the pipe from its final approved placement.

Pipe encased in drainfill—The pipe shall be firmly and uniformly placed on bedding of specified drainfill. Drainfill shall be placed and compacted as specified in section 14 of this specification or as shown on the drawings to form a continuous uniform support around the entire circumference of the pipe. The pipe shall be loaded sufficiently during backfilling around the sides and during compaction to prevent displacement of the pipe.

7. Backfill

Initial backfill—Unless otherwise specified, initial backfill to 6 inches above the top of the conduit is required. Earth haunching and initial backfill material shall consist of soil material that is free of rocks, stones, or hard clods more than 1 inch in diameter. Coarse backfill material shall be the specified sand, gravel, crushed rock, or drainfill material.

Initial backfill shall be placed in two stages. In the first stage (haunching), backfill is placed to the pipe spring line (center of pipe). In the second stage, it is placed to 6 inches above the top of the pipe.

The first stage material shall be worked carefully under the haunches of the pipe to provide continuous support throughout the entire pipe length. The haunching backfill material shall be placed in layers that have a maximum thickness of about 6 inches and are compacted as specified in section 14 of this specification or as shown on the drawings. During compaction operations, care shall be taken to ensure that the tamping or vibratory equipment does not come in contact with the pipe and the pipe is not deformed or displaced.

When pressure testing is not specified, the pipe shall be covered with a minimum of 6 inches of backfill material as soon as possible following assembling of the pipe in the trench, but not later than within the same day that placement has occurred. When pressure testing is specified, sufficient backfill material shall be placed over the pipe to anchor the conduit against movement during pressure testing activities.

Final backfill—Final backfill shall consist of placing the remaining material required to complete the backfill from the top of the initial backfill to the ground surface, including mounding at the top of the trench. Final backfill material within 2 feet of the top of the pipe shall be free of debris or rocks larger than 3 inches nominal diameter. Coarse backfill material shall be the specified sand, gravel, crushed rock, or drainfill. Final backfill shall be placed in approximately uniform, compacted layers. Final backfill compaction requirements shall be as specified in section 14 of this specification or as shown on the drawings.

Vehicles or construction equipment shall not be allowed to cross the pipe until the minimum earth cover and required density as specified in section 14 of this specification has been obtained.

8. Pipe encasement in concrete

Concrete encasement shall be carefully placed to form a continuous uniform support around the entire circumference of the pipe as specified in section 14 of this specification or as shown on the drawings. Pipes encased in concrete shall be securely anchored to prevent movement of the pipe during concrete placement. A clear distance of 1.5 inch shall be maintained between the pipe and the reinforcing steel.

The concrete for the encasement shall conform to the requirements of Construction Specification 32, Structure Concrete, for Class 3000M concrete unless otherwise specified.

9. Joints

Unless otherwise specified in section 14 of this specification or shown on the drawings, joints shall be either bell and spigot type with elastomeric gaskets, coupling type, solvent cement bell and spigot, or jointed by butt heat fusion. When a lubricant is required to facilitate joint assembly, it shall be a type having no deleterious affect on the gasket or pipe material.

Pipe joints shall be watertight at the pressures specified except where unsealed joints are indicated.

Pipe shall be installed and joined in accordance with the manufacturer's recommendations. Laying deflections and joint fitting or stab depths shall be within the manufacturer's recommended tolerances.

When solvent cement joints are specified for PVC or ABS pipe and fittings, they shall be made in accordance with the following ASTMs and the related appendix of each ASTM; D 2855 for PVC pipe and fittings and D 2235 for ABS pipe and fittings.

Flanged, banded, heat-fusion, or elastomeric-sealed mechanical joints shall be used when joining polyethylene (PE) and high density polyethylene (HDPE) pipe and fittings unless otherwise specified in section 14 of this specification or as shown on the drawings.

Pipe ends shall be cut square and be deburred to provide a uniform, smooth surface for the jointing process. Reference marks shall be placed on the spigot ends to assist in determining when proper seating depth has been achieved within the joint.

10. Fittings

Unless otherwise specified, steel fittings, valves, and bolted connections shall be painted or coated as recommended by the manufacturer.

Fittings for nonpressure pipe shall be of the same or similar material as the pipe and shall provide the same durability, watertightness, and strength as the pipe unless otherwise specified.

11. Thrust blocks and anchors

When specified, concrete thrust blocks and anchors shall be installed as shown on the drawings or specified in section 14 of this specification.

The concrete for the thrust blocks and anchors shall conform to the requirements of Construction Specification 32, Structure Concrete, for Class 3000M concrete unless otherwise specified in section 14 of this specification.

The thrust block cavity shall be hand dug into undisturbed soil or previously placed compacted backfill. The cavity shall be formed with soil or wood to hold the freshly placed concrete without displacement until an initial set has occurred.

When excavation beyond the designated trench widths and depths as shown on the drawings or specified in section 14 of this specification occurs at locations where installation of concrete thrust blocks is required, the contractor shall install an alternative thrust block provision. The concrete thrust block shall have a thickness of one pipe diameter and a contact face area that shall be formed against the pipe as shown on the drawings or specified in section 14 of this specification. Backfill shall be placed on all sides of the thrust block and to the sides of the excavation. It shall be compacted as specified for initial backfill.

12. Pressure testing

Method 1—Pressure testing of the completed conduit is not required.

Method 2—The conduit shall be tested for leaks in the following manner:

a. Before pressure testing:

- (1) Joints of the assembled pipeline shall be allowed to cure as recommended by the manufacturer.
- (2) Pipeline shall be flushed and cleaned.
- (3) All concrete anchors and thrust blocks shall be in place and allowed to cure for a minimum of 3 days.
- (4) Earth backfill shall be sufficient to anchor the conduit against movement during the pressure testing and shall be compacted as specified in Section 14 of this specification or as shown on the drawings.

- (5) The conduit shall be braced, anchored, or both, at each end to restrict all potential pipe movement.
 - (6) The ends of the conduit shall be plugged. The upstream plug shall have a standpipe installed vertically having a minimum diameter of 2 inches and shall be equipped with a shutoff valve. All high points in the line shall be vented to evacuate air pockets. The conduit and the standpipe shall be slowly filled with water such that no air is entrapped during the filling operation. After filling is complete, all vents shall be closed.
- b. During pressure testing, the water level in the standpipe shall be continuously maintained at a minimum of 10 feet above the highest invert elevation of the conduit for no less than 2 hours unless otherwise specified in section 14 of this specification or as shown on the drawings.

The volume of water leakage in the 2-hour test period shall be recorded. The maximum allowable leakage (L) in gallons per hour shall not exceed 0.02 times the nominal pipe diameter (D) in inches for each 1,000 feet of pipe line, which is about 50 pipe joints ($L = 0.02 \times D$).

- c. When observed leakage exceeds the allowable, leaks shall be sealed by replacement of pipe and fittings as necessary. The conduit shall be retested as described above. This procedure shall be repeated until the conduit leakage does not exceed the allowable specified above.

The contractor shall be fully responsible for any and all work required to correct leakage exceeding the amount specified.

Method 3—The conduit shall be tested for leaks in the following manner:

- a. Before pressure testing:
- (1) Joints of the assembled pipeline shall be allowed to cure as recommended by the manufacturer.
 - (2) Pipeline shall be flushed and cleaned.
 - (3) All concrete anchor and thrust blocks shall be in place and allowed to cure for at least 3 days.
 - (4) Earth backfill shall be sufficient to anchor the conduit against movement during the pressure testing and compacted as specified in section 14 of this specification or as shown on the drawings.
 - (5) The conduit shall be braced and/or anchored at each end to prevent all potential pipe movement.
 - (6) The ends of the conduit shall be plugged, and a pressure gauge shall be attached to the upstream and downstream ends. All high points along the pipeline shall be vented to permit the complete removal of all air within the pipeline. The conduit shall be slowly filled with water such that no air is entrapped during the filling operations.
- b. The testing pressure specified in section 14 of this specification shall be continuously maintained at the upstream gauge for a minimum of 2 hours. The pressure at the downstream gauge shall not exceed the pressure rating of the pipe.
- c. The volume of water leakage for the 2-hour test period shall be recorded. Maximum allowable leakage shall be in accordance with the following:

Allowable leakage for plastic pipe
(gal/hr/1,000 feet, or 50 pipe joints) ^{1/}

Nominal pipe size (in)	Test pressure in the pipeline (lb/in ²)			
	50	100	150	200
	----- Allowable leakage -----			
4	.19	.27	.33	.38
6	.29	.41	.50	.57
8	.38	.54	.66	.76
10	.48	.68	.83	.96
12	.57	.81	.99	1.15
14	.67	.95	1.16	1.34
15	.72	1.02	1.25	1.44
16	.76	1.07	1.32	1.52
18	.86	1.22	1.49	1.72

1/ Computation basis

$$L = \frac{ND\sqrt{P}}{7,400}$$

where:

- L = allowable leakage in gallons per hour
N = number of joints (pipe and fittings)
D = nominal diameter of pipe in inches
P = test pressure in pounds per square inch

- d. When observed leakage exceeds the allowable, leaks shall be sealed by replacement of pipe and fittings as necessary. The conduit shall be retested as described in this section. The procedure shall be repeated until the conduit leakage does not exceed the allowable specified above.

The contractor shall be fully responsible for any and all work required to correct leakage exceeding the amount specified.

13. Measurement and payment

Method 1—For items of work for which specific unit prices are established in the contract, the quantity of each kind, size, and class of pipe is determined to the nearest foot by measurement of the laid length along the crown centerline of the conduit. Payment for each kind, size, and class of pipe is made at the contract unit price for that kind, size, and class. Such payment constitutes full compensation for furnishing, transporting, and installing the pipe including excavation, shoring, backfill, bedding, thrust blocks, and all fittings, appurtenances, and other items necessary and incidental to the completion of the work. Payment for appurtenances listed separately in the bid schedule is made at the contract prices for those items.

Method 2—For items of work for which specific unit prices are established in the contract, the quantity of each kind, size, and class of pipe is determined as the sum of the nominal laying lengths of the sections used. Payment for each kind, size, and class of pipe is made at the contract unit price for the kind, size, and class. Such payment constitutes full compensation for furnishing, transporting, and installing the pipe including excavation, shoring, backfill, bedding, thrust blocks, and all fittings, appurtenances, and other items necessary and incidental to the completion of the work. Payment for appurtenances listed separately in the bid schedule is made at the contract prices for those items.

Method 3—For items of work for which specific unit prices are established in the contract, the quantity of each kind, size, and class of pipe is determined to the nearest foot by measurement of the laid length along the crown centerline of the conduit. Payment for each kind, size, and class of pipe is made at the contract unit price for the kind, size, and class. Such payment constitutes full compensation for furnishing, transporting, and installing the pipe including shoring, all fittings, thrust blocks, appurtenances, and other items necessary and incidental to the completion of the work. Payment for appurtenances listed separately in the bid schedule is made at the contract prices for those items.

Method 4—For items of work for which specific unit prices are established in the contract, the quantity of each kind, size, and class of pipe is determined as the sum of the nominal laying lengths of the pipe sections used. Payment for each kind, size, and class of pipe is made at the contract unit price for that kind, size, and class. Such payment constitutes full compensation for furnishing, transporting, and installing the pipe including shoring, all fittings, thrust blocks, appurtenances, and other items necessary and incidental to the completion of the work. Payment for appurtenances listed separately in the bid schedule is made at the contract prices for those items.

Methods 3 and 4—Excavation, backfill, and bedding is paid separately under their respective bid items.

All measurement and payment methods—Compensation for any items of work described in the contract, but not listed in the bid schedule, is included in the payment for the item of work to which it is made subsidiary. Such items and items to which they are made subsidiary are identified in section 14 of this specification.

14. Items of work and construction details

14. Items of Work and Construction Details

In Section 2, Material, the P.V.C. plastic pipe shall be either AWWA C900, pressure class 150; ASTM D1785, Schedule 80; or ASTM D2241, SDR 17.

In Section 6, Pipe embedment, earth bedding and pipe encased in drainfill shall apply. In addition to the details stated in Section 6 for bedding of P.V.C. pipe, the bedding shall be as shown on the drawings.

In Section 7, Backfill:

- a. Initial backfill of P.V.C. pipe shall be as shown on the drawings and as specified in Section 6, Pipe embedment.
- b. Final backfill of P.V.C. pipe shall be as shown on the drawings and as specified in Section 6, Pipe embedment.
- c. Compaction of the initial and final backfill shall be as specified in Construction Specification 24 for drainfill and Construction Specification 23 for earth backfill.

In Section 10, Fittings, fittings shall be P.V.C. and shall have a design pressure rating and external load-carrying capacity equal to or exceeding that specified for the pipe to which it is attached. P.V.C. fittings shall be one-piece injection molded or fabricated from P.V.C. pipe and one-piece injection molded P.V.C. fittings. Fittings that are fabricated from one-piece injection molded P.V.C. manufactured for solvent weld construction shall have a maximum 2'-0" stub of spigot or bell, as appropriate, solvent welded in place to permit installation of elastomeric gasket bell and spigot pipe to maintain articulation. The stubs shall be selected to permit the bell to face upstream.

In Section 12, Pressure testing, Method 1 shall apply.

In Section 13, Measurement and payment, Method 3 shall apply.

In Material Specification 547, Section 3, Perforations, item c. shall not apply. Slotted pipe shall be used. Slot dimensions and geometry shall be as shown on the drawings.

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item 28, Plastic Pipe, PVC, 6" I.D.

- (1) This item shall consist of furnishing and installing the 6-inch diameter slotted and non-perforated P.V.C. and the 6-inch diameter ductile iron pipes along with all necessary fittings, couplings, and all other items and appurtenances necessary and incidental to completion of the work including but not limited to excavation, pipe bedding, backfill, earthwork and protection for outlets, as shown on the drawings.
- (2) This item shall consist of all 6-inch I.D. plastic pipe required for the principal spillway drainage system, RCC underdrains, foundation toe drains and principal spillway filter diaphragm outlet pipe as shown on the drawings.

- (3) The P.V.C. pipe shall have a minimum of 2 feet of cover before traversing wheeled equipment over the pipe.
- (4) The item of work subsidiary to this bid item is Ductile-Iron Pipe as specified in Construction Specification 53.

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Construction Specification 53—Ductile-Iron Pipe

1. Scope

The work consists of furnishing and installing ductile-iron pipe, fittings, and appurtenances as specified in section 9 of this specification and as shown on the drawings.

2. Material

Ductile-iron pipe and fittings shall conform to the requirements of Material Specification 553, Ductile-Iron Pipe. Thickness class of pipe and rated working pressure shall be as specified in section 9 of this specification or as shown on the drawings.

Unless otherwise specified, special fittings and appurtenances shall be the same material as the pipe.

3. Laying and bedding the pipe

Pipe shall be installed to the lines and grades shown on the drawings with bell socket ends aligned upstream unless otherwise specified. The pipe shall be installed in accordance with the manufacturer's recommendations, unless otherwise specified. Two copies of the pipe manufacturer's installation instructions shall be provided to the engineer before any pipe placement. The pipe shall be firmly and uniformly bedded within the trench throughout the entire length of the pipe section to the depth and in the manner specified. Bell holes for flanged, push-on, or mechanical joint pipe shall be provided as necessary to allow space for joint assembly and to permit the pipe barrel to be uniformly supported on the bedding.

4. Joints and connections

Pipe joints shall conform to the details shown on the drawings and shall be sound and watertight at the pressures specified in section 9 of this specification.

5. Handling the pipe

The contractor shall furnish all equipment and facilities needed to handle, store, and place the pipe without damaging the pipe, lining, encasement, or coating. Pipe coating, encasement, or lining that is damaged shall be repaired using methods recommended by the manufacturer unless otherwise specified in section 9 of this specification.

6. Pressure testing

Pressure testing of the conduit, when specified, shall be conducted as follows:

- a. Placement of backfill before pressure testing shall be as specified in section 7 of this specification.
- b. Before pressure testing, the pipeline shall be flushed and free of all foreign material.
- c. The pipeline shall not be pressure tested until concrete for anchor and thrust blocks has attained the minimum specified compressive strength unless other specified methods of thrust restraint are provided.
- d. The total conduit or continuous section of conduit to be tested shall be filled with clean water at a rate not to exceed the maximum specified and tested at the pressure(s) specified in section 9 of this specification.
- e. The section of conduit being tested shall be allowed to stand full of water for a minimum of 24 hours before the start of pressure and leakage tests. Test pressures shall be held constant for 2 hours. When the amount of water loss exceeds the maximum allowable loss specified in section 9 of this specification, the leak(s) shall be repaired or otherwise corrected and the conduit shall be re-tested. The testing procedure shall be repeated until the requirements of the specifications are met.

7. Backfill

Method 1—Backfill in accordance with section 9 of this specification shall be accomplished only in sufficient amount to hold the conduit in place during testing, with the following exceptions:

- a. Compacted backfill shall be placed to its final depth as shown on the drawings at vertical and horizontal deflection points, road crossings, and thrust blocks. Backfill shall be placed so that conduit and joint displacement does not occur.
- b. All joints and connections shall be completely exposed for visual observation during testing, except at locations described in the exception above.

Method 2—Backfill in accordance with section 9 of this specification shall be to the final depth as shown on the drawings for the section of conduit being tested.

Use with either method—The contractor shall be fully responsible for any and all work required to correct any leakage when the leakage test results in water loss that exceeds the amount specified in section 9 of this specification.

8. Measurement and payment

For items of work for which specific unit prices are established in the contract, the quantity of each size, and thickness class of pipe is determined to the nearest foot by measurement of the installed length of pipe along the crown centerline of the conduit. Payment for each size and thickness class of pipe is made at the contract unit price for that size and thickness class of pipe. Such payment constitutes full compensation for furnishing, transporting, handling, and installing the pipe and necessary fittings and appurtenances complete in place.

Compensation for any item of work described in the contract, but not listed, is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 9 of this specification.

9. Items of work and construction details

9. Items of Work and Construction Details

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Subsidiary Item, Ductile-Iron Pipe

- (1) This item shall consist of furnishing and installing the two, ten (10) feet long, 6-inch I.D. ductile iron pipes as the termination for the 6-inch I.D. P.V.C. filter diaphragm drain outfall line as described in the drawings.
- (2) Separate payment will not be made for this item of work. Compensation for this bid item will be included in the payment for Plastic Pipe, PVC, 6" I.D.

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Construction Specification 61—Rock Riprap

1. Scope

The work consists of the construction of rock riprap revetments and blankets, including filter or bedding where specified.

2. Material

Rock riprap must conform to the requirements of Material Specification 523, Rock for Riprap, or if so specified, must be obtained from designated sources. It must be free from dirt, clay, sand, rock fines, and other material not meeting the required gradation limits.

At least 30 days before rock is delivered from other than designated sources, the contractor must designate in writing the source from which rock material will be obtained and provide information satisfactory to the contracting officer that the material meets contract requirements. The contractor must provide the responsible engineer free access to the source for the purpose of obtaining samples for testing. The size and grading of the rock must be as specified in section 8.

Rock from approved sources must be excavated, selected, and processed to meet the specified quality and grading requirements at the time the rock is installed.

Based on a specific gravity of 2.65 (typical of limestone and dolomite) and assuming the individual rock is shaped midway between a sphere and a cube, typical size/weight relationships are:

Sieve size of rock	Approx. weight of rock	Weight of test pile
16 inches	300 pounds	6,000 pounds
11 inches	100 pounds	2,000 pounds
6 inches	15 pounds	300 pounds

When specified in section 8 or when it is necessary to verify the gradation of the rock riprap, a particle size analysis must be performed in accordance with ASTM D5519, Test Method A or B. The analysis must be performed at the work site on a test pile of representative rock. The mass of the test pile must be at least 20 times the mass of the largest rock in the pile. The results of the test are compared to the gradation required for the project. Test pile results that do not meet the construction specifications must be cause for the rock to be rejected. The test pile that meets contract requirements must be left on the job site as a sample for visual comparison. The test pile must be used as part of the last rock riprap to be placed.

Filter or bedding aggregates when required must conform to Material Specification 521, Aggregates for Drainfill and Filters, unless otherwise specified. Geotextiles must conform to Material Specification 592, Geotextile.

3. Subgrade preparation

The subgrade surface on which the rock riprap, filter, bedding, or geotextile is to be placed must be cut or filled and graded to the lines and grades shown on the drawings. When fill to subgrade lines is required, it must consist of approved material and must conform to the requirements of the specified class of earthfill.

Rock riprap, filter, bedding, or geotextile must not be placed until the foundation preparation is completed and the subgrade surface has been inspected and approved.

4. Equipment-placed rock riprap

The rock riprap must be placed by equipment on the surface and to the depth specified. It must be installed to the full course thickness in one operation and in such a manner as to avoid serious displacement of the underlying material. The rock for riprap must be delivered and placed in a manner that ensures the riprap in place is reasonably homogeneous with the larger rocks uniformly distributed and firmly in contact one to another with the smaller rocks and spalls filling the voids between the larger rocks. Some hand placing may be required to provide a neat and uniform surface.

Rock riprap must be placed in a manner to prevent damage to structures. Hand placing is required as necessary to prevent damage to any new and existing structures.

5. Hand placed rock riprap

The rock riprap must be placed by hand on the surface and to the depth specified. It must be securely bedded with the larger rocks firmly in contact one to another without bridging. Spaces between the larger rocks must be filled with smaller rocks and spalls. Smaller rocks must not be grouped as a substitute for larger rock. Flat slab rock must be laid on its vertical edge except where it is laid like paving stone and the thickness of the rock equals the specified depth of the riprap course.

6. Filter or bedding

When the contract specifies filter, bedding, or geotextile beneath the rock riprap, the designated material must be placed on the prepared subgrade surface as specified. Compaction of filter or bedding aggregate is not required, but the surface of such material must be finished reasonably smooth and free of mounds, dips, or windrows.

7. Measurement and payment

Method 1—For items of work for which specific unit prices are established in the contract, the quantity of each type of rock riprap placed within the specified limits is computed to the nearest ton by actual weight. The volume of each type of filter or bedding aggregate is measured within the specified limits and computed to the nearest cubic yard by the method of average cross-sectional end areas. For each load of rock riprap placed as specified, the contractor must furnish to the responsible engineer a statement-of-delivery ticket showing the weight to the nearest 0.1 ton.

Payment is made at the contract unit price for each type of rock riprap, filter, or bedding. Such payment is considered full compensation for completion of the work.

Method 2—For items of work for which specific unit prices are established in the contract, the quantity of each type of rock riprap placed within the specified limits is computed to the nearest 0.1 ton by actual weight. The quantity of each type of filter or bedding aggregate delivered and placed within the specified limits is computed to the nearest 0.1 ton. For each load of rock riprap placed as specified, the contractor must furnish to the engineer a statement-of-delivery ticket showing the weight to the nearest 0.1 ton. For each load of filter or bedding aggregate, the contractor must furnish to the responsible engineer a statement-of-delivery ticket showing the weight to the nearest 0.1 ton.

Payment is made at the contract unit price for each type of rock riprap, filter, or bedding. Such payment is considered full compensation for completion of the work.

Method 3—For items of work for which specific unit prices are established by the contract, the volume of each type of rock riprap and filter or bedding aggregate is measured within the specified limits and computed to the nearest cubic yard by the method of average cross-sectional end areas.

Payment is made at the contract unit price for each type of rock riprap, filter, or bedding. Such payment is considered full compensation for completion of the work.

Method 4—For items of work for which specific unit prices are established by the contract, the volume of each type of rock riprap, including filter and bedding aggregate, is measured within the specified limits and computed to the nearest cubic yard by the method of average cross-sectional end areas.

Payment is made at the contract unit price for each type of rock riprap, including filter and bedding. Such payment is considered full compensation for completion of the work.

Method 5—For items of work for which specific unit prices are established by the contract, the quantity of each type of rock riprap placed within the specified limits is computed to the nearest ton by actual weight. For each load of rock for riprap placed as specified, the contractor must furnish to the responsible engineer a statement-of-delivery ticket showing the weight to the nearest 0.1 ton.

Payment is made at the contract unit price for each type of rock riprap, and includes compensation for any aggregate or geotextile installed as specified for filter or bedding. Such payment is considered full compensation for completion of the work.

Method 6—For items of work for which specific unit prices are established by the contract, the volume of each type of rock riprap is measured within the specified limits and computed to the nearest cubic yard by the method of average cross-sectional end areas.

Payment is made at the contract unit price for each type of rock riprap and includes compensation for any aggregate or geotextile installed as specified for filter or bedding. Such payment is considered full compensation for completion of the work.

All methods—The following provision applies to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed in the bid schedule, is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 8.

No separate payment is made for testing the gradation of the test pile. Compensation for testing is included in the appropriate bid item for riprap.

8. Items of work and construction details

8. Items of Work and Construction Details

In Section 7, Measurement and payment, Method 5 shall apply.

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. **Bid Item 28, Rock Riprap**

- (1) This item shall include furnishing and placing the rock riprap to construct the upstream wave protection, rock lined principal spillway outlet channel, rock lined auxiliary spillway outlet channel, the rock scour apron upstream, and the scour pad on the sides of the RCC auxiliary spillway as shown on the drawings.
- (2) Rock for use as riprap shall comply with the requirement of Material Specification 523, Rock Type 1.
- (3) The gradation requirements for rock placed at each location are shown on the construction drawings.
- (4) Prior to delivery of rock to the construction site, the Contractor shall provide a sample load of rock weighing at least five (5) tons and shall furnish certified test results (or other evidence satisfactory to the Engineer) showing that the rock sample furnished complies with the specified gradation. This rock sample shall be deposited on the construction site at designated location and maintained at this location until rock placement has been completed. This sample shall be used as a frequent reference for judging the gradation of the riprap supplied. Any difference of opinion between the Engineer and the Contractor concerning gradation of the riprap being delivered on the site shall be resolved by dumping and checking the gradation of one random truck load of riprap. In the event such additional checking procedure becomes necessary, the mechanical equipment, preparation of a sorting site, and labor needed to prove the gradation by weighing shall be provided by the Contractor at no additional cost.
- (5) If, at any time, the rock is delivered to the construction site, separation or segregation of the smaller rock fraction from the larger rock fraction has occurred, the rock shall be reworked as necessary to ensure a reasonably uniform distribution of the various sizes prior to placement of the rock. Due care shall be exercised during this rework operation (if required) to prevent inclusion of earth or other undesirable materials in the riprap.
- (6) Riprap delivery shall be made only during scheduled working hours, and delivery tickets shall be furnished to the Engineer.
- (7) Riprap may be equipment placed. Placement shall be accomplished by equipment capable of controlling the drop. The maximum drop is 3 feet and shall avoid damage to the geotextile. Equipment shall not be allowed on the rock during or after placement.
- (8) The item of work subsidiary to this bid item is Excavation, Common, Rock Riprap as specified in Construction Specification 21.

Construction Specification 71—Water Control Gates

1. Scope

The work consists of furnishing and installing water control gates including gate stems, hoists, lifts, and other appurtenances.

2. Material

The gates furnished shall conform to the requirements of Material Specifications 571, 572, and 573, as appropriate, and as specified in section 8 of this specification and on the drawings. All gates shall be furnished complete with hoisting equipment and other specified appurtenances.

3. Installing gates

The contractor shall install the gates in a manner that prevents leakage around the seats and binding of the gates during normal operation.

Surfaces of metal against which concrete will be placed shall be free from oil, grease, loose mill scale, loose paint, surface rust, and other debris or objectionable coatings.

Anchor bolts, thimbles, and spigot frames shall be secured in true position within the concrete forms and maintained in alignment during concrete placement.

Concrete surfaces against which rubber seals will bear or against which flat frames or plates are to be installed shall be finished to provide a smooth and uniform contact surface.

When a flat frame is installed against concrete, a layer of concrete mortar shall be placed between the gate frame and the concrete.

When a gate is attached to a wall thimble, a mastic or resilient gasket shall be applied between the gate frame and the thimble in accordance with the recommendations of the gate manufacturer.

Wall plates, sills, and pin brackets for radial gates shall be adjusted and fastened by grouting and bolting after the gates have been completely assembled in place.

4. Installing hoists and lifts

Gate stems, stem guides, and gate lifts shall be carefully aligned so that the stem shall be parallel to the guide bars or angles on the gate frame following installation.

5. Radial gate seals

The rubber seals for radial gates shall be installed so that the seals contact the walls or wall plates throughout the entire gate length when the gate is in the closed position.

6. Operational tests

After the gate(s) and hoist(s) (or lifts) have been installed, they shall be cleaned, lubricated, and otherwise serviced by the contractor in accordance with the manufacturer's instructions. The contractor shall test the gate and hoist by operating the system several times throughout its full range of operation. The contractor shall make any changes or adjustments necessary to ensure satisfactory operation of the complete gate system.

7. Measurement and payment

The number of each type, size, and class of gate is counted. Payment for furnishing and installing each type, size, and class of gate shall be made at the contract unit price for that type, size, and class of gate. Such payment constitutes full compensation for all labor, equipment, material, and all other items necessary and incidental to the completion of the work including furnishing and installing anchor bolts and all specified appurtenances and fittings.

Compensation for any item of work described in the contract, but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and items to which they are made subsidiary are identified in section 8 of this specification.

8. Items of work and construction details

8. Items of Work and Construction Details

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item 30, Water Control Slide Gate, 12" x 12"

- (1) This item shall consist of furnishing and installing the 12" x 12" slide gate on the principal spillway inlet including the wall thimble, gate, stem, stem guides, lift pedestal, hand wheel, wedges, and all associated appurtenances.
- (2) The gate shall conform to the requirements of Material Specification 571 for Type MHS-2, and shall be Class 55-20, Square Opening.
- (3) Anchor bolts shall be stainless steel.
- (4) The gate frame shall be of the flat back or flange back type.
- (5) The gate stem shall be the rising type and shall be stainless steel and be of sufficient diameter as recommended by the manufacturer to withstand the thrusts encountered in operation of the specified type and class gate.
- (6) Stem guides shall be adequately spaced and of sufficient number as recommended by the manufacturer to properly support the stem during operation of the gate.
- (7) The wall bracket shall be as recommended by the manufacturer.
- (8) Hoist or lift shall be of the handwheel type as recommended by the manufacturer.
- (9) The gate shall be designed to operate satisfactorily at any degree of opening.
- (10) The wall thimble shall be of cast iron and shall be Type F, 12 inches in length and shall have a square opening.
- (11) All bolts shall be furnished with flat washers and lock washers or with flat washers and double nuts for lock nuts. All washers and nuts shall be of the same materials and have the same coatings as the bolts on which applied.

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Construction Specification 81—Metal Fabrication and Installation

1. Scope

The work consists of furnishing, fabricating, and erecting metalwork, including the metal parts and fasteners of the composite structures.

2. Material

Unless otherwise specified, material shall conform to the requirements of Material Specification 581, Metal. Steel shall be structural quality unless otherwise specified. Castings shall be thoroughly cleaned and subjected to careful inspection before installation. Finished surfaces shall be smooth and true to assure proper fit. Galvanizing shall conform to the requirements of Material Specification 582, Galvanizing.

3. Fabrication

Fabrication of structural steel shall conform to the requirements of Specification for the Design, Fabrication and Erection of Structural Steel for Buildings (Riveted, Bolted and Arc-Welded Construction), American Institute of Steel Construction.

Fabrication of structural aluminum shall conform to the requirements in the Aluminum Design Manual available from The Aluminum Association.

4. Erection

The frame of metal structures shall be installed true and plumb. Temporary bracing shall be placed wherever necessary to resist all loads to which the structure may be subjected, including those applied by the installation and operation of equipment. Such bracing shall be left in place as long as may be necessary for safety.

As erection progresses the work shall be securely bolted up, or welded, to resist all dead load, wind, and erection stresses. The contractor shall furnish such installation assisting bolts, nuts, and washers as may be required.

No riveting or welding shall be performed until the structure is stiffened and properly aligned.

Rivets driven in the field shall be heated and driven with the same care as those driven in the shop.

All field welding shall be performed in conformance to the requirements for shop fabrication except those that expressly apply to shop conditions only.

5. Protective coatings

Items specified to be galvanized shall be completely fabricated for field assembly before the application of the zinc coatings. Galvanized items shall not be cut, welded, or drilled after the zinc coating is applied.

Items specified to be painted shall be painted in conformance to the requirements of Construction Specification 82 for the specified paint systems.

6. Measurement and payment

Method 1—The work is not measured. Payment for metal fabrication and installation is made at the contract lump sum price in the contract. Such payment constitutes full compensation for all labor, equipment, material, and all other items necessary and incidental to the completion of the work including connectors and appurtenances, such as rivets, bolts, nuts, pins, studs, washers, hangers, and weld metal.

Method 2—The weight of metal installed complete in place shall be determined to the nearest pound. Unless otherwise specified, the weight of metal shall be computed by the method specified in section 3 of the Code of Standard Practice for Steel Buildings and Bridges, American Institute of Steel Construction, except that the following unit weights shall also be used, as appropriate, as the basis of computation:

Material	Unit weight (lb/ft ³)
Aluminum alloy	173
Bronze or copper alloy	536
Iron, malleable	470
Iron, wrought	487

Payment for furnishing, fabricating, and installing metalwork is made at the contract unit price for the specified types of labor, material, equipment, and all other items necessary and incidental to the completion of the work.

Method 3—The work is not measured. Payment for furnishing, fabricating, and installing each item of metalwork is made at the contract price for that item. Such payment constitutes full compensation for all labor, equipment, material, and all other items necessary and incidental to the completion of the work including connectors and appurtenances, such as rivets, bolts, nuts, pins, studs, washers, hangers, and weld metal.

All methods—The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed in the bid schedule, is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 7 of this specification.

7. Items of work and construction details

7. Items of Work and Construction Details

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item 31, Metal Fabrications

- (1) This item shall consist of furnishing, fabricating, and installing metal works for the following:
 - (a) Trash rack for the new principal spillway inlet;
 - (b) Manhole frame and cover for the new principal spillway inlet;
 - (c) Metal frames and covers for the RCC drainage system cleanouts, including concrete completion;
 - (d) Rodent guards for drain outfalls through principal spillway impact basin and outfalls on RCC spillway.
- (2) In Section 6, Measurement and payment, Method 1 shall apply. Payment for this bid item shall include full compensation for the concrete required for the foundation cleanout covers as shown in the construction drawings.
- (3) All metal parts shall be galvanized after fabrication, with the exception of the manhole and cleanout frames and covers and any stainless steel hardware.
- (4) Submit shop drawings of all fabricated steel and miscellaneous metalwork items for review and approval by the Contracting Officer or Engineer including all dimensions, sizes, finishes, fasteners, welds, and relationship of work to adjoining construction. Riveted connections will not be permitted.
- (5) For standard manufactured items, submit catalog worksheets showing illustrated cuts of items to be furnished, including scale details, dimensions, and materials of construction for review and approval by the Contracting Officer or Engineer.
- (6) The rodent guards shall be fabricated as shown on the drawings. The metal straps and bars shall be galvanized or painted with two coats of zinc oxide paint after fabrication. The guards shall be bolted to the impact basin sidewalls as shown on the drawings to allow for periodic inspection and maintenance of the outfall pipes.
- (7) The principal spillway inlet structure manhole cover shall be Neenah Foundry Company R-6078 round series with Type E locking device including stainless steel cap screws or equivalent as approved by the Contracting Officer or Engineer. If an approved equivalent is used, it shall have a similar locking device.
- (8) The foundation toe drain cleanout casings shall be galvanized (ASTM A123) Schedule 40, steel round or square tubes cut at a 45-degree angle for a flush mount. The cleanout covers shall be lockable, hinged, watertight lids secured either to the casing or concrete pad. Provide padlocks for each cleanout location. All padlocks shall be keyed the same. R-1470-E

- (9) Metalwork with damaged galvanized surfaces shall be repaired or replaced at no additional cost to the Owner. Field repairs of galvanized surfaces shall be made using “Galvinox,” “Galvo-Weld,” or similar commercially available galvanizing repair material meeting the requirements of Mil Spec P-21035 and must contain a minimum of 90 percent zinc by weight in dry film. Apply in accordance with the manufacturer’s instructions.
- (10) Epoxy grout shall be fast curing, no sag, and no drip. It should be able to be installed in damp holes, and in a temperature range of 104°F down to 23°F. The epoxy shall be capable of developing the ultimate strength of the embedded anchor when installed in Class 4000 concrete.

b. Subsidiary Item, Fence Stiles

- (1) This item shall consist of furnishing, fabricating, galvanizing, and installing the fence stile as shown on the drawings.
- (2) Separate payment will not be made for this item of work. Compensation for this item will be included in the payment for the bid item for Fence, Barbed Wire.

c. Subsidiary Item, Chain Link Fence Post Base Plates

- (1) This item shall consist of furnishing, fabricating, galvanizing, and installing the chain link fence post base plates as shown on the drawings.
- (2) Separate payment will not be made for this item of work. Compensation for this item will be included in the payment for the bid item for Fence, Chain Link.

Construction Specification 91—Chain Link Fence

1. Scope

The work consists of furnishing and installing chain link fencing complete with all posts, braces, gates, and all other appurtenances.

2. Material

The material for the chain link fence must be as follows:

Galvanized

Chain link fence fabric must conform to the requirements of ASTM A392, 2-inch mesh and 9-gauge galvanized steel wire. Zinc coating must be class 2.

Posts and fence framework must conform to the requirements of ASTM F1043 Group 1A, for Heavy Industrial Fence. Coatings must be a type A galvanized coating for internal and external surfaces. Steel pipe posts must conform to the requirements of ASTM F1043 and F1083.

Fence fittings must conform to the requirements of ASTM F626. Fittings must be galvanized steel. Wire ties and clips must be 9 gauge.

Gates, gateposts, and gate accessories must conform to the requirements of ASTM F900. Coating must be the same as selected for adjoining fence and framework.

Barbed wire must be 12.5 gauge and must conform to the requirements of ASTM A121, chain link fence grade.

Galvanized and PVC coated

Chain link fence fabric must conform to the requirements of ASTM F668 for class 2a or 2b, 2-inch mesh, and 9-gauge galvanized steel wire. The fabric must have a polymer top coating of the color specified in section 6.

Posts and fence framework must conform to the requirements of ASTM F1043 Group 1A, for Heavy Industrial Fence. Coatings must be a type-A galvanized coating for internal and external surfaces and covered with a polymer top coating of color as specified in section 6.

Fence fittings must conform to the requirements of ASTM F626. Fittings must be galvanized steel with a polymer top coating of color as specified in section 6.

Any damage to the coating must be repaired in accordance with the manufacturer's recommendations, or the damaged fencing material must be replaced. The contractor must provide the engineer a copy of the manufacturer's recommended repair procedure and materials before correcting damaged coatings.

3. Installing fence posts

Unless otherwise specified, line posts must be placed at intervals of 10 feet measured from center to center of adjacent posts. In determining the post spacing, measurement is made parallel with the ground surface.

Posts must be set in concrete backfill in the manner shown on the drawings.

Posts set in the tops of concrete walls must be grouted into preformed holes to a depth of 12 inches.

Posts may be attached to base plates that are bolted to the concrete. Bolts must be epoxied into drilled holes to a depth recommended by the bracket manufacturer. Alternatively, the base plates may have a stem that is epoxied into a hole in the concrete or a saddle that is bolted with a minimum of two bolts that pass from side to side through the wall. Bolts must be stainless steel with stainless steel lock washers and nuts.

All corner posts, end posts, gateposts, and pull posts must be embedded, braced, and trussed as shown on the drawings or in accordance with appropriate industry practice if not otherwise shown or specified.

4. Installing wire fabric

Fencing fabric must not be stretched until at least 4 days after the posts are grouted into walls or 7 days after the posts are set in the concrete backfill.

Fencing fabric must be installed on the side of the posts designated on the drawings.

The fabric must be stretched taut and securely fastened by means of tie clips to the posts at intervals not exceeding 15 inches and to the top rails or tension wires at intervals not exceeding 2 feet. Care must be taken to equalize the fabric tension on each side of each post.

Barbed wire must be installed as shown on the drawings and must be pulled taut and fastened to each post or arm with the tie wires or metal tie clips.

5. Measurement and payment

Method 1—The length of fence is measured to the nearest 0.1 foot along the fence, including gates. Payment is made at the contract unit price for the specified height of fence. Such payment constitutes full compensation for all labor, material, equipment, and all other items necessary and incidental to the completion of the work.

Method 2—The length of fence is measured to the nearest 0.1 foot along the fence, excluding gate openings. Payment is made at the contract unit price for the specified height of fence. The number of each size and type of gate installed is determined. Payment is made at the contract unit price for that type and size of gate. Such payment constitutes full compensation for all labor, material, equipment, and all other items necessary and incidental to the completion of the work.

All methods—The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed in the bid schedule, is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 6 of this specification.

6. Items of work and construction details

6. Items of Work and Construction Details

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item 32, Fence, Chain Link

- (1) This item shall consist of furnishing all materials required and all work necessary for the installation of the chain link fence for the principal spillway impact basin and auxiliary spillway sidewalls as shown on the drawings.
- (2) In Section 2, Material, chain link fence fabric shall be Galvanized only and not PVC coated.
- (3) The chain link fence posts shall be installed as shown on the drawings.
- (4) Standard of Manufacture: Standards of Manufacture for fence and gates shall comply with the standards of the Chain Link Fence Manufacturer's Institute Product Manual and applicable referenced ASTM standards.
- (5) Provide chain link fence as a complete unit produced by a single manufacturer, including necessary erection accessories, fittings, and fastenings.
- (6) Contractor shall have been in the fence installation business for at least two years. Contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.
- (7) Deliver materials and accessories in packed cartons or firmly tied rolls, in an undamaged condition. Equipment shall be delivered in original packages with labels intact and identification clearly marked.
- (8) Materials and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants.
- (9) Upon receipt at the job site, all materials and components shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism, and theft.
- (10) Materials or components damaged prior to acceptance shall be replaced at no cost to the Contracting Local Organization.
- (11) In Section 5, Measurement and payment, Method 1 shall apply.
- (12) Item of work subsidiary to this bid item are:
 - (a) Chain Link Fence Post Base Plates as specified in Construction Specification 81 as it applies to this bid item.

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Construction Specification 92—Field Fence

1. Scope

The work shall consist of furnishing and installing field fence, including gates and fittings.

2. Material

Material for field fence shall conform to the requirements of Material Specification 591. All wooden posts shall be of the same species, when available.

Unless otherwise specified, surfacing, cutting, and boring of preservative treated wooden posts and braces shall be completed before treatment. If field cutting or field repair of treated material is approved, all cuts and abrasions shall be carefully trimmed and coated with copper naphthenate preservative containing a minimum of 2.0 percent copper metal. The treatment preservative shall be applied according to the product label. Any excess preservative not absorbed by the wood member shall be cleaned from the surface prior to the use of the member. Bored holes for connectors or bolts may be treated by pumping coal-tar roofing cement meeting ASTM D5643 into the holes using a caulk gun or similar device. After assembly, any unfilled holes shall be plugged with tightly fitting wooden plugs that have been treated with preservative as specified.

3. Setting posts

Concrete or wood posts shall be set in holes and backfilled with earth except where otherwise specified. Wood posts may be driven when approved by the engineer. Steel posts shall be driven unless otherwise specified.

Holes for installing fence posts shall be at least 6 inches larger than the diameter or side dimension of the posts.

Earth backfill around posts shall be thoroughly tamped in layers not thicker than 4 inches and shall completely fill the posthole up to the ground surface. Concrete backfill around posts shall be rodded into place in layers not thicker than 12 inches and shall completely fill the posthole to the surface of the ground. Backfill, either earth or concrete, shall be crowned-up around posts at the ground surface.

No stress shall be applied to posts set in concrete for a period of not less than 24 hours following the development of a firm set of the concrete.

4. Corner assembly

Unless otherwise specified in section 11, corner assemblies shall be installed at all points where the fence alignment changes 15 degrees or more.

5. End panels

End panels shall be built at gates and fence ends.

6. Pull post assembly

Pull post assembly (bracing within a section of straight fence) shall be installed at the following locations:

- a. In straight fence sections, at intervals not to exceed 660 feet.
- b. At any point where the vertical angle described by two adjacent reaches of wire is upward and exceeds 10 degrees (except as provided in section 11 of this specification).
- c. At the beginning and end of each curved fence section.

7. Attaching fencing to posts

The fencing shall be stretched and attached to posts as follows:

- a. The fencing wire or netting shall be placed on the side of the post opposite the area being protected except for installation along curved sections.
- b. The fencing wire or netting shall be placed on the outside for installation along curved sections.
- c. The fencing wire or netting shall be fastened to each end post, corner post, and pull post by wrapping each horizontal strand around the post and tying it back on itself with not less than three tightly wound wraps.
- d. The fencing wire or netting shall be fastened to wooden line posts by means of steel staples. Woven-wire fencing shall be attached at alternate horizontal strands. Each strand of barbed wire shall be attached to each post. Steel staples shall be driven diagonally with the grain of wood and at a slight downward angle and shall not be driven so tightly as to bind the wire against the post.
- e. The fencing wire or netting shall be fastened to steel or concrete line posts with either two turns of 14 gauge galvanized steel or iron wire or in accordance with recommendations provided by the post's manufacturer.
- f. Wire shall be spliced by means of a Western Union splice or by suitable splice sleeves applied with a tool designed for that purpose. The Western Union splice shall have no less than eight wraps of each end about the other. All wraps shall be tightly wound and closely spaced. Splices made with splice sleeves shall have a tensile strength no less than 80 percent of the strength of the wire being spliced.

8. Stays

Stays shall be attached to the fencing at the spacing outlined in section 11 or as shown on the drawings to ensure maintenance of the proper spacing of the fence wire strands.

9. Crossings at depressions and watercourses

Where fencing is installed parallel to the ground surface, the line posts subject to upward pull shall be anchored.

- a. If the fence wire or netting is installed parallel to the ground surface, the line posts subject to uplift shall be anchored by means of extra embedment or by special anchors as detailed on the drawings.
- b. If the fence wire is installed with the top wire straight and parallel to the ground surface on either side of the depression, extra length posts shall be used to allow normal post embedment. Unless otherwise specified, excess space between the bottom of the fence and the ground shall be closed with extra strands of barbed wire or with netting.

10. Measurement and payment

Method 1—The length of each type and kind of fence is measured to the nearest foot along the profile of the fence, including gate openings. Payment for each type and kind of fence is made at the contract unit price for that type and kind of fence. Such payment constitutes full compensation for completion of the work, including fabricating and installing gates.

Method 2—The length of each type and kind of fence is measured to the nearest foot along the profile of the fence, excluding gate openings. Payment is made at the contract unit price for the specified height of fence. The number of each size and type of gate installed is determined. Payment is made at the contract unit price for that type and size of gate. Such payment constitutes full compensation for all labor, material, equipment, and all other items necessary and incidental to the completion of the work.

All methods—The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed in the bid schedule, is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 11 of this specification.

11. Items of work and construction details

11. Items of Work and Construction Details

In Section 10, Measurement and payment, Method 1 shall apply.

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item 33, Fence, Barbed Wire

- (1) This item shall consist of furnishing all materials required and constructing fences of the type designated on the drawings. This item shall include (7) gates in locations shown on drawings.
- (2) The approximate location of the fences to be constructed is shown on the construction drawings. The final location of the fences (including corners, gates, pull and brace panels, stiles and special anchorage) shall be as staked by the Engineer.
- (3) The items of work subsidiary to this bid item are Fence Stiles as specified in Construction Specification 81.

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Construction Specification 94—Contractor Quality Control

1. Scope

The work consists of developing, implementing, and maintaining a quality control system to ensure that the specified quality is achieved for all materials and work performed.

2. Equipment and materials

Equipment and material used for quality control shall be of the quality and condition required to meet the test specifications cited in the contract. Testing equipment shall be properly adjusted and calibrated at the start of operations and the calibration maintained at the frequency specified. Records of equipment calibration tests shall be available to the engineer at all times. Equipment shall be operated and maintained by qualified operators as prescribed in the manufacturer's operating instructions, the references specified, and as specified in section 10 of this specification. All equipment and materials used in performing quality control testing shall be as prescribed by the test standards referenced in the contract or in section 10.

All equipment and materials shall be handled and operated in a safe and proper manner and shall comply with all applicable regulations pertaining to their use, operation, handling, storage, and transportation.

3. Quality control system

Method 1—The contractor shall develop, implement, and maintain a system of quality control to provide the specified material testing and verification of material quality before use. The system activities shall include procedures to verify adequacy of completed work, initiate corrective action to be taken, and document the final results. The identification of the quality control personnel and their duties and authorities shall be submitted to the contracting officer in writing within 15 calendar days after notice of award.

Method 2—The contractor shall develop, implement, and maintain a system adequate to achieve the specified quality of all work performed, material incorporated, and equipment furnished before use. The system established shall be documented in a written plan developed by the contractor and approved by the contracting officer. The system activities shall include the material testing and inspection needed to verify the adequacy of completed work and procedures to be followed when corrective action is required. Daily records to substantiate the conduct of the system shall be maintained by the contractor. The quality control plan shall cover all aspects of quality control and shall address, as a minimum, all specified testing and inspection requirements. The plan provided shall be consistent with the planned performance in the contractor's approved construction schedule. The plan shall identify the contractor's onsite quality control manager and provide an organizational listing of all quality control personnel and their specific duties. The written plan shall be submitted to the contracting officer within 15 calendar days after notice of award. The contractor shall not proceed with any construction activity that requires inspection until the written plan is approved by the contracting officer.

All methods—The quality control system shall include, but not be limited to, a rigorous examination of construction material, processes, and operation, including testing of material and examination of manufacturer's certifications as required, to verify that work meets contract requirements and is performed in a competent manner.

4. Quality control personnel

Method 1—Quality control activities shall be accomplished by competent personnel. A competent person is: One who is experienced and capable of identifying, evaluating, and documenting that materials and processes being used will result in work that complies with the contract; and, who has authority to take prompt action to remove, replace, or correct such work or products not in compliance. Off-site testing laboratories shall be certified or inspected by a nationally recognized entity. The Contractor shall submit to the Contracting Officer, for approval, laboratory certification or inspection information. The Contractor shall submit to the Contracting Officer, for approval, the names, qualifications, authorities, certifications, and availability of the competent personnel who will perform the quality control activities.

Method 2—Quality control activities shall be accomplished by competent personnel who are separate and apart from line supervision and who report directly to management. A competent person is one who is experienced and capable of identifying, evaluating, and documenting that material and processes being used will result in work that complies with the contract, and who has authorization to take prompt action to remove, replace, or correct such work or products not in compliance. Offsite testing laboratories shall be certified or inspected by a nationally recognized entity. The Contractor shall submit to the Contracting Officer, for approval, laboratory certification or inspection information. The contractor shall submit to the contracting officer, for approval, the names, qualifications, authorities, certifications, and availability of the competent personnel who will perform the quality control activities.

5. Post-award conference

The contractor shall meet with the contracting officer before any work begins and discuss the contractor's quality control system. The contracting officer and the contractor shall develop a mutual understanding regarding the quality control system, including procedures for correcting quality control issues.

6. Records

The contractor's quality control records shall document both acceptable and deficient features of the work and corrective actions taken. All records shall be on forms approved by the contracting officer, be legible, and be dated and signed by the competent person creating the record.

Unless otherwise specified in section 10 of this specification, records shall include:

- a. Documentation of shop drawings including date submitted to and date approved by the contracting officer, results of examinations, any need for changes or modifications, manufacturer's recommendations and certifications, if any, and signature of the authorized examiner.
- b. Documentation of material delivered including quantity, storage location, and results of quality control examinations and tests.
- c. Type, number, date, time, and name of individual performing quality control activities.
- d. The material or item inspected and tested, the location and extent of such material or item, and a description of conditions observed and test results obtained during the quality control activity.
- e. The determination that the material or item met the contract provisions and documentation that the engineer was notified.
- f. For deficient work, the nature of the defects, specifications not met, corrective action taken, and results of quality control activities on the corrected material or item.

7. Reporting results

The results of contractor quality control inspections and tests shall be communicated to the engineer immediately upon completion of the inspection or test. Unless otherwise specified in section 10, the original plus one copy of all records, inspections, tests performed, and material testing reports shall be submitted to the engineer within one

working day of completion. The original plus one copy of documentation of material delivered shall be submitted to the engineer before the material is used.

8. Access

The contracting officer and the engineer shall be given free access to all testing equipment, facilities, sites, and related records for the duration of the contract.

9. Payment

Method 1—For items of work for which lump sum prices are established in the contract, payment is made as the work proceeds, after presentation by the contractor of invoices showing related costs and evidence of charges by suppliers, subcontractors, and others for furnishing supplies and work performed. If the total of such payments is less than the lump sum contract price for this item, the remaining balance is included in the final contract payment. Payment of the lump sum contract price constitutes full compensation for completion of the work.

Payment is not made under this item for the purchase cost of material and equipment having a residual value.

Method 2—For items of work for which lump sum prices are established in the contract, payment is prorated and paid in equal amounts on each monthly estimate. The number of months used for prorating shall be the number estimated to complete the work. The final month's prorate amount is made with the final payment. Payment as described above constitutes full compensation for completion of the work.

Payment is not made under this item for the purchase cost of material and equipment having a residual value.

All methods—Compensation for any item of work described in the contract, but not listed in the bid schedule, is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 10.

10. Items of work and construction details

10. Items of Work and Construction

In Section 3, Quality control system, Method 2 shall apply, except that the written plan shall be submitted to the Contracting Officer within 10 calendar days after notice of award.

In Section 4, Quality control personnel, Method 2 shall apply.

In Section 9, Payment, Method 2 shall apply.

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. **Bid Item 34, Contractor Quality Control**

- (1) This item shall consist of furnishing all equipment, tools, materials, and labor and performing all work to accomplish the work defined in Section 1 of this specification.
- (2) The burden of proof that work performed meets contract requirements rests upon the Contractor. Quality assurance inspections and tests by the Contracting Local Organization (CLO) are for the sole benefit of the CLO. The use of such words as "as approved by the Engineer or Contracting Officer" and words of like import in the specifications or drawings which refer to approval by the Contracting Officer are considered to be a part of the CLO's Quality Assurance program and do not relieve the Contractor in any part for the Contractor's Quality Control Responsibilities as specified.
- (3) Quality Control is defined as a rigorous examination and inspection of construction materials, processes and operations to verify that the work being performed meets contract requirements and shall be performed by a qualified Inspector employed by or under contract to the Contractor.
- (4) The Contractor's quality control system shall be approved and operational before commencement of work. The Contractor's Quality Control Personnel shall submit to the on-site CLO Inspector Daily Quality Control Reports, for each day the Contractor is on site performing work.
- (5) Quality control tests shall be conducted in accordance with the standard test methods identified in the specifications. The Contractor shall provide all equipment required to perform all quality control tests. Testing equipment shall meet the requirements as specified by ASTM test methods and be properly calibrated and serviced.
- (6) All mention of inspection or Inspector in (7) and (8) below is referring to work performed by the Contractor's Quality Control Personnel unless otherwise noted.
- (7) The degree of quality control specified shall be defined as:
 - (a) Periodic review or inspection is defined as the intermittent presence of the Inspector to observe construction operations and/or perform tests and take measurements as needed to determine and document that the work being performed complies with the specifications.

- (b) Full-time inspection is defined as the full-time presence of the Inspector to observe one or more construction operations and/or perform tests and take measurements at critical points in various operations to determine and document that the work being performed complies with the specifications and to be available for consultation in case of emergency or changes in work conditions.
 - (c) Continuous inspection is defined as the continuous presence of the Inspector to observe one construction operation and/or perform tests and take measurements at critical points in the operation to determine and document that the work being performed complies with the specifications and to be immediately available for consultation in case of emergency or changes in work conditions.
- (8) The Contractor's inspection system shall include the following items of work that will require the Contractor's quality control. Any item of work not listed below shall be performed or constructed as shown on the drawings and as specified in the construction and material specifications.
- (a) The Contractor's inspection on all items not listed in (b) through (n) below shall consist of periodic review of those items to assure that all contract specifications are being met and that the items are being properly installed or carried out.
 - (b) Seeding, Sprigging, and Mulching - Quality control shall consist of determining that the vegetative materials supplied comply with the specifications; that the areas to be vegetated are properly prepared, smoothed and graded; and that sprigging is performed as specified. Full-time inspection shall be required.
 - (c) Excavation - Quality control shall consist of full-time inspection to determine that all excavation is being accomplished as specified and that the specified excavation has removed all required or unsuitable materials and that grades are properly documented. The Inspector shall determine that all materials selected for use in backfill of the specified works are free of undesirable materials and that all materials are placed in the designated waste, stockpile or fill areas.
 - (d) Earthfill - Quality control shall consist of full-time inspection of earthfill placement. The Inspector shall select materials from the required excavations, stockpiles, and/or borrow area(s) to ensure the completed earthfills are constructed in accordance with the drawings and specifications.

The Inspector shall select and obtain representative samples of the materials and have moisture-density curves made (according to ASTM D698 test procedures) of each Unified Soil Classification material to be placed in the specified earthfills using Class A compaction. Moisture density curves shall be completed as necessary to provide data needed when earthfill operations begin and may be needed as earthfill progresses to insure correct selection and specified compaction of earthfill materials. A "One-Point Family of Curves Method" (hereafter referred to as the one-point method) shall be employed to determine the optimum moisture and maximum density values for all earthfill materials. The procedure for performing the one-point method is as follows: (1) construct a family of curves using compaction test data compiled on soil samples tested in accordance with the procedure set forth in ASTM D698, (2) make a one-point compaction test specimen from soil material representing the earthfill material that is being placed (moisture content shall be on the dry side of

optimum), (3) plot the one-point moisture-density values, obtained from the test, on the family of curves, (4) using the curves above and below the plotted point as a guide, draw a new compaction curve through the plotted point, (5) use this curve as the control for the moisture and density of the material being placed. Unless otherwise directed by the Engineer, at least one one-point test shall be conducted for every three in-place moisture density tests that are taken.

More frequent tests shall be required if compaction requirements are not being obtained or if compaction requirements are not being met or if earthfills are being placed in critical areas such as conduit and concrete backfills and cutoff backfills. In the event that compaction correlation or requirements are not being met, continuous inspection shall be required during all earthfill and backfill placement to determine that foundation conditions are satisfactory; that earthfills materials are of the type selected for placement and are free of undesirable materials; that proper compaction and moisture requirements are being maintained; and that hand and mechanical compaction are being accomplished as specified.

The Contractor is responsible for pre-construction testing of soil materials in potential borrow sources to confirm suitability materials for earthfill in accordance with the criteria specified on the Drawings. The Contractor is also responsible for ongoing quality control testing shall be during construction to identify potential material changes. Testing shall be performed in the borrow area, although supplemental testing of the as-placed earthfill may also be required by the Inspector. The required quality control testing methods and frequency shall be as follows:

Gradation (ASTM D6913/1140):	2 per borrow area and every 2,500 CY
Atterberg limits (ASTM D4318):	2 per borrow area and every 2,500 CY
Standard Proctor (ASTM D698):	1 per borrow area and every 10,000 CY
Crumb Test (ASTM D6572):	2 per borrow area and every 2,500
CYDouble Hydrometer (ASTM D4221):	1 per borrow area and every 10,000 CY

- (e) Drainfill - Quality control shall consist of full-time inspection of drainfill placement. It shall include testing of the gradation of drainfill material; determining that the material complies with specified qualities and that the specified compaction is accomplished and the grades are properly documented. The Inspector shall have at least one sieve analysis prepared for each type of drainfill placed. These analyses shall be made from materials as delivered to the job site. If changes in gradation of drainfill appear to develop, additional sieve analysis shall be made.
- (f) Reinforced Concrete - Quality control shall consist of continuous inspection during the placement of concrete. In addition, the Inspector shall assure that the concrete design mix meets contract requirements and that proper certifications are provided. The Inspector shall inspect all formwork prior to concrete placement to assure integrity of the forms and compliance with design detail with proper documentation. Slump, time of cement induction, and temperature and air content measurements shall be determined on each mixer load of concrete prior to placement to assure compliance with specifications. Three sets of compressive strength cylinders (4

cylinders each) will be taken from each pour. One cylinder from each set shall be tested at 7 days and the other two tested at 28 days. The remaining cylinder shall be tested, if necessary, to verify results of a suspect cylinder. The Inspector shall also assure that the concrete is cured according to specifications, the forms removed as specified and the concrete is repaired and finished as required.

- (g) Steel Reinforcement - Quality control shall consist of continuous inspection during concrete placement. The Inspector shall also determine that the steel reinforcement complies with the specified quality and is placed in accordance with the drawings and specifications with proper documentation. The Inspector shall check to determine that it is adequately secured to prevent its displacement during concrete placement and that it has not been displaced during concrete placement. These inspections shall also take place immediately before and during placement of the concrete.
- (h) Roller Compacted Concrete (RCC) – Quality control shall consist of continuous inspection during the installation of the RCC. The Inspector shall ensure that the cement and pozzolan meet temperature and storage requirements. The Inspector shall ensure that the mix produced meets the job mix and proper documentation is furnished. The Inspector shall perform the uniformity tests as specified in Construction Specification 36 and measure and record temperature of RCC. The Inspector shall determine the average maximum density on the test fills and check density on the fill. The Inspector shall also ensure the RCC is cured according to specifications.
- (i) Reinforced Concrete Pressure Pipe Spillway Conduits - Quality control shall consist of continuous inspection while the pipe is being installed. The Inspector shall also determine and document that the pipe meets the specified requirements, that the pipe has not been damaged in shipment and delivery, that the pipe is properly bedded and laid at specified grade and alignment and that all joints are fully closed and properly sealed.
- (j) PVC Plastic Pipe - Quality control shall consist of continuous inspection during the installation of the PVC plastic pipe. The Inspector shall determine and document that the PVC plastic pipe and fittings comply with the specifications, that the perforations are to the size and orientation specified, that the pipe is installed at the lines and grades shown on the drawings and as specified and that the pipe is properly bedded and carefully backfilled.
- (k) Rock Riprap - Quality control shall consist of full-time inspection during the placement of the rock riprap. The Inspector shall also determine that the rock riprap complies with the specified quality and gradation limits; that proper certifications are provided; that the rock is placed as shown on the drawings and as specified and that segregation of particle sizes has not occurred during delivery or placement. At least one onsite gradation test will be made by the Contractor.
- (l) Metal Fabrication - Quality control shall consist of periodic inspection during installation of metalwork. The Inspector shall determine and document the fabricated metal work meets material specifications and dimensions, coatings are applied according to specifications and the erected work is to the lines and grades specified.

- (m) Geotextile - Quality control shall consist of continuous inspection during the installation of the geotextile. The Inspector shall determine and document that the geotextile complies with the specifications, that the subgrade has been excavated and smoothed to grade, that the geotextile is installed in accordance with the plans and specifications and that the geotextile is not punctured, damaged or caked with mud during installation.
 - (n) Conduit Abandonment - Quality control shall consist of continuous inspection during the placement of grout inside the conduit. In addition, the Inspector shall assure that the grout design mix meets contract requirements, that conduit is properly prepared, and that the grout is properly placed to prevent voids or air pockets.
 - (o) Geotechnical Instrumentation - Quality control shall consist of continuous inspection during the installation of the geotechnical instrumentation. The Inspector shall determine and document that the geotechnical instrumentation complies with the specifications. Detailed quality control requirements are included in Construction Specification 401-Geotechnical Instrumentation.
- (9) The skills, knowledge, abilities and experience needed by the Contractor's quality control personnel to perform the quality control shall be as follows:
- (a) Must have the ability to maintain communications with the landowners, the Contracting Officer and the Contractor.
 - (b) Knowledge of cut and grade staking and earthwork installations.
 - (c) Knowledge of soils, including foundation conditions, density and classifications.
 - (d) Knowledge of sampling of soils and determination of density of in-place soils.
 - (e) When applicable, must have knowledge of acceptable moisture-density test methods and the ability to satisfactorily perform the tests.
 - (f) Have the ability to interpret survey notes and to prepare quantity computations.
 - (g) Have the ability to maintain adequate files and records of construction inspection work.
 - (h) Have the ability to interpret construction drawings and specifications.
 - (i) Must have knowledge of tests required for placement of acceptable concrete and the procedures required for satisfactory placement.
 - (j) Must have knowledge and ability to perform concrete tests that include slump tests, air contents and temperature measurements, and preparation of compressive strength cylinders.
 - (k) Must have knowledge of steel placement details and the ability to interpret steel requirements from construction drawings.

- (l) Must have knowledge of form construction and bracing for construction of concrete structures.
 - (m) Must have knowledge of the United Soil Classification System and the ability to interpret soil classification requirements from the construction drawings.
 - (n) Must have knowledge of tests required for placement of acceptable RCC and the procedures required for satisfactory placement.
 - (o) Concrete Laboratory Testing Technicians – Must have certification from the American Concrete Institute (ACI) for Concrete Laboratory Testing Technician.
- (10) Quality control personnel shall also be responsible for maintaining a record of progress with photographs. Construction activities shall be documented with 10 megapixels or greater digital photography in a JPEG file format. Photographs of daily construction work, problems encountered, and unique construction practices shall be taken to insure full coverage of all work performed. The photographs shall be numbered, date and time imprinted and indexed with documentation explaining construction activities shown, and must be submitted with the request for final payment.

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Construction Specification 95—Geotextile

1. Scope

This work consists of furnishing all material, equipment, and labor necessary for the installation of geotextiles.

2. Quality

Geotextiles shall conform to the requirements of Material Specification 592 and this specification.

3. Storage

Before use, the geotextile shall be stored in a clean, dry location out of direct sunlight, not subject to extremes of either hot or cold temperatures, and with the manufacturer's protective cover undisturbed. Receiving, storage, and handling at the job site shall be in accordance with the requirements listed in ASTM D 4873.

4. Surface preparation

The surface on which the geotextile is to be placed shall be graded to the neat lines and grades as shown on the drawings. It shall be reasonably smooth and free of loose rock and clods, holes, depressions, projections, muddy conditions, and standing or flowing water (unless otherwise specified in section 7 of this specification).

5. Placement

Before the geotextile is placed, the soil surface will be reviewed for quality assurance of the design and construction. The geotextile shall be placed on the approved prepared surface at the locations and in accordance with the details shown on the drawings and specified in section 7 of this specification. It shall be unrolled along the placement area and loosely laid, without stretching, in such a manner that it conforms to the surface irregularities when material or gabions are placed on or against it. The geotextile may be folded and overlapped to permit proper placement in designated area(s).

Method 1—The geotextile shall be joined by machine sewing using thread material meeting the chemical requirements for the geotextile fibers or yarn. Thread shall be polypropylene, polyester, or Kevlar™ aramid thread, unless a specific thread type is specified. The thread shall consist of two parallel stitched rows at a spacing of about 1 inch and shall not cross (except for any required re-stitching). The stitching shall be a lock-type stitch. Each row of stitching shall be located a minimum of 2 inches from the geotextile edge. Unless otherwise specified, the seam tensile strength as measured according to ASTM D4884 shall be a minimum of 90 percent of the geotextile tensile strength in the weakest principal direction as measured according to ASTM D4632.

The geotextile shall be temporarily secured during placement of overlying material to prevent slippage, folding, wrinkling, or other displacement of the geotextile. Unless otherwise specified, methods of securing shall not cause punctures, tears, or other openings to be formed in the geotextile.

Method 2—The geotextile shall be joined by overlapping a minimum of 18 inches (unless otherwise specified) and secured against the underlying foundation material. Securing pins, approved and provided by the geotextile manufacturer, shall be placed along the edge of the panel or roll material to adequately hold it in place during installation. Pins shall be steel or fiberglass formed as a U, L, or T shape or contain "ears" to prevent total penetration through the geotextile. Steel washers shall be provided on all but the U-shaped pins. The upstream or upslope geotextile shall overlap the abutting downslope geotextile. At vertical laps, securing pins shall be inserted through the bottom layers along a line through approximately the mid-point of the overlap. At horizontal laps and across slope labs, securing shall be inserted through the bottom layer only. Securing pins shall be placed along a line about 2 inches in from the edge of the placed geotextile at intervals not to exceed 12 feet unless otherwise specified. Additional pins shall be installed as necessary and where appropriate to prevent any undue slippage or movement of the geotextile. The use of securing pins will be held to the minimum necessary. Pins are to remain in place unless otherwise specified.

Should the geotextile be torn or punctured, or the overlaps or sewn joint disturbed, as evidenced by visible geotextile damage, subgrade pumping, intrusion, or grade distortion, the backfill around the damaged or displaced area shall be removed and restored to the original approved condition. The repair shall consist of a patch of the same type of geotextile being used and overlaying the existing geotextile. When the geotextile seams are required to be sewn, the overlay patch shall extend a minimum of 1 foot beyond the edge of any damaged area and joined by sewing as required for the original geotextile except that the sewing shall be a minimum of 6 inches from the edge of the damaged geotextile. Geotextile panels joined by overlap shall have the patch extend a minimum of 2 feet from the edge of any damaged area.

Geotextile shall be placed in accordance with the following applicable specification according to the use indicated in section 7:

Slope protection—The geotextile shall not be placed until it can be anchored and protected with the specified covering within 48 hours or protected from exposure to ultraviolet light. In no case shall material be dropped on uncovered geotextile from a height of more than 3 feet.

Subsurface drains—The geotextile shall not be placed until drainfill or other material can be used to provide cover within the same working day. Drainfill material shall be placed in a manner that prevents damage to the geotextile. In no case shall material be dropped on uncovered geotextile from a height of more than 5 feet.

Road stabilization—The geotextile shall be unrolled in a direction parallel to the roadway centerline in a loose manner permitting conformation to the surface irregularities when the roadway fill material is placed on its surface. In no case shall material be dropped on uncovered geotextile from a height of more than 5 feet. Unless otherwise specified, the minimum overlap of geotextile panels joined without sewing shall be 24 inches. The geotextile may be temporarily secured with pins recommended or provided by the manufacturer, but they shall be removed before the permanent covering material is placed.

6. Measurement and payment

Method 1—For items of work for which specific unit prices are established in the contract, the quantity of geotextile for each type placed within the specified limits is determined to the nearest specified unit by measurements of the covered surfaces only, disregarding that required for anchorage, seams, and overlaps. Payment is made at the contract unit price. Such payment constitutes full compensation for the completion of the work.

Method 2—For items of work for which specific unit prices are established in the contract, the quantity of geotextile for each type placed with the specified limits is determined to the nearest specified unit by computing the area of the actual roll size or partial roll size installed. The computed area will include the amount required for overlap, seams, and anchorage as specified. Payment is made at the contract unit price. Such payment constitutes full compensation for the completion of the work.

Method 3—For items of work for which specific lump sum prices are established in the contract, the quantity of geotextile is not measured for payment. Payment for geotextiles is made at the contract lump sum price and constitutes full compensation for the completion of the work.

All methods—The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed in the bid schedule, is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 7 of this specification.

7. Items of work and construction details

7. Items of Work and Construction Details

In Section 5, Placement, Method 2 shall apply.

In Section 6, Measurement and Payment, Method 1 shall apply

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. **Bid Item 35, Geotextile**

- (1) This item shall consist of furnishing and placing the geotextile for the rock riprap located along the upstream wave protection, rock lined principal spillway outlet channel, rock lined auxiliary spillway outlet channel, and the rock scour apron upstream of the auxiliary spillway as shown on the drawings.
- (2) Placing the geotextile for the rock riprap includes all excavation, fill and backfill required for keying geotextile into the slope, as shown on the drawings.
- (3) Geotextiles shall be non-woven Class I and meet Material Specification 592.
- (4) The geotextile shall have the following properties as indicated in Table 592-1 of Material Specification 592:

Apparent Opening Size (AOS): 0.05 millimeters (maximum)

Porosity: 30% (minimum)

Mass-per-unit area: 8 oz/square yard (minimum)

- (5) The geotextile shall be placed and approved by the Engineer immediately prior to the placement of the rock riprap.

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Construction Specification 99—Conduit Abandonment

1. Scope

The work consists of furnishing and installing cellular concrete to fill a conduit.

2. Material

Admixtures must conform to the requirements of Material Specification 533, Chemical Admixtures for Concrete. If air-entraining cement is used, any additional air-entraining admixture must be of the same type as that in the cement.

Fly ash must conform to the requirements of Material Specification 532, Supplementary Cementitious Materials, for the specified class.

Foaming agents must conform to the requirements of ASTM C869.

Portland cement must conform to the requirements of Material Specification 531, Portland Cement, for the specified type.

Water reducing and/or retarding admixtures must conform to the requirements of Material Specification 533, Chemical Admixtures for Concrete.

Water used for the job mix must be clean and free from injurious amounts of oil, salt, acid, alkali, organic matter or other deleterious substances. Potable water may be used without testing. Nonpotable water must conform to the requirements of ASTM C1602.

3. Terminology

For the purpose of this specification the following definitions and terms apply:

bulkhead—A form, seal, or other apparatus installed to contain cellular concrete in the abandoned conduit.

cellular concrete—A lightweight concrete having a homogeneous void or cell structure made with a foaming agent, which may contain typical concrete admixtures or supplementary cementitious materials, such as fly ash; synonymous with grout.

cold weather—The condition that exists when the average daily ambient temperature is less than 40 degrees Fahrenheit for 3 consecutive days and the temperature is less than 50 degrees Fahrenheit for more than one-half of any 24-hour period.

engineer—The person responsible to the contracting officer or owner for verifying the technical adequacy of the work.

gauge saver—A device installed between a grout line and a pressure gauge to prevent grout from entering the pressure gauge.

grout line—Equipment through which the cellular concrete is pumped to the point of deployment.

hot weather—Any combination of high temperatures, low relative humidity, high winds, and solar radiation that impairs the quality of freshly mixed or hardened concrete or grout by accelerating the rate of moisture loss and rate of cement hydration, or otherwise causes detrimental results.

inline rotor-stator mixer—A type of high-shear mixer that can be installed in a grout line and used to combine foam or a foaming additive with neat-cement grout.

job mix—A cellular concrete mix that has been designed to comply with this specification and has the engineer's concurrence for its specified use.

neat-cement grout—A mixture of Portland cement and water that may contain admixtures or a supplementary cementitious material such as fly ash.

prefoamed grout—A mixture of Portland cement, water, and a foaming agent that may contain additives or a supplementary cementitious material such as fly ash.

pumped cellular concrete—Cellular concrete sampled at or beyond the point of grout line discharge.

prepumped cellular concrete—Cellular concrete sampled at the mixer before it is pumped through the grout line.

slick line—Tubing that is used to deliver cellular concrete to a point within the abandoned conduit.

4. Submittals

At least 14 days before filling the conduit, furnish the engineer a written plan for the operation. Include evidence satisfactory to the engineer that the cellular concrete will be installed by a contractor having completed a minimum of 10 cellular concrete installations that are similar in nature to that specified.

Include a cellular concrete mix design report with a statement of all materials to be incorporated into the mix, the mix proportions, and evidence that the materials and the mix meet specification requirements. Provide results of ASTM C232 for bleeding, ASTM C495 for compressive strength, and wet density as specified in section 9. Include a detailed description of the mechanisms that will be used for producing and conveying the job mix into the conduit. Address the installation of bulkheads, vents, grout nipples, slick lines, and any other materials and equipment necessary to maintain pressure and flow of the mix. Once approved by the engineer, the statement of materials and proportions will constitute the job mix. Any change to the job mix must be approved by the engineer.

Include any materials and methods proposed to seal holes and separated joints. A description of bonding surface preparation and adhesives must be included.

When applicable, include a plan for confined space entry or permit-required confined space entry, as applicable, as defined in OSHA 1910.

After approval of the plan, it must not change without prior written notice and the engineer's concurrence with the change.

During the grouting operation, the contractor must furnish the engineer a record of the mix ingredients and proportions. Any materials batched offsite shall must include the time of batching and the time the load was discharged.

Report the results of onsite testing to determine that cellular concrete density and temperature comply with specification requirements at the time of determination.

Submit a final written report to the engineer including all test results. Include location, date, and time of sampling and testing with all density values. Described corrective actions including, but not limited to, mix proportion adjustments, adjustments in foam generation, and pumping pressure adjustments. Include the results of oven-dry density and 28-day compressive strength tests made and reported in accordance with ASTM C495.

5. Design of job mix

Proportion the mix according to recommendations of the manufacturer of the foaming admixture.

Use Portland cement and a pozzolan such as fly ash with the amount of pozzolan ranging from 25 to 50 percent of the volume of cementitious materials.

Control the water/cementitious materials ratio so that bleeding does not occur.

The job mix must have a wet density ranging from 40 to 70 pounds per cubic foot.

The job mix 28-day compressive strength must equal or exceed 200 pounds per square inch.

6. Preparing the conduit

Remove all sediment and debris from the conduit, and flush it with water prior to installing the carrier pipe. The quality of the water must be such that no residue remains in the conduit after flushing. Remove all standing water from within the conduit prior to filling with cellular concrete.

Holes in the conduit or separated joints must be sealed unless otherwise specified in section 11.

7. Mixers and mixing

Cellular concrete production must comply with requirements set forth by the manufacturer of the foaming admixture and this specification.

Neat-cement grout to be used in the production of the job mix may be batched and mixed on site or batched and mixed elsewhere and transported to the site. Use a high-speed paddle or high-shear mixer to mix the foaming agent or prefoamed grout with the neat-cement grout. A concrete drum mixer must not be used for adding foam or a foaming agent to the job mix.

If an inline rotor-stator mixer is used for incorporating prefoamed grout into the neat-cement grout, install a point of discharge with a valve just beyond the inline mixer for the purpose of sampling and measuring the prepumped wet density of the job mix.

The prepumped wet density of the job mix must not vary more than 2 pounds per cubic foot throughout the grouting operation.

8. Grouting

Convey and pump the job mix into the conduit within 90 minutes after the introduction of the cement to the mix. The mix shall must be conveyed and pumped as rapidly as practical at pressures at or below the specified maximum.

Pump the job mix with progressive cavity pumps, positive displacement pumps, eccentric screw pumps, eccentric cavity pumps, peristaltic pumps, or other nonpulsing pumps. Piston pumps and other pumps which subject the mix to pulsing pressures shall must not be used.

The pumped wet density must not vary more than 5 pounds per cubic foot and must be maintained, throughout the grouting operation, within 5 pounds per cubic foot of the prepumped density.

Pumping—Pumping pressure must be controlled and provisions made to guard against sudden failure of pump lines, and bulkheads, or and pressure-induced separation of the conduit.

With both vents open, pump the job mix into a grout nipple in the downstream bulkhead. Close the downstream vent when cellular concrete begins flowing from the vent.

Cellular concrete may be conveyed the entire length of the pipe from the bulkhead provided the whole conduit is filled and the pressure at the point of discharge does not exceed the maximum pressure specified in section 11.

Discharge the job mix at multiple points in the abandoned conduit if the job mix cannot be deployed throughout the conduit without exceeding the specified maximum pressure or damaging the bulkheads or conduit. When discharging at multiple points is necessary, begin pumping into the shortest slick line and proceeding to the next shortest slick line, repeating the process to completely fill the abandoned conduit.

Hold period—With all vents, slick lines, and all unconnected grout nipples closed, maintain 2 to 4 pounds per square inch pressure on the closed system for a minimum of 5 minutes. After the hold period, close the connected

grout nipple and disconnect the grout line. Leave the bulkheads in place for a minimum period of 24 hours after the hold period or until the job mix is set as determined.

Determining if the job mix has set—Fill a container having a minimum volume of 0.2 cubic foot with cellular concrete discharged from the grout line. Seal the container to prevent drying or evaporation and store it away from sunlight. The mix will have set when it will not flow from the open container.

Cold weather—The job mix must not be conveyed and pumped into the conduit during cold weather unless it is insulated or otherwise prevented from freezing for a period of 24 hours after setting. The temperature of the mix must equal or exceed 40 degrees Fahrenheit at the time of pumping into the conduit.

Hot weather—In hot weather or under conditions contributing to quick stiffening of the mix, the time between the introduction of the water into the mix and pumping must not exceed 45 minutes. The engineer may allow a longer time, provided the setting time of the mix is increased a corresponding amount by the addition of an approved set-retarding admixture. The temperature of mix must not exceed 90 degrees Fahrenheit at the time of pumping into the annular space.

9. Monitoring and testing

Monitor wet density of prepumped and pumped cellular concrete throughout the grouting operation and make adjustments to comply with this specification.

Use a cylindrical container of known weight and volume to monitor the wet density of prepumped and pumped cellular concrete. The container must be at least 0.2 cubic foot in volume and made of nonabsorbent material. Tap the sides of the container by hand or rubber mallet while collecting a representative sample of cellular concrete. Overfill the container and screed excess concrete with a sawing motion using a glass, acrylic, or metal strike-off plate. Clean excess concrete from the container exterior and weigh the sample with a scale accurate to 0.1 pounds. Compute and record the wet density to the nearest 0.5 pound per cubic foot.

Test prepumped wet density at the beginning of cellular concrete production and test pumped wet density prior to connecting the grout line to the grout nipple entering the conduit. Test prepumped and pumped wet density at least every 30 minutes during the grouting operation, when there are visually noticeable changes in the cellular concrete, and after corrective actions to adjust the density.

Test the mix for bleeding according to ASTM C232.

Prepare strength test specimens according to ASTM C495. Obtain six initial strength specimens from the grout line discharge immediately prior to making the first grout nipple connection. Obtain six final strength test specimens immediately prior to making the last grout nipple connection. Test specimens for 28-day compressive strength and oven-dry density according to ASTM C495.

10. Measurement and payment

Payment for conduit abandonment will be made at the contract lump sum price and will constitute full compensation for all labor, equipment, materials, and all other items necessary and incidental to the completion of the work.

Compensation for any item of work described in the contract, but not listed in the bid schedule, is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 11 of this specification.

11. Items of work and construction details

11. Items of Work and Construction Details

In Section 8, Grouting, the maximum grout pressure shall not exceed 4 psi.

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item 36, Conduit Abandonment

- (1) This item consists of filling the existing principal spillway conduit designated to be abandoned with the job mix as specified in Section 5.

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Construction Specification 401 – Geotechnical Instrumentation

1. Geotechnical Instrumentation Work

This specification covers geotechnical instrumentation for the Plum Creek No. 2 Dam Upgrade project as shown on the Drawings. Geotechnical instrumentation is required for future monitoring of dam performance and confirmation of design assumptions with respect to potential ground movement and piezometric levels. The geotechnical instrumentation required to monitor ground and structure movements and piezometric levels within the area of the proposed auxiliary spillway structure include, but are not limited to the following:

- a. Drilling boreholes.
- b. Installing instrumentation in boreholes (piezometers).
- c. Decommissioning existing piezometers to be abandoned.
- d. Installing surface survey monitoring points.

All geotechnical instrumentation work shall be performed in accordance with all local, state, and federal safety regulations and permits required for the project, including Engineering Regulation (ER) 1110-1-1807: *Drilling in Earth Embankment Dams and Levees*.

2. References

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C150/150M	(2020) Standard Specification for Portland Cement
ASTM D1586	(2019) Penetration Test and Split-Barrel Sampling of Soils
ASTM D1587	(2015) Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
ASTM D2113	(2014) Rock Core Drilling and Sampling of Rock for Site Investigation
ASTM D2487	(2020) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2488	(2018) Description and Identification of Soils (Visual-Manual Procedure)
ASTM D3550	(2017) Thick Wall, Ring-Lined, Split Barrel, Drive Sampling of Soils
ASTM D4220	(2014) Preserving and Transporting Soil Samples
ASTM D5079	(2017) Preserving and Transporting Rock Core Samples
ASTM D5434	(2012) Field Logging of Subsurface Explorations of Soil and Rock
ASTM D6032	(2017) Determining Rock Quality Designation (RQD) or Rock Core

Natural Resources Conservation Service (NRCS)

National Engineering Handbook, Part 631, Chapter 2, Engineering Geologic Investigations	
National Engineering Handbook, Part 631, Chapter 3, Characterization of Earth	
National Engineering Handbook, Part 631, Chapter 4, Engineering Classification of Rock Materials	
National Engineering Handbook, Part 631, Chapter 5, Engineering Geology Logging, Sampling, and Testing	
National Engineering Manual, Title 210,	
Construction Specification 8	Mobilization and Demobilization
Construction Specification 21	Excavation
Construction Specification 23	Earthfill
Construction Specification 26	Topsoiling
Construction Specification 45	Plastic Pipe
Construction Specification 94	Contractor Quality Control

Material Specification 521	Aggregate for Drainfill and Filters
Material Specification 531	Portland Cement
Material Specification 532	Supplementary Cementitious Materials
Material Specification 547	Plastic Pipe

Texas Department of Licensing And Regulation (TDLR)

Well Construction and Plugging Specifications <https://www.tdlr.texas.gov/www/wwdspeccs.htm>

United States Army Corps of Engineers (USACE)

Engineering Regulation (ER) 1110-1-1807: *Drilling in Earth Embankment Dams and Levees*.

3. Definitions

- a. **Piezometer (PZ):**
A specially constructed observation well constructed in a borehole using a blank pipe section near the ground surface and a specially slotted pipe section at the bottom of the well. The slotted section of pipe can be adjusted to measure a groundwater level in a specific zone, or the slots can extend over large intervals to measure an average overall groundwater level in the vicinity of the well.
- b. **Well Sounder (WS):**
A well sounder measures the water level in a well or standpipe by sensing the level of the water when a special electrical contact tip touches the water surface. The tip is attached to the end of a specially marked graduated cable which enables the reader to measure the water depth.
- c. **Piezometer Decommission:**
Decommissioning an existing piezometer by plugging in accordance with all applicable Federal, State, and local regulations.
- d. **Survey Monitoring Point (SMP):**
Inscribed marking or approved surveyor's nail or rebar driven flush with surface or brass cap installed into new or existing concrete, masonry, roller-compacted concrete (RCC), asphalt, or soil at predetermined locations to measure vertical (elevation) and horizontal (coordinates) locations of ground surface or structural element.

4. Submittals

Qualifications

The Contractor shall submit the name of the instrumentation firm and written documentation summarizing the qualifications and references for three (3) similar projects to the Engineer at least 30 days prior to the start of work for review and approval. Provide resumes detailing the experience of all instrumentation personnel.

Instrumentation Work Plan

The Contractor shall submit a detailed Instrumentation Work Plan to the Engineer for review and approval at least 30 days prior to the start of work describing the proposed equipment and installation methods to be used including the following:

- a. List of all instruments to be installed.

- b. Manufacturer's data sheets for all materials to be included in instrument types to be installed as listed in PRODUCT DATA.
- c. Proposed drilling equipment and installation techniques prior to commencing any drilling.
- d. Details for identifying, protecting, and maintaining utilities in working service and existing structures.

Product Data

- a. Portland Cement
- b. Well Casing and Slotted Screen
- c. Filter Sand
- d. Bentonite
- e. Survey Monuments
- f. Grout Mix Design

As-Built Submittals

Within a maximum twenty-five days following the installation of the instruments, the Contractor shall submit to the Engineer for review As-Built Drawings showing the exact installed location (a plan view of the instrument locations), the instrument identification number (ID), the instrument type, and the installation date and time. Include details of installed instruments, instrument calibrations, accessories, and protective measures including all dimensions and materials used. Amend project drawings during construction to reflect changes in instrumentation installations. A pre-installation form and an installation form are required for each instrument.

All records shall be in U.S. Customary Units; for example: feet, inches, pounds, pounds per square inch, and degrees Fahrenheit.

The Pre-installation form shall contain the following:

- a. Instrument type and model number;
- b. Instrument ID;
- c. Verification of no apparent damage in shipping; and
- d. Signature of the person performing the pre-installation testing.

The Installation form shall include:

- a. Instrument ID;
- b. Date and time of installation;
- c. As-built instrument locations indicating accurate elevations (using a licensed Texas surveyor) and as-built geometry of each instrument following installation.
- d. Electronic photographs of each instrument installation shall be provided.
- e. Conditions encountered during the installation; and
- f. Signature of person in charge of installation and testing.

A geotechnical Boring Log of each borehole drilled for instrument installation, as described further in Section 13 FIELD QUALITY CONTROL.

Construction details for instrumentation installation / decommission as follows:

- a. As-Built Piezometer Construction Detail
- b. As-Built Piezometer Decommission Detail
- c. As-Built SMP Construction Detail
- d. As-Built tabulated survey data for all instruments
- e. TDLR/TCEQ Well Reports

5. Quality Assurance

Submit the name of the Instrumentation Firm and Drilling Firm and written documentation summarizing their qualifications to the Engineer for review and approval at least 30 days prior to the start of work in accordance with Section 4 SUBMITTALS. The submittals shall, where applicable, identify individuals who will be working on this contract and their relevant experience. No changes shall be made in approved personnel without prior approval of the Contracting Officer.

Qualifications of Instrumentation Firm and Personnel

Submit Instrumentation Firm qualifications and experience records for approval. Experience records shall identify all the individuals responsible for the instrumentation and shall include a listing of at least three (3) projects of similar scope performed within the specified period along with references and contact information. Installer qualifications must be approved prior to the installation of any instrumentation. The instrumentation shall be installed by a firm which is regularly engaged in the installation and monitoring of such devices and has at least 10 years' experience in the installation of similar instrumentation.

The Instrumentation Firm's personnel shall include a Superintendent who will be in responsible charge during the geotechnical instrumentation program. The Superintendent shall have prior field experience in installation, monitoring, and abandonment of piezometers dams, and shall have supervised instrumentation programs of similar magnitude in similar subsurface conditions on existing earth embankment dams. The Superintendent shall be a Professional Geologist (PG) or Professional Engineer (PE) licensed to practice in the State of Texas. The Superintendent shall:

- a. Be on site and supervise all instrument installations, and pre-installation and post-installation acceptance tests as required.
- b. Supervise data collection, reduction, plotting, and reporting, except for survey data.

A Registered Professional Land Surveyor (RPLS) in the State of Texas shall be in responsible charge of the installation of SMPs and surveying all geotechnical instrumentation. Both the Professional Surveyor and the Field Survey Party Chief shall have experience in the measurements of the types and accuracies specified herein.

Drilling Firm Qualifications

Submit Drilling Firm qualifications and experience records for approval. Experience records shall identify all the individuals responsible for the drilling activities and shall include a listing of at least three (3) projects of similar scope performed within the specified period along with references and contact information. The project Driller shall be a licensed Well Driller with the Texas Department of Licensing and Regulation (TDLR), and shall be on-site full time to supervise drilling, installation, and abandonment of piezometers.

6. Delivery, Storage, and Handling

Materials shall be protected, transported, and stored in a manner to prevent contamination or damage to any components. Materials shall be suitably wrapped, packaged, or covered at the factory or shop to prevent being affected by dirt, water, oil, grease, and rust. Protect materials against abrasion or damage during shipment and handling. Place materials stored at the site above ground on a well-supported platform and covered with plastic or other approved material. Materials shall be protected from adjacent construction operations. Inspect materials for damage and reject and remove from the site materials which are damaged.

7. Materials

General

Materials shall conform to the requirements indicated on the Drawings or referred to herein, and, when not covered thereby, materials and equipment of commercial grade quality suited to the intended use and as approved by the Engineer shall be furnished.

Centralizers

Centralizers for piezometer casing and slotted sections shall be fabricated from plastic, steel, or other material approved by the Engineer which is nondetrimental to the installation. Wood shall not be used. The centralizer shall be able to support the piezometer casing in the drill hole so a minimum of 2 inch of backfill cover is provided. Centralizers and spacers shall permit backfill and grout materials to freely flow into the annular space of the drillhole. Centralizers will be placed one foot above and one foot below the screen and at approximately 40-foot intervals along the casing of monitoring wells, except that wells installed using hollow-stem auger methods do not require centralizers.

Grout

Grout shall be a neat cement mixture of Portland cement, bentonite, and water. The grout mixture shall contain ten percent bentonite by weight and sufficient water to produce a pourable consistency. The grout mixture may be varied with the Engineer's approval.

Materials for grout shall be in accordance with the following requirements:

- a. Cement shall meet the requirements of ASTM C150 for Type II Portland cement. Only cement furnished in sacks shall be used.
- b. Water shall be free from sulfates and organic or other particulate matter, and meet the requirements for water for concrete as specified in Construction Specification 31, Concrete for Major Structures.
- c. Bentonite shall be powdered premium commercial grade. Bentonite shall be hydrated with water prior to mixing it with cement. The hydrated bentonite shall be batched as a slurry in such proportions that approximately ten percent bentonite powder, by dry weight, is used for each bag of cement, or as otherwise required by the Engineer.

Piezometer Surface Completion and Protection

Surface completion shall consist of a stick-up type enclosure with lockable end cap compatible with the enclosure diameter. The enclosure shall be five- to eight-inch diameter steel pipe with a minimum 0.250-inch wall thickness. The pipe shall extend approximately 2.5 feet above the ground surface. Compatible padlocks shall be furnished for each lockable enclosure. All padlocks shall be brass construction and keyed the same, and keys shall be provided to the Contracting Officer at the end of the construction contract.

The surface completion shall be properly labeled with an identification plate consisting of durable, weatherproof, rustproof material and permanently secured to the surface completion where it is readily visible. It shall be permanently marked to show:

- a. Company name and certification number of driller who installed the well;
- b. Date well was completed;
- c. Total depth (feet);
- d. Casing depth (feet);
- e. Screened interval;
- f. Piezometer identification number; and
- g. Static water level.

In areas accessible to vehicular traffic, the Contractor shall provide three protective bollards around the perimeter of the stick-up enclosure. The bollards shall be minimum 4-inch diameter steel pipe filled with concrete, and have a minimum 3-foot stick up and 1.5-foot embedment. The embedded zones shall be concreted in-place.

The Contractor shall provide temporary protective barriers around piezometers in construction areas, suitable for protecting from damage due to construction activities.

PVC Well Casing

PVC well casing shall consist of watertight flush-joint threaded Schedule 80 PVC manufactured by Boart Longyear Company or equal. Diameter is indicated in the Drawings.

PVC Slotted Screen

PVC slotted screen shall consist of flush-joint threaded Schedule 80 PVC manufactured by Boart Longyear Company or equal. Screen shall be machine-slotted with maximum 0.010-inch (0.253 mm) aperture slots. Diameter is indicated in the Drawings.

Filter pack

Filter pack materials shall consist of clean, washed silica sand. Silica sand shall be 10/20 mixture or other gradation which is compatible with the surrounding soil types and slot size of the PVC screen and allows free groundwater flow into the screened casing.

Bentonite Seal

Bentonite seal shall consist of 3/8- to 1/2-inch uncoated bentonite pellets hydrated in the borehole. Alternative bentonite products may be submitted to the Engineer for review and approval.

Epoxy / Grout for SMPs

If epoxy or grout is required to install SMPs on structures, submit manufacturer data to the Engineer for review and approval. Epoxy or grout for SMPs shall be a non-shrink, volumetrically-stable, structural-grade product manufactured for the intended purpose.

8. Equipment

Where model numbers are given in this section, they shall be understood to represent models selected on the basis of past factory specifications and project experience demonstrating that the equipment, including stipulations herein, will meet the performance objectives of this Work. The Contractor shall verify with any selected manufacturer that the designated model, or the updated version, or allowed equal, meets the design performance outlined by these drawings and specifications. Detailed working drawings and updated technical specifications for the project shall be submitted to the Engineer for approval, prior to starting installation. All equipment/materials listed in the Drawings and Specifications must be approved by the Engineer.

The Contractor shall furnish all installation tools, materials, and miscellaneous instrumentation components required to accomplish the work except where noted within these Specifications.

Spare parts/equipment shall be available on site to maintain instrumentation monitoring in satisfactorily operating condition at all times during execution of the tunnel work.

Drilling Equipment

Provide drilling equipment suitable for advancing the drill tools to the depths and at the alignment. Drill bit(s) for boreholes shall be capable of advancing through subsurface conditions which may be encountered.

Grouting Equipment

Grouting equipment shall consist of grout pumps, water pumps, hoses, mixing tanks, and tremie pipe. Grouting equipment shall be capable of continuous mechanical mixing that will produce uniform and thoroughly mixed

grout which is free of lumps and undispersed cement. The grouting equipment shall be capable of delivering the grout to the bottom of the borehole via tremie methods at low flow rates and in a controlled manner. The diameter of the tremie pipe shall be adequate to reach the bottom of the borehole and fully grout the annular space around the casing.

Well Sounder

Well sounder shall be electrical type contact well sounder as manufactured by Solinst, Toronto, Canada, or equal. The well sounder cable shall be a minimum of 100 ft long.

9. Execution

General

All work shall be performed in accordance with local, state, and federal safety regulations and any other permits required for this project.

The Contractor shall provide equipment and materials necessary for instrument installation except where indicated. All instrumentation shall be installed in accordance with the Drawings in a neat workmanlike manner and according to the manufacturer's recommendations.

The Contractor shall be responsible for providing adequate security and protection of the instrumentation during the entire period of construction, including protection from vandalism.

The Contractor shall notify the Engineer 5 working days in advance of the installation of any instrument.

The Contractor shall locate conduits and underground utilities in all areas where borings are to be drilled and instruments installed. Instrument locations shall be modified, as approved by the Engineer, to avoid interference with the existing conduits and utilities. Repair damage to existing utilities resulting from instrument installations at no additional cost to the Owner.

Immediately following installation, the Contractor shall survey and provide horizontal coordinates and vertical elevations of the top of all instruments. The Contractor shall employ a Land Surveyor, licensed in the State of Texas, for this purpose.

10. Installation of Piezometers

Drilling

Boreholes shall be drilled at the locations shown and to the depths and diameters indicated on the Drawings and Table 401-2. The locations of the holes may be changed only as approved by the Contracting Officer.

Boreholes drilled from the ground surface shall be subject to permitting. The Contractor shall obtain necessary permits for each such instrument and conform to the permit requirements during drilling and installation. Disposal of cuttings and drilling fluids according to local, state, and federal regulations shall be the Contractor's responsibility.

Drilling for boreholes for instrumentation shall be within 2 degrees of vertical. The Contractor shall determine the drilling method to be used, except that air rotary and mud rotary drilling methods shall NOT be permitted due to risk of hydrofracture in the dam embankment. Care shall be taken while drilling to avoid damage of any kind to existing structures. Damages of any nature will be evaluated by the Contracting Officer and repairs or

replacements shall be made as required by the Contractor at the Contractor's expense. Borehole diameter shall be no less than 6 inches.

The Contractor shall use metal pans or tanks to contain any waste drilling fluids. The Contractor shall not permit oil or grease waste on the fill. The Contractor shall dispose of drilling fluids, oil and grease waste, and all other waste in accordance with applicable regulatory requirements.

Geologic Sampling and Logging

Boreholes drilled for instrument installation shall be logged by the instrumentation Superintendent in accordance with NRCS procedures and supplemented by ASTM procedures (refer to Section 2 REFERENCES). Field boring log forms will be completed by the Superintendent, and will contain information as prescribed in Section 13 FIELD QUALITY CONTROL, BORING LOGS.

Soil samples shall be collected at no greater than 2.5-foot intervals in the upper 20 feet, and at 5-foot intervals thereafter. Sampling methods may include continuous coring, Standard Penetration Test (SPT) split-spoon sampling, and/or Shelby tubes, and may be supplemented with grab samples from auger cuttings as appropriate, and shall be conducted in accordance with applicable ASTM standards.

Split-spoon and grab samples should be stored in resealable plastic bags or glass jars. Core boxes should be used to store continuous core samples. The samples should be labeled with indelible ink indicating boring or well number and sample interval.

The Contractor shall store soil/rock samples in a climate-controlled facility located within 100 miles of the project site throughout the duration of construction. Samples shall be made readily available for inspection by the Owner and possible laboratory testing. Samples will be retained by the Contractor for a period of 6 months following completion of the construction contract, or be shipped by the Contractor to the NRCS-Lincoln, Nebraska materials testing laboratory if requested by the Contracting Officer.

Preparation

The final dimensions for each piezometer, including the total depth, screened interval, screen type, filter pack, and slot size may need to be adjusted based upon hydrologic and geologic conditions encountered and the judgement of the instrumentation Superintendent. The Engineer shall be notified immediately when significant deviation from planned installation is recommended by the Superintendent.

Verify that all drill holes have been drilled to the correct size, depth, and orientation prior to installation of instruments. Prior to installing the instrument through drill casing or augers, all materials adhering to the inside of the casing or augers, and all cuttings, shall be removed thoroughly.

Installation and Backfilling

Set the bottom of the slotted pipe to the elevation indicated. Flush drilling fluid, if used, out of the hole through the inside of the slotted pipe and casing.

Place sand filter pack material in the hole to surround the pipe up to the elevation of the seal as shown in the Drawings. Seal the annulus around the riser pipe with a plug of hydrated bentonite pellets as shown on the Drawings. Frequent sounding with a weighted tape should be performed to confirm filter/seal depth and confirm no bridging. Following adequate hydration time of the bentonite seal, backfill the remainder of the hole with approved cement-bentonite grout. The theoretical volume of grout should be calculated for each borehole prior to commencement of grouting, and actual volume of grout introduced to the borehole should be recorded. Grouting of the annular space around the standpipes above the bentonite seal shall be conducted through tremie pipes.

Drill casing shall be withdrawn as the backfill materials are placed. Whenever withdrawing drill casing or augers during instrument installation in a borehole, care shall be taken to minimize the length of unsupported borehole and the rate of casing or auger withdrawal. Collapse of the borehole shall not be allowed to occur; the borehole shall be over-drilled in the event that any collapse is suspected. Backfill materials shall not be allowed to build up inside the casing or auger such that the instrument is lifted as the casing or auger is withdrawn. The casing or auger shall be withdrawn without rotation. The casing or auger may be omitted, if allowed by the Contracting Officer, only where it can be confirmed that instrument installation without the casing or auger will not cause collapse of the borehole or in any way adversely affect instrument installation. If casing or augers are omitted, or the Contracting Officer allows withdrawal of casing or augers prior to instrument installation, the following requirements shall apply: the instrument shall be installed in the borehole in a continuous operation, starting when instrumentation materials are first placed in the borehole, and shall not be interrupted prior to complete backfilling of the borehole to the ground surface; partially completed instrument installations shall not be left in unsupported boreholes overnight or longer without prior written concurrent from the Contracting Officer.

Inspect the grout level 24 hours after initial grouting to determine if curing is occurring properly and if grout levels have dropped. Top-off grout as needed and re-check the fluid level after another 24 hours to determine if additional top-off grouting is required.

Surface Completion and Protection

Following adequate grout curing and confirmation of no further grout settlement, the Contractor shall install surface completions as shown on the Drawings and described in Section 7, MATERIALS (PIEZOMETER SURFACE COMPLETION AND PROTECTION).

Well Development

The development method selected will depend upon the location, purpose, condition of the well, strata encountered, type of filter pack, screen size, etc. Acceptable development methods may include pumping or bailing. Alternate methods shall be subject to review and approval by the Contracting Officer. The development techniques used shall be documented. This documentation shall include a log of the time intervals of the various development processes used.

Well development shall not be initiated within 24 hours of the installation of the final stage of grout. Only potable water shall be used in monitoring well development.

Development shall continue until clear, sediment-free water return is consistently produced. If possible, the well should be developed until the turbidity is <15 Nephelometer Turbidity Units (NTUs). Development parameter measurements shall be documented. Measurements to be taken during development may include specific conductance, pH, temperature, turbidity, and yield. Any sediment that has accumulated in the sump during development shall be removed.

Proper well development may require the use of additives such as sodium phosphate which expedite the breakdown of drilling fluids that are trapped in the formation.

Data Collection and Records

Submit driller logs and records as specified in Section 13 FIELD QUALITY CONTROL, BORING LOGS. The presence of a CLO inspector or the keeping of separate drilling records by the Contracting Officer shall not relieve the Contractor of the responsibility for the work specified in this paragraph.

All depths and elevations of the piezometer materials (screened interval, seal, etc.) shall be recorded as specified in Section 13 QUALITY CONTROL. Calculated theoretical grout volume and the actual introduced volume of cement-bentonite grout shall be recorded on the diagrams.

Payment will not be made for any work for which the required records have not been furnished by the Contractor. Data collection, reading frequency, and reporting shall be done in accordance with Table 401-1.

11. Decommission of Piezometers

General

Existing piezometers which interfere with the proposed structures as indicated on the Drawings and Table 401-3 shall be decommissioned as specified. The decommission method shall be overdrilling and/or grouting at the Contracting Officer's direction. All PVC casing, screen, and filter pack shall remain in the piezometer, unless directed otherwise by the Contracting Officer. Protective surface casings and/or manholes shall be removed.

Prior to grouting, each piezometer shall be checked for blockage or caving. Blocked or caved holes shall be cleared to the full depth of the original drilled hole, or to the depth of previous grouting as approved by the Engineer.

Grout shall be tremied through a pipe from the bottom of the hole upward so that the hole is completely backfilled with grout, unless specified otherwise herein.

The Contractor shall at all times provide for disposal of all wash and waste water, cement bags and other debris, in accordance with all state and local regulations, and shall remove all waste grout caused by its operations. If approved by the Contracting Office, waste grout may be disposed at designated on-site waste areas where provided that a minimum 12-inch topsoil cover is provided over the waste grout.

Grouting

Piezometers shall be filled with a neat, non-shrinking cement grout and bentonite mixture. The cement grout shall consist of a mixture of neat cement (Portland Type II) and 5 to 6 gallons of potable water per 94-pound sack of neat cement. Grout materials shall be weighed and metered by the amount of water used (water-to-cement ratio = a slurry weight of approximately 16 pounds per gallon). The consistency of the grout shall be sufficient to flow through the well screen and into the filter pack.

The piezometer will be filled with grout placed via tremie methods under gravity pressure only. The fluid grout level shall be checked a minimum period of 24 hours after grouting procedures have ceased, and topped off as required to maintain grout level at proposed elevation.

After each well has been grouted, the top 2 feet of each well shall be over excavated and back-filled to surface with compacted embankment fill. Topsoil will be added in areas where no further fill and/or structures are planned.

Over Drilling

If directed by the Contracting Officer, overdrilling the piezometers shall be destroyed by over drilling and grouting (with a tremie pipe) the entire length of each well; thereby, sealing the subsurface (first groundwater zone) from surface water infiltration.

The over drilling and grouting shall follow the following processes:

- a. Hollow stem auger (HSA) over drilling, using 8-inch drill bits and auger or larger, shall be used to conduct the over drilling of the entire depth of each well location.

- b. After the over drilling is completed each PVC well casing (blank and screen) shall be removed (pulled out) from the original borehole; thereby, leaving an open borehole from surface to total depth.
- c. Each borehole shall be filled with cement grout from total depth to 3 feet below ground surface.
- d. Grouting shall follow procedures listed in GROUTING.

Data Collection and Records

Prior to piezometer decommission, final groundwater levels shall be collected in each of the piezometers and recorded. An estimate of the reservoir elevation at the time of data collection shall also be obtained.

The date and time of decommission, decommission method employed, field observations, and other pertinent information required by TCEQ/TDLR shall be recorded and submitted for review. Data shall be submitted within 48 hours of decommission.

12. Installation of SMPs

General

The SMPs shall be installed on structures at the locations as indicated on the Drawings and Table 401-4. Locate and construct monitoring points in a manner that will not create a hazard to pedestrians and vehicles. Maintain access to monitoring points.

Placing

The SMPs shall be monitored by the Contractor. The SMPs shall be installed and surveyed as early as feasible (either as part of structure construction or shortly thereafter) to establish a baseline for future readings.

All the equipment used in handling and installing the SMPs shall not damage or deteriorate the assembly or the structure into which it is installed. Acceptable methods of SMP installation may include drill and epoxy grout, casting into the fluid RCC/concrete, and/or pressing into the semi-solid RCC/concrete. Driving SMPs into the surface of hardened concrete/RCC should be done with caution so as not to damage or crack the finished surface. The Contractor shall be responsible for any damage to structures resulting from SMP installation.

Data Collection and Records

Baseline survey of the SMPs shall be conducted after a period of 24 hours to allow grout/concrete/RCC curing, and within 72 hours of installation. Subsequent readings shall be performed in accordance with frequency schedule in Table 401-1.

13. Field Quality Control

General

The Contractor shall provide and maintain an effective quality control program that fulfills the requirements found herein and in Construction Specification 94, Contractor Quality Control.

Boring Logs

Submit the original handwritten log and 3 copies in typed format within 2 days of the completion of each hole. Keep accurate driller logs and record all work accomplished under this contract and deliver complete, legible copies of these logs and records to the Contracting Officer upon completion of the work or at such other time or times as the Contracting Officer may direct. All such records shall be preserved in good condition and order by

the Contractor until they are delivered and accepted, and the Contracting Officer shall have the right to examine such records at any time prior to their delivery. Separate logs shall be made for each hole. Use United States Army Corps of Engineers (USACE) DRILLING LOG, ENG FORM 1836 and 1836A, or other form approved by the Engineer which provides the required information for the logs. The following information shall be included on the logs or in the records for each hole:

- a. Hole number or designation and elevation of top of hole.
- b. Inclination of the hole.
- c. Make and manufacturer's model designation of drilling equipment.
- d. Dates and time when drilling operations were performed.
- e. USCS classification and interpreted geologic unit, and depths at which they were encountered. This classification or description shall be made immediately following sampling. Elevation of top of rock.
- f. Steel casing seat elevation.
- g. Depths and elevations at which core was recovered or attempts made to core including top and bottom depth of each run.
- h. Time required for drilling each run.
- i. Percentage of core recovered and rock quality designation per run.
- j. Depth and elevation of rod drops, difficult drilling, and other unusual occurrences.
- k. Depth and elevation at which groundwater is encountered 1) at first entry during drilling; 2) at the end of drilling; and 3) immediately prior to piezometer installation.
- l. Depths and elevations at which drill water is lost and regained and amounts.
- m. Depth and elevation of bottom of hole, determined by measuring the drill steel length and verifying using a weight tape immediately prior to piezometer installation.

Piezometer Installation Records

Submit as-built construction detail for each piezometer installed within 1 week of completion of each installation. The construction detail shall include the following information:

- a. Piezometer identification number and/or corresponding borehole identification number.
- b. Surveyed horizontal position and top elevation and horizontal position for 1) the top of PVC casing; and 2) poured concrete pad.
- c. Total length, depths, and elevations of the screened interval, and geologic unit in which the piezometer is screened.
- d. Total length and stick-up height of the PVC solid casing.
- e. Depths and elevations of the sand filter pack, bentonite seal, cement-bentonite grout backfill, and concrete surface seal.
- f. Embedment depth and stick-up height of protective enclosure.
- g. Calculated theoretical and actual volumes of annular grout used to backfill, as well as information on grout top-off.

Well development records shall be submitted within 1 week of development, and shall include the following information:

- a. Piezometer identification number.
- b. Development method used.
- c. Dates and times of development.
- d. Initial and final well development water quality parameters as indicated in Section 10, INSTALLATION OF PIEZOMETERS (WELL DEVELOPMENT).
- e. Groundwater depth/elevation measurements immediately prior to and immediately following well development.

Periodic repeat groundwater levels collected after installation shall be submitted according to the frequency schedule in Table 401-1.

Piezometer Decommission Records

Submit copies of the TCEQ well abandonment forms to document completion of piezometer decommission. The forms shall indicate the date of decommission, abandonment method, and other required information.

SMP Records

Submit the initial baseline survey of each SMP within 1 week of installation. Periodic repeat survey data of SMPs collected after installation shall be submitted according to the frequency schedule in Table 401-1.

Survey Records

Following completion of all instrument installation, submit an instrumentation plan drawing which illustrates as-built locations of all instrumentation installed and decommissioned. The drawing shall include a summary table with surveyed coordinates and elevations of the top of all instruments. The drawing shall be stamped by the Texas RPLS.

14. Maintenance

The Contractor is responsible for maintaining all geotechnical instrumentation in working order for the duration of the contract. Maintain all instrumentation installations until the tunnel is handed over to the Owner. Immediately repair or replace any damage. Maintenance shall include all work necessary to maintain the ability to take readings.

15. Performance Criteria and Acceptance

General

Geotechnical Instrumentation shall be considered acceptable when instrument data are repeatable and match manual readings, or at the discretion of the Engineer.

Surveying Standards

Surveying of instruments shall be performed as follows:

- a. All vertical elevations shall commence from a minimum of two National Geodetic Survey (NGS) second order or better published benchmarks.
- b. All elevations shall be established to NGS third order standards and certified to those standards by a Professional Surveyor registered in the State of Texas.
- c. All level runs shall be double run (forward and back) or looped into two NGS second order or better published benchmarks.
- d. All elevations shall be established in NAVD88 Datums. Following installation, State Plane Coordinates shall be established at all instrument locations with a positional accuracy of +/- 1 feet for piezometers, and +/- 0.01 feet for SMPs.
- e. Survey data shall have an accuracy of at least 0.01 feet in the x, y, and z directions unless otherwise specified.

Replacement of Rejected Instrumentation

Any instrument that fails to meet acceptance criteria and/or is rejected by the Contracting Officer shall be replaced. A replacement instrument, including a new drill hole (if required), shall be provided by the Contractor at no expense to the CLO. The location of the replacement instrument shall be as directed by the Contracting Officer. Provide all materials, supplies, equipment, and labor necessary to provide a new instrument assembly to the satisfaction of the Contracting Officer. No drilling shall be performed for a replacement instrument until the grouting of all instruments within 50 feet of the replacement instrument location has been allowed to set for at least 24 hours. Payment will not be made for rejected instruments and/or instrument which do not meet acceptance criteria. Either remove rejected instrumentation or leave in place as directed by the Contracting Officer.

16. Measurement and Payment

Measurement

The work is not measured. Payment for monitoring instrumentation and installation is made at the contract lump sum price in the contract. Progress payments for instrumentation monitoring and installation will be made according to the completion percentage at the end of each invoicing period according to the Contractor's approved schedule of values, subject to review and approval by the Contracting Officer. Such payment constitutes full compensation for all labor, equipment, material, and all other items necessary and incidental to the completion of the work.

17. Items of Work and Construction Details

Items of work to be performed in conformance with this specification and the construction details therefore are:

a. Bid Item 37, Geotechnical Instrumentation

- (1) This item shall consist of furnishing, fabricating, and installing, and monitoring geotechnical instrumentation for the following:
 - (a) Installation of fifteen (15) survey monitoring points (SMP) as shown on the drawings.
 - (b) Installation of four (4) piezometers as shown on the drawings.
 - (c) Decommissioning of two (2) existing piezometers.
 - (d) Monitoring instrumentation in conformance with this specification.
 - (e) Installation of (1) reservoir staff gauge, hot dip galvanized steel
 - (f) Installation of (1) reservoir staff gauge, reinforced concrete

Table 401-1. Instrument Readings Schedule

Instrument	Schedule
Survey Monitoring Points (SMP)	1. One set of initial readings immediately after installation. 2. Weekly readings for the first 2 months following installation. 3. Monthly readings thereafter until construction completion. 4. Daily readings when fill or excavation operations occur within 100 feet of SMP. May be reduced to weekly readings at the discretion of the Contracting Officer.
Piezometers	1. One set of initial readings immediately prior to and after well development. 2. Weekly readings for the first 2 months following installation. 3. Monthly readings thereafter until construction completion.

Table 401-2. Piezometer Installation Details

ID No.	Location	Approx. Prop. Ground Elev. (ft NAVD88)	Est. Total Depth (feet)	Nested Piezometer Screened Zone	Screened Geologic Unit	Screen Length (ft)	Est. Screen Depth (ft)		Est. Screen Elev. (ft NAVD88)		Remarks
							Top	Bottom	Top	Bottom	
PZ-1	Right Side of Prop. RCC Spillway (Embankment Crest)	664	40	Upper (U)	Embank. & Resid.	10	9	19	655	645	Stratigraphy estimated based on boring 14-20
				Lower (L)	Residuum	10	29	39	635	625	
PZ-2	Right Side of Prop. RCC Spillway (Downstream Toe)	652	30	Upper (U)	Alluv. & Resid.	10	7	17	645	635	Stratigraphy estimated based on boring 703-20
				Lower (L)	Residuum	5	24	29	628	623	
PZ-3	Left Side of Prop. RCC Spillway (Downstream Toe)	650	30	Upper (U)	Residuum	5	8	13	642	637	Stratigraphy estimated based on boring 601-19
				Lower (L)	Residuum	10	20	30	630	620	
PZ-4	Left Side of Prop. PSW (Downstream Toe)	639	30	Upper (U)	Alluvium	5	10	15	629	624	Stratigraphy estimated based on boring 305-19
				Lower (L)	Resid. & Shale	5	24	29	615	610	

Table 401-3. Piezometer Decommission Details

ID No.	Location	Existing Ground Elev. (ft NAVD88)	Total Depth (feet)	Borehole Diam. (inch)	Screened Geologic Unit	Screen Diam. (inch)	Screen Length (ft)	Screen Depth (ft)		Screen Elev. (ft NAVD88)		Remarks
								Top	Bottom	Top	Bottom	
702-20	Proposed RCC Spillway (Downstream Toe)	647.79	30	8	Residuum	2.0	20	10	30	637.79	617.79	Refer to GI Report

Table 401-4. Survey Monitoring Point (SMP) Installation Details

ID No.	Location	Approx. Final Ground Elev. (ft NAVD88)	Remarks
AS-SM-1	RCC Spillway – Top Left Wall (Crest)	663.65	Install on top of RCC wall
AS-SM-4	RCC Spillway – Chute (Crest)	658.65	Install flush with top of RCC step
AS-SM-7	RCC Spillway – Chute (Crest)	658.65	Install flush with top of RCC step
AS-SM-10	RCC Spillway – Chute (Crest)	658.65	Install flush with top of RCC step
AS-SM-13	RCC Spillway – Top Right Wall (Crest)	663.65	Install on top of wall
AS-SM-2	RCC Spillway – Top Left Wall (Midslope)	658.65	Install on top of wall
AS-SM-5	RCC Spillway – Chute (Midslope)	653.65	Install flush with top of RCC step
AS-SM-8	RCC Spillway – Chute (Midslope)	653.65	Install flush with top of RCC step
AS-SM-11	RCC Spillway – Chute (Midslope)	653.65	Install flush with top of RCC step
AS-SM-14	RCC Spillway – Top Right Wall (Midslope)	658.65	Install on top of wall
AS-SM-3	RCC Spillway – Top Left Wall (Toe)	653.65	Install on top of wall
AS-SM-6	RCC Spillway – Chute (Toe)	641.7	Install flush with stilling basin invert
AS-SM-9	RCC Spillway – Chute (Toe)	641.7	Install flush with stilling basin invert
AS-SM-12	RCC Spillway – Chute (Toe)	641.7	Install flush with stilling basin invert
AS-SM-15	RCC Spillway – Top Right Wall (Toe)	653.65	Install on top of wall
PS-SM-16	Principal Spillway – Impact Basin (Left Wall, Upstream)	639.96	Install on top of wall
PS-SM-17	Principal Spillway – Impact Basin (Left Wall, Downstream)	634.29	Install on top of wall
PS-SM-18	Principal Spillway – Impact Basin (Right Wall, Upstream)	639.96	Install on top of wall
PS-SM-19	Principal Spillway – Impact Basin (Right Wall, Downstream)	634.29	Install on top of wall
PS-SM-20	Principal Spillway – Inlet Tower (Top)	650.73	Install on top of deck

Table 401-5. Reservoir Staff Gauge Installation Details

ID No.	Location	Approx. Final Ground Elev. (ft NAVD88)	Remarks
PS-SG-1	PSW Inlet	632.0 to 650.0	Install on side of inlet structure wall, hot dip galvanized steel
PS-SG-2	Upstream Embankment at PSW alignment	650.0 to 662.5	Install on upstream embankment at PSW alignment, reinforced concrete

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Material Specification 521—Aggregates for Drainfill and Filters

1. Scope

This specification covers the quality of mineral aggregates for the construction of drainfill and filters.

2. Quality

Drainfill and filter aggregates shall be sand, gravel, or crushed stone or mixtures thereof. Aggregates shall be composed of clean, hard, durable, mineral particles free from organic matter, clay balls, soft particles, or other substances that would interfere with the free-draining properties of the aggregates.

Coarse aggregate may be crushed limestone or other material that has limestone particles included. Aggregates from crushed limestone shall be thoroughly washed and screened to remove limestone dust, limestone fines, and fine soil particles. Limestone shall not be used for fine aggregates except in combination with other material, such that not more than 5 percent of the portion finer than the No. 4 sieve shall be limestone.

Aggregates shall be tested for soundness according to ASTM Method C88 and shall have a weighted average loss in 5 cycles of not more than 12 percent when sodium sulfate is used or 18 percent when magnesium sulfate is used.

3. Grading

Drainfill and filter aggregates shall conform to the specified grading limits after being placed or after being compacted when compaction is specified. Grading shall be determined by ASTM Method C136. The percentage of material finer than the No. 200 sieve shall be determined by the method in ASTM Designation C117.

4. Storing and handling

Drainfill and filter aggregates shall be stored and handled by methods that prevent segregation of particle sizes or contamination by mixing with other material.

Material Specification 522—Aggregates for Portland Cement Concrete

1. Scope

This specification covers the quality of fine aggregate and coarse aggregate for use in the manufacture of portland cement concrete.

2. Quality

Aggregate shall conform to the requirements of ASTM Specification C 33 for the specified sizes. Aggregates that fail to meet any requirement may be accepted only when either:

- a. The specified alternate conditions of acceptance can be proven before the aggregates are used on the job and within a period such that no work under the contract will be delayed by the requirements of such proof,
- or
- b. The specification for concrete expressly contains a provision of special mix requirements to compensate for the effects of the deficiencies.

3. Reactivity with alkalis

The potential reactivity of aggregates with the alkalis in cement shall be evaluated by petrographic examination and, where applicable, the chemical method of test, ASTM Designation C 289, or by the results of previous tests or service records of concrete made from similar aggregates from the same source. The standards for evaluating potential reactivity shall be as described in ASTM Specification C 33, appendix A1.

Aggregates indicated by any of the above to be potentially reactive shall not be used except under one of the following conditions:

- a. Applicable test results of mortar bar tests made according to ASTM Method C 227 are available which indicate an expansion of less than 0.10 percent at 6 months in mortar bars made with cement containing not less than 0.8 percent alkalis expressed as sodium oxide; or
- b. Concrete made from similar aggregates from the same source has been demonstrated to be sound after 3 years or more of service under conditions of exposure to moisture and weather similar to those anticipated for the concrete under these specifications.

Aggregates indicated to be potentially reactive, but within acceptable limits as determined by mortar bar test results or service records, shall be used only with low alkali cement, containing less than 0.60 percent alkalis expressed as sodium oxide.

4. Storing and handling

Aggregates of each class and size shall be stored and handled by methods that prevent segregation of particles sizes or contamination by intermixing with other material.

Material Specification 523—Rock for Riprap

1. Scope

This specification covers the quality of rock to be used in the construction of rock riprap.

2. Quality

Individual rock fragments must be dense, sound, and free from cracks, seams, and other defects conducive to accelerated weathering. Except as otherwise specified, the rock fragments must be angular to subrounded. The least dimension of an individual rock fragment must not be less than one-third the greatest dimension of the fragment. ASTM D4992 provides guidance on selecting rock.

Except as otherwise provided, the rock must be tested and must have the following properties:

Rock type 1

- **Bulk specific gravity (*saturated surface-dry basis*)**—Not less than 2.5 when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
- **Absorption**—Not more than 2 percent when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
- **Soundness**—The weight loss in five cycles must not be more than 10 percent when sodium sulfate is used or more than 15 percent when magnesium sulfate is used.

Rock type 2

- **Bulk specific gravity (*saturated surface-dry basis*)**—Not less than 2.5 when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
- **Absorption**—Not more than 2 percent when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
- **Soundness**—The weight loss in five cycles must be not more than 20 percent when sodium sulfate is used or more than 25 percent when magnesium sulfate is used.

Rock type 3

- **Bulk specific gravity (*saturated surface-dry basis*)**—Not less than 2.3 when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
- **Absorption**—Not more than 4 percent when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
- **Soundness**—The weight loss in five cycles must be not more than 20 percent when sodium sulfate is used or more than 25 percent when magnesium sulfate is used.

3. Methods of soundness testing

Rock cube soundness—The sodium or magnesium sulfate soundness test for all rock types (1, 2, or 3) must be performed on a test sample of $5,000 \pm 300$ grams of rock fragments, reasonably uniform in size and cubical in shape, and weighing, after sampling, about 100 grams each. They must be obtained from rock samples that are representative of the total rock mass, as noted in ASTM D4992, and that have been sawed into slabs as described in ASTM D5121. The samples must further be reduced in size by sawing the slabs into cubical blocks. The thickness of the slabs and the size of the sawed fragments must be determined by the size of the available test apparatus and as necessary to provide, after sawing, the approximate 100-gram samples. The cubes must undergo five cycles of soundness testing in accordance with ASTM C88.

Material Specification 523 Rock for Riprap (continued)

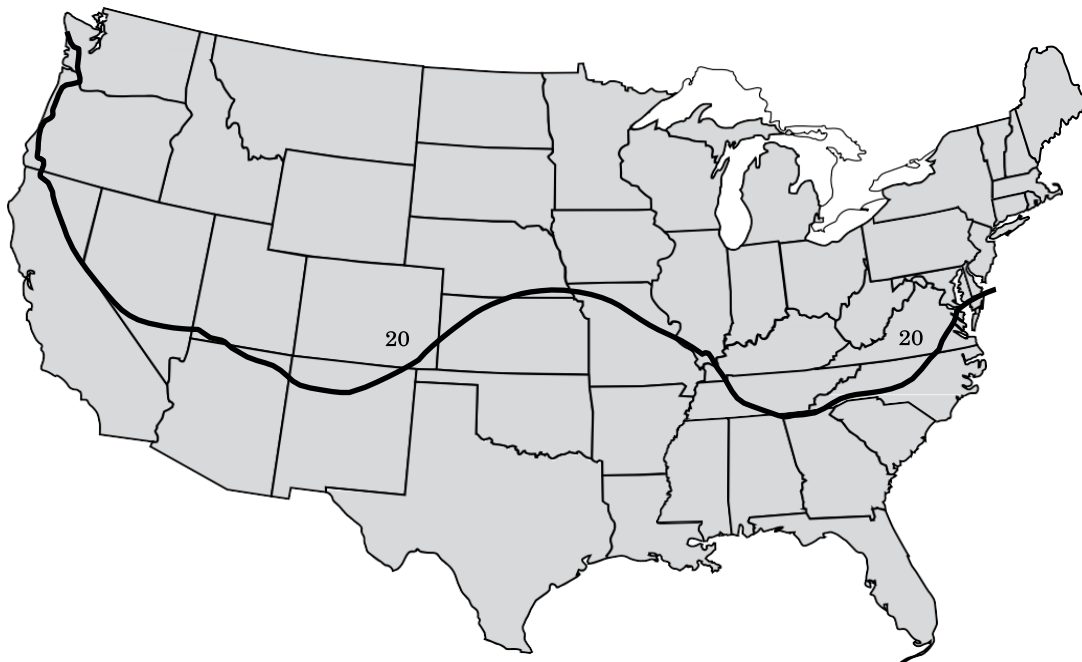
Internal defects may cause some of the cubes to break during the sawing process or during the initial soaking period. Do not test any of the cubes that break during this preparatory process. Such breakage, including an approximation of the percentage of cubes that break, must be noted in the test report.

After the sample has been dried following completion of the final test cycle and washed to remove the sodium sulfate or magnesium sulfate, the loss of weight must be determined by subtracting from the original weight of the sample the final weight of all fragments that have not broken into three or more fragments.

The test report must show the percentage loss of the weight and the results of the qualitative examination.

Rock slab soundness—When specified, the rock must also be tested in accordance with ASTM D5240. Deterioration of more than 25 percent of the number of blocks is cause for rejection of rock from this source. Rock must also meet the requirements for average percent weight loss stated below.

- For projects located north of the Number 20 Freeze-Thaw Severity Index Isoline (fig. 523–1), unless otherwise specified, the average percent weight loss for Rock Type 1 must not exceed 20 percent when sodium sulfate is used or 25 percent when magnesium sulfate is used. For Rock Types 2 and 3, the average percent weight loss must not exceed 25 percent for sodium sulfate soundness or 30 percent for magnesium sulfate soundness.
- For projects located south of the Number 20 Freeze-Thaw Severity Index Isoline, unless otherwise specified, the average percent weight loss for Rock Type 1 must not exceed 30 percent when sodium sulfate is used or 38 percent when magnesium sulfate is used. For Rock Types 2 and 3, the average percent weight loss must not exceed 38 percent for sodium sulfate soundness or 45 percent for magnesium sulfate soundness.

Material Specification 523 Rock for Riprap (continued)**Figure 523–1** Number 20 Freeze-Thaw Severity Index Isoline (map approximates the map in ASTM D5312)**4. Field durability inspection**

Rock that fails to meet the material requirements stated above (if specified), may be accepted only if similar rock from the same source has been demonstrated to be sound after 5 years or more of service under conditions of weather, wetting and drying, and erosive forces similar to those anticipated for the rock to be installed under this specification.

A rock source may be rejected if the rock from that source deteriorates in less than 5 years under similar use and exposure conditions expected for the rock to be installed under this specification, even though it meets the testing requirements stated above.

Deterioration is defined as the loss of more than one-quarter of the original rock volume, or severe cracking that would cause a block to split. Measurements of deterioration are taken from linear or surface area particle counts to determine the percentage of deteriorated blocks. Deterioration of more than 25 percent of the pieces is cause for rejection of rock from the source.

5. Grading

The rock must conform to the specified grading limits after it has been placed within the matrix of the rock riprap. Grading tests must be performed, as necessary, according to ASTM D5519, Method A, B, or C, as applicable.

Material Specification 523

Rock for Riprap (continued)

Material Specification 524—Aggregates for Roller Compacted Concrete

1. Scope

This specification covers the quality of aggregate for use in the manufacture of roller compacted concrete (RCC).

2. Quality

Aggregate shall conform to the quality requirements of ASTM Specification C33.

3. Gradation

Aggregate gradation shall be within the limits provided below for the total aggregate weight in a unit volume of RCC. For the sieve sizes shown below that are larger than #4, no more than 20 percent of the total aggregate shall be retained on an individual sieve. For sieve sizes smaller than 3/8 inch, at least 3 percent of the total aggregate shall be retained on each sieve.

Sieve size	Percent passing
2"	100
1-1/2"	85–100
1"	70–100
3/4"	60–84
1/2"	50–70
3/8"	40–60
#4	32–50
#8	26–42
#16	20–35
#30	14–28
#50	8–22
#100	4–15
#200	0–7

Unless otherwise specified, the fines (material passing the #200 sieve) shall have a plasticity index less than four.

Particle shape—The amount of flat and elongated particles with a length-to-width or width-to-thickness ratio greater than 3:1, as determined by ASTM D4791, shall not exceed 25 percent on any individual sieve size group nor a weighted average of 20 percent for all of the sieve sizes in the total gradation.

4. Reactivity with alkalis

The potential reactivity of aggregates with the alkalis in cement shall be evaluated by petrographic examination and, where applicable, the chemical method of test, ASTM C289, or by the results of previous tests or service records of RCC or concrete made from similar aggregates from the same source. The standards for evaluating potential reactivity shall be as described in ASTM C33, appendix A1.

Aggregates indicated by any of the above to be potentially reactive shall not be used unless applicable test results of mortar bar tests made according to ASTM Method C227 are available and indicate an expansion of less than 0.10 percent at 6 months in mortar bars made with cement containing not less than 0.8 percent alkalis expressed as sodium oxide.

Aggregates indicated to be potentially reactive, but within acceptable limits as determined by mortar bar test results or service records, shall be used only with low alkali cement, containing less than 0.60 percent alkalis expressed as sodium oxide.

5. Acceptance

Aggregates that fail to meet any requirement may be accepted only when the specification for RCC expressly contains either:

- a. Special provisions for acceptance that can be proven before the aggregates are used on the job and within a period such that no work under the contract will be delayed by the requirements of such proof, or

Material Specification 524 Aggregates for Roller Compacted Concrete (continued)

- b. Special provisions for specific mix requirements to compensate for the effects of the deficiencies.

6. Storing and handling

Aggregates shall be stored in stockpiles at specified storage areas. Separators, such as timbers, boards, or pre-cast concrete panels, shall be used between adjacent stockpiles to prevent the contamination and intermixing of dissimilar materials. The contractor shall be responsible for providing a system that reliably and consistently stockpiles the aggregates and allows the withdrawal of the aggregates from the stockpiles without contamination or segregation. Segregated or contaminated aggregates will not be allowed in production of RCC.

Material Specification 531—Portland Cement

1. Scope

This specification covers the quality of Portland cement.

2. Quality

Portland cement shall conform to the requirements of ASTM Specification C 150 for the specific types of cement. When Type I Portland cement is specified, Type IS Portland blast-furnace slag cement or Type IP Portland-pozzolan cement conforming to the requirements of ASTM Specification C 595 may be used unless prohibited by the specifications.

When air-entraining cement is required, the contractor shall furnish the manufacturer's written statement providing the source, amount, and brand name of the air-entraining component.

3. Storage at the construction site

Cement shall be stored and protected at all times from weather, dampness, or other destructive elements. Cement that is partly hydrated or otherwise damaged will not be accepted.

Material Specification 532—Supplementary Cementitious Materials

1. Scope

This specification covers the quality of supplementary cementitious materials for concrete.

2. Quality

Fly ash used as a partial substitution of Portland cement shall conform to the requirements of ASTM C618, Class Cor F except the loss on ignition shall not exceed 3 percent, unless otherwise specified. Lot-to-lot variation in the loss on ignition shall not exceed 1 percent. When specified, fly ash shall conform to one or more of the supplementary optional physical requirements listed in ASTM C618.

Blast-furnace slag used as a partial substitution of portland cement shall conform to ASTM Standard C989 for ground granulated blast-furnace slag.

Silica fume used as a partial substitution of Portland Cement shall conform to ASTM C1240.

Material Specification 533—Chemical Admixtures for Concrete

1. Scope

This specification covers the quality of chemical admixtures for manufacturer of portland cement concrete.

2. Quality

Air-entraining admixtures shall conform to the requirements of ASTM Specification C 260.

Water-reducing and/or retarding admixtures shall conform to the requirements of ASTM Specification C 494, Types A, B, D, F, or G.

Plasticizing or plasticizing and retarding admixtures shall conform to ASTM C 494, Types F or G, or C 1017 as applicable.

Accelerating or water-reducing and accelerating admixtures shall be noncorrosive and conform to the requirements of ASTM Specification C 494, Types C and E. The manufacturer shall provide long-term test data results from an independent laboratory verifying that the product is noncorrosive when used in concrete exposed to continuously moist conditions.

Material Specification 534—Concrete Curing Compound

1. Scope

This specification covers the quality of liquid membrane-forming compounds suitable for spraying on concrete surfaces to retard the loss of water during the concrete curing process.

2. Quality

The curing compound shall meet the requirements of either ASTM Specification C 309 or C 1315. If Type 1 is specified, a fugitive dye shall be used.

3. Delivery and storage

All curing compounds shall be delivered to the site of the work in the original container bearing the name of the manufacturer and the brand name. The compound shall be stored in a manner that prevents damage to the container and protects water-emulsion types from freezing.

Material Specification 535—Preformed Expansion Joint Filler

1. Scope

This specification covers the quality of preformed expansion joint fillers for concrete.

2. Quality

Preformed expansion joint filler shall conform to the requirements of ASTM Specification D 1752, Type I, Type II, or Type III, unless bituminous type is specified. Bituminous type preformed expansion joint filler shall conform to the requirements of ASTM Specification D 994, or D 1751.

Material Specification 536—Sealing Compound for Joints for Concrete and Concrete Pipe

1. Scope

This specification covers the quality of sealing compound for filling joints in concrete pipe and concrete structures.

2. Type

The compound must be a cold-application material unless otherwise specified.

3. Quality

The sealing compound must conform to the requirements of one of the following specifications:

- ASTM Specification C990—Joints for concrete pipe, manholes, and precast box sections using preformed flexible joint sealants.
- ASTM Specification C877—External sealing bands for concrete pipe, manholes, and precast box sections.
- ASTM Specification D6690—Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
- ASTM Specification C920—Elastomeric joint sealants for cold applied sealing and caulking of joints on mortar and concrete structures not subject to fuel spills. Use type S or M, grade NS for vertical joints; use type S or M, grade P or NS for horizontal joints. For class 25, use type M.

The sealing compound if used with other joint material, such as fillers or gaskets, must be compatible.

Material Specification 537—Nonmetallic Waterstops

1. Scope

This specification covers nonmetallic waterstops for use in joints of concrete structures.

2. Classification

Classes—Nonmetallic waterstops shall be of the following classes, as specified:

Class I shall be fabricated of either natural or synthetic rubber.

Class II shall be fabricated of vinyl chloride polymer or copolymer.

Types—Nonmetallic waterstops may be either split or solid and shall conform to the following types, as specified (see fig. 537–1):

Type A shall have ribbed anchor flanges and a smooth web. Flanges may be of uniform thickness or may have either a converging or a diverging taper toward the edges.

Type B shall have ribbed anchor flanges and a smooth web containing a hollow tubular center bulb having a wall thickness equal to at least one-half the web thickness, and the inside diameter (D) specified in the specifications or shown on the drawings. Flanges may be of uniform thickness or may have either a converging or a diverging taper toward the edges.

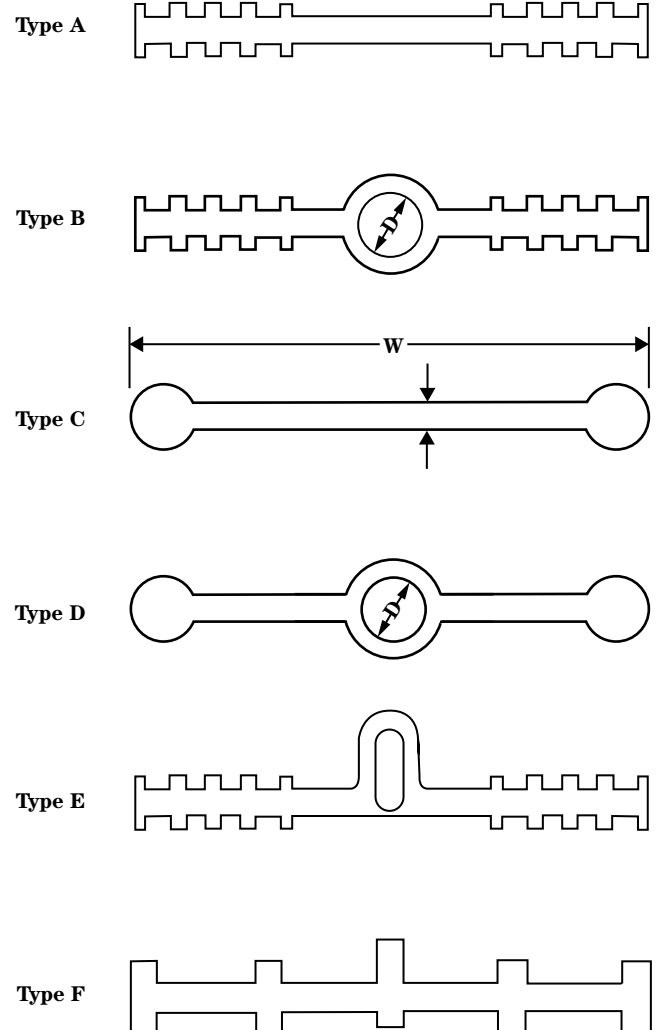
Type C shall have a single, circular bulb-type anchor flange at each edge and a smooth web.

Type D shall have a single, circular bulb-type anchor flange at each edge and a smooth web containing a hollow tubular center bulb having a wall thickness equal to at least one-half the thickness of the web, and the inside diameter (D) specified in the contract.

Type E shall have ribbed anchor flanges and a web molded or extruded in the form of a round or U-shaped bulb of the dimensions specified in the contract or shown on the drawings. The web bulb shall be connected at the open-end of the U by a thin membrane having a minimum thickness of 1/64 inch and a maximum thickness of 1/5 of the web thickness and design to prevent infiltration of wet concrete into the bulb and to tear when expansion of the joint

occurs. Flanges may be of uniform thickness or may have either a converging or a diverging taper toward the edges. Auxiliary positioning or nailing flanges may be provided as long as the functioning of the web bulb is not altered.

Figure 537–1 Types of nonmetallic waterstops



Material Specification 537 Nonmetallic Waterstops (continued)

Type F shall have ribbed anchor flanges with at least two extra heavy ribs designed to resist displacement of the waterstop during concrete placement on each flange, and a smooth web having a positioning or nailing flange attached at the center.

Type G shall be of special design conforming to the details shown on the drawings.

Sizes—Waterstops of types A through F shall be of the sizes specified in the specifications or shown on the drawings and listed in table 537–1 of this specification. Type G waterstops shall have the dimensions shown on the drawings.

3. Physical requirements

The extruded or molded material shall exhibit the properties specified herein when tested by the methods specified in section 4 of this specification.

Class I waterstops

- Hardness as determined by the Shore A durometer method shall be a minimum of 60.
- Specific gravity shall be a maximum of 1.2.
- Tensile strength shall be a minimum of 2,500 pounds per square inch.
- Ultimate elongation shall be a minimum of 450 percent.
- Compression set shall be a maximum of 30 percent.
- Water absorption in weight measurements shall not exceed 5 percent.
- Decrease in tensile strength and ultimate elongation after aging shall not exceed 20 percent.
- There shall be no sign of failure due to brittleness at a temperature of minus 35 degrees Fahrenheit.

Class II waterstops

- Hardness as determined by the Shore A durometer method shall be a minimum of 60.
- Specific gravity shall be a maximum of 1.4.

- Tensile strength shall be a minimum of 1,400 pounds per square inch.
- Ultimate elongation of the web shall be a minimum of 280 percent, and the flanges shall be a minimum of 200 percent.
- There shall be no sign of failure due to flange brittleness at a temperature of 0 degrees Fahrenheit nor of web brittleness at a temperature of minus 35 degrees Fahrenheit.

Table 537–1 Sizes of waterstops

Size designation	Web thickness (T) (inches)	Width (W) (inches)
1	1/16	5 1/4
2	3/32	3 3/4
3	3/32	4
4	3/32	5 1/4
5	3/32	6
6	1/8	4
7	1/8	5 1/4
8	1/8	6
9	5/32	4
10	5/32	4 1/2
11	5/32	9
12	3/16	4
13	3/16	5
14	3/16	6
15	3/16	9
16	1/4	6
17	1/4	9
18	3/8	5
19	3/8	6
20	3/8	9
21	1/2	6
22	1/2	9
23	1/2	12

Material Specification 537 Nonmetallic Waterstops (continued)

- Decrease in either tensile strength or ultimate elongation after accelerated extraction shall not exceed 15 percent.
- Results of alkali exposure:
 - a. After immersion for 7 days, the sample shall exhibit no loss of weight and a maximum weight gain of 0.25 percent, and the hardness measured by the Shore A durometer method shall not vary more than 5 points either plus or minus from the untreated sample.
 - b. After immersion for 30 days, the sample shall exhibit no loss of weight and a maximum weight gain of 0.40 percent, and the dimensions of the treated sample shall not vary by more than 1 percent from the untreated sample.

4. Test methods

Testing shall be conducted by the methods cited herein. All cited test methods are included in ASTM as follows:

- a. Hardness shall be determined by ASTM D 2240.
- b. Specific gravity shall be determined by ASTM D 792.
- c. Tensile strength shall be determined by ASTM D 412 for Class I waterstops and ASTM D 638 for Class II waterstops.
- d. Ultimate elongation shall be determined by ASTM D 412 for Class I waterstops and ASTM D 638 for Class II waterstops.
- e. Compression set shall be determined by ASTM D 395.
- f. Water absorption shall be determined by ASTM D 570.
- g. Tensile strength and ultimate elongation after aging shall be determined by ASTM D 412 for Class I waterstops and ASTM D 638 for Class II waterstops.
- h. Brittleness shall be determined by ASTM D 746 for Class II waterstops.

- i. Accelerated extraction shall be accomplished by procedures outlined by United States Army Corps of Engineers (USACE), Concrete Research Division (CRD) C 572 under the following conditions:

- (1) Samples shall not be less than 1/16 inch nor more than 1/8 inch in thickness.
- (2) The immersion medium shall be a solution prepared by dissolving 5 grams of chemically pure sodium hydroxide and 5 grams of chemically pure potassium hydroxide in 1 liter of water.
- (3) The samples shall be immersed in the medium for 14 days at a temperature of 145 degrees Fahrenheit, plus or minus 5 degrees Fahrenheit.
- (4) During the period of immersion, air shall be gently bubbled through the medium from a 0.25-inch diameter glass tube at an approximate rate of one bubble per second.

- (5) Fresh medium shall be provided each day.
- (6) Samples need not be dipped in acetone.

- j. The effects of alkalis shall be determined by USACE CRD C 572 under the following conditions:

- (1) Sample shall have a maximum thickness of 0.25 inch.
- (2) The immersion medium shall be as described for accelerated extraction above.
- (3) Fresh medium shall be provided every 7 days.
- (4) The samples shall be immersed in the medium for 30 days.
- (5) Samples need not be dipped in acetone.

5. Condition

Waterstops shall be extruded or molded in such a manner that the material is dense and homogeneous throughout and free from voids, tears, thins, indentations, or other imperfections. Unless otherwise

Material Specification 537 Nonmetallic Waterstops (continued)

specified, waterstops shall be symmetrical in shape and uniform in dimensions and shall be furnished in continuous strips a minimum length of 50 feet. Factory splices shall have a minimum tensile strength of 50 percent of the unspliced section.

6. Packaging and storing

Waterstops shall be packaged and stored by methods that provide protection from prolonged exposure to direct sunlight and/or excessive heat.

Material Specification 539—Steel Reinforcement (for concrete)

1. Scope

This specification covers the quality of steel reinforcement for reinforced concrete.

2. Quality

All reinforcement shall be free from loose or flaky rust, soil, oil, grease, paint, or other deleterious matter.

Steel bars for concrete reinforcement shall be grade 40, 50, or 60 deformed bars conforming to one of the following specifications:

- Deformed and plain billet-steel bars for concrete reinforcement—ASTM A 615
- Rail-steel deformed bars for concrete reinforcement—ASTM A 996
- Axle-steel deformed bars for concrete reinforcement—ASTM A 996

Dowels shall be plain round bars conforming to the same specifications listed above for steel bars.

Fabricated deformed steel bar mats for concrete reinforcement shall conform to the requirements of ASTM A 184.

Plain steel welded wire reinforcement for concrete reinforcement shall conform to the requirements of ASTM A 185.

Deformed steel welded wire reinforcement for concrete reinforcement shall conform to the requirements of ASTM A 497.

Epoxy-coated steel bars for concrete reinforcement shall conform to the requirements of ASTM A 775.

3. Dimensions of welded wire reinforcement

Gauges, diameters, spacing, and arrangement of wires for welded steel wire fabric shall be as defined for the specified style designations.

4. Storage

Steel reinforcement inventories at the site of the work shall be stored above the ground surface on platforms, skids, or other supports and shall be kept clean and protected from mechanical injury and corrosion.

Material Specification 541—Reinforced Concrete Pressure Pipe

1. Scope

This specification covers the quality of reinforced concrete pressure pipe and fittings.

2. Manufacture and fabrication

The pipe, the material used in its manufacture, and the methods of fabrication shall conform to the requirements of the following specifications applicable to the specified type of pipe.

Steel cylinder type, pre-stressed—AWWA Standard C301 for Pre-stressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids.

Steel cylinder type, not pre-stressed—AWWA Standard C300 for Reinforced Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids.

Noncylinder type, not pre-stressed—AWWA Standard C302 for Reinforced Concrete Pressure Pipe, Non-Cylinder Type, for Water and Other Liquids.

Steel cylinder type, pre-tensioned—AWWA Standard C303 for Concrete Pressure Pipe, Bar-Wrapped, Steel Cylinder Type for Water and Other Liquids.

Low head pressure pipe—ASTM Specification C361.

The following specification sections shall not apply:

- AWWA C300 and C301, sections 1.5 and 1.6.
- AWWA C302 and C303, sections 4.2 and 4.3.

3. Design

The actual pipe and fittings shall be designed by the manufacturer to withstand the specified external loads and internal pressures. Designs shall be by either of the following methods as applicable to the type of pipe specified:

Indirect design—ASTM C497 for Standard Test Method for Concrete Pipe, Manhole Sections, or Tile. Pipe design shall be based on the results of external crushing strength tests on a minimum 2-foot length of pipe or a specimen of equivalent size, design, and material. The test shall demonstrate the following bearing loads:

- For pipe manufactured according to ASTM C361, AWWA C300, or AWWA C302, the load required to produce a 0.01-inch crack 1 foot long.
- For pipe manufactured according to AWWA C301, the load required to produce a 0.001-inch crack 1 foot long or the load 10 percent greater than the specified three-edge bearing strength, whichever occurs first.

In lieu of actual testing for this contract, pipe design may be based on design curve previously approved and published by the Natural Resources Conservation Service.

Direct design—AWWA C304 for Design of Pre-Stressed Concrete Cylinder Pipe or AWWA Manual M9 for Concrete Pressure Pipe. Pipe design shall be based on structural analysis and design calculations.

Standard design—ASTM C361 for Reinforced Concrete Low Head Pressure Pipe. Pipe design shall be as published in the standard.

Material Specification 541 Reinforced Concrete Pressure Pipe (continued)**4. Steel reinforcement**

The steel reinforcements shall conform to the requirements of the specifications cited in section 2 for the specified type of pipe except that elliptical reinforcing cages or other reinforcements that require special orientation of the pipe during placement are not allowed.

5. Joints

The pipe joints shall conform to the requirements of the applicable specification for the pipe. They shall be bell-and-spigot type or double-spigot-and-sleeve type and shall have a positive groove in the spigot to contain the rubber gasket. The size and shape of the groove shall be such that it prevents displacement of the gasket by either internal or external water pressure when the joint is in any position within the required range of movement capability. Joint sleeves, also referred to as collars or coupling bands, shall conform to the requirements for bell rings in the applicable pipe specification.

The joints shall be constructed to permit relative movement of the adjoining pipe sections with no reduction of watertightness. The joint length and the limiting angle defining the required capability of relative movement at each joint shall be no less than specified.

Joint length refers to the permissible axial movement in the joint. It is defined as the maximum distance through which the spigot can move, relative to the bell or sleeve, from the fully engaged to the fully extended condition of the joint when the adjoining pipe sections are in parallel, concentric alignment. The joint is considered to be fully engaged when the spigot is inserted as far as it will go into the bell or sleeve and is fully extended when it is inserted the least amount that will ensure full confinement of the gasket and complete watertightness.

Joint length specified for double-spigot joints refers to the permissible movement in each of the spigot-to-sleeve connections, not the sum of the two.

The limiting angle of the joint is defined as the maximum deflection angle between adjoining pipe sections the joint will permit before the outer surface of the spigot comes into direct contact with inside of the mating bell or sleeve. If both spigot-to-sleeve connections of a double-spigot joint permit angular movement, the limiting angle of the joint is the sum of the two deflection angles permitted by the two connections.

6. Gaskets

The pipe joint gaskets shall conform to the requirements of the specifications cited in section 2 of this specification. They shall be endless rubber gaskets having circular cross section. The cross-sectional diameter of the gaskets shall conform to the pipe manufacturer's recommendation for the type and size of pipe furnished.

7. Marking

All pipe sections and special fittings shall be marked by the manufacturer with the manufacturer's name or trademark, the date of manufacture, the nominal size, design head, design external load, and the structure site for which it was designed and manufactured.

8. Certification

All component material and actual pipe fabrication shall be tested, inspected, and documented as prescribed in the manufacturing specifications for the type of pipe specified. All documentation as noted in the manufacturing specifications shall be submitted to the engineer. Documentation shall include current test reports on steel and steel wire reinforcing and compression tests of concrete used in the manufacture of the furnished pipe. Current tests are those that have been conducted within the last year.

Material Specification 541 Reinforced Concrete Pressure Pipe (continued)

For pipe design based on actual external crushing strength tests, the engineer shall witness the actual test.

For pipe design based on published design curves, a copy of the appropriate design curve marked to show the resultant concrete core stress and corresponding three-edge bearing load and a specification sheet showing all data and dimensions necessary to calculate the resultant core stress for the pipe furnished shall be submitted to the engineer.

For pipe design based on structural analysis and calculations, such analysis and calculations shall be submitted to the engineer. Printouts of such calculations by computer programs shall be sufficiently detailed to enable comparison with standardized procedures and methods.

Drawings, details, and descriptions of the pipe joints as necessary to show that the joint conforms to the specified requirements shall also be submitted.

Material Specification 547—Plastic Pipe

1. Scope

This specification covers the quality of poly vinyl chloride (PVC), polyethylene (PE), high-density polyethylene (HDPE), and acrylonitrile-butadiene-styrene (ABS) plastic pipe, fittings, and joint materials.

2. Material

Pipe—The pipe must be as uniform as commercially practicable in color, opaqueness, density, and other specified physical properties. It must be free from visible cracks, holes, foreign inclusions, or other defects. The dimensions of the pipe must be measured as prescribed in ASTM D2122.

Unless otherwise specified, the pipe must conform to the requirements listed in this specification and the applicable reference specifications in table 547–2, the requirements specified in Construction Specification 45, Plastic Pipe, and the requirements shown on the drawings.

Fittings and joints—Fittings and joints must be of a schedule, SDR or DR, pressure class, external load carrying capacity, or pipe stiffness that equals or exceeds that of the plastic pipe. The dimensions of fittings and joints must be compatible with the pipe and measured in accordance with ASTM D2122. Joint and fitting material must be compatible with the pipe material. The joints and fittings must be as uniform as commercially practicable in color, opaqueness, density, and other specified physical properties. They must be free from visible cracks, holes, foreign inclusions, or other defects.

Fittings and joints must conform to the requirements listed in this specification, the requirements of the applicable specification referenced in the ASTM or AWWA specification for the pipe, the requirements specified in Construction Specification 45, and the requirements shown on the drawings.

Solvents—Solvents for solvent welded pipe joints must be compatible with the plastic pipe used and must conform to the requirements of the applicable specification referenced in the ASTM or AWWA specification for the pipe, fitting, or joint.

Gaskets—Rubber gaskets for pipe joints must conform to the requirements of ASTM F477, Elastomeric Seals (Gaskets) for Jointing Plastic Pipe.

3. Perforations

When perforated pipe is specified, perforations must conform to the following requirements unless otherwise specified in Construction Specification 45 or shown on the drawings:

- a. Perforations must be either circular or slots.
- b. Circular perforations must be $1/4 \pm 1/16$ -inch diameter holes arranged in rows parallel to the axis of the pipe.
- c. Perforations must be evenly spaced along each row such that the center-to-center distance between perforations is not less than eight times the perforation diameter. Perforations may appear at the ends of short and random lengths. The minimum perforation opening per foot of pipe must be as shown in table 547–1.

Material Specification 547

Plastic Pipe (continued)

Table 547-1 Perforations

Nominal pipe size (in)	Minimum number of rows		Minimum opening/foot (in ²)
	circular	slot	
4	4	2	0.22
6	4	2	0.44
8	4	2	0.44
10	4	2	0.44
12	6	2	0.66

- d. Rows must be arranged in two equal groups at equal distance from the bottom on each side of the vertical centerline of the pipe. The lower-most rows of perforations must be separated by an arc of not less than 60 degrees or more than 125 degrees. The uppermost rows of perforations must be separated by an arc not to exceed 166 degrees. The spacing of rows between these limits must be uniform. The minimum number of rows must be as shown in table 547-1.
- e. Slot perforations must be symmetrically located in two rows, one on each side of the pipe centerline. Slot perforations must be located within the lower quadrants of the pipe with slots no wider than 1/8 inch and spaced not to exceed 11 times the perforation width. Minimum perforation opening per lineal foot of pipe must be as shown in table 547-1.
- f. On both the inside and outside of the pipe, perforations must be free of cuttings or frayed edges and of any material that would reduce the effective opening.

Material Specification 547 Plastic Pipe (continued)**Table 547–2** Pipe specification

Pipe	Specification
Poly vinyl chloride (PVC) pipe	
Plastic pipe - Schedules 40, 80, 120	ASTM D1785
	ASTM D2466
Pressure rated pipe - SDR Series	AWWA C900
	ASTM D2241
Plastic drain, waste, and vent pipe and fittings	ASTM D2665
Joints for IPS PVC pipe using solvent weld cement.....	ASTM D2672
Composite sewer pipe.....	ASTM D2680
Type PSM PVC sewer pipe and fittings	ASTM D3034
Large-diameter gravity sewer pipe and fittings.....	ASTM F679
Smooth-wall underdrain systems for highway, airport, and similar drainage	ASTM F758
Profile gravity sewer pipe and fittings based on controlled inside diameter.....	ASTM F794
Corrugated sewer pipe with a smooth interior and fittings.....	ASTM F949
Pressure pipe, 4-inch through 12-inch for water distribution	AWWA C900
Water transmission pipe, nominal diameters 14-inch through 36-inch.....	AWWA C905
Polyethylene (PE) plastic pipe	
Schedule 40.....	ASTM D2104
12 to 60-inch annular corrugated profile-wall polyethylene (PE) pipe and fittings	ASTM F2306
SIDR-PR based on controlled inside diameter.....	ASTM D2239
Schedules 40 and 80 based on outside diameter.....	ASTM D2447
SDR-PR based on controlled outside diameter	ASTM 3035
High-density polyethylene (HDPE) plastic pipe	
Plastic pipe and fittings.....	ASTM D3350
SDR-PR based on controlled outside diameter	ASTM F714
Heat joining polyolefin pipe and fittings	ASTM D2657
Acrylonitrile-butadiene-styrene (ABS) pipe	
Plastic pipe, schedules 40 and 80	ASTM D1527
Composite sewer pipe.....	ASTM D2680

Material Specification 553—Ductile Iron Pipe

1. Scope

This specification covers the quality of ductile iron pipe and fittings.

2. Pipe

Ductile iron pipe shall conform to the requirements of ANSI/AWWA C151/A21.51, Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds for Water or Other Liquids, and ANSI/AWWA C115/A21.15, Flanged Ductile Iron Pipe with Threaded Flanges.

3. Fittings

Ductile-iron pipe fittings shall conform to the requirements of ANSI/AWWA C110/A21.10, Ductile Iron and Gray Iron Fittings, 3 through 48 inch, for Water and Other Liquids, and ANSI/AWWA C153/A21.53, Ductile Iron Compact Fittings, 3 through 12 inch, for Water and Other Liquids.

4. Joints

Rubber-gasket joints for ductile iron pipe and fittings where either mechanical or push-on joints are used shall conform to the requirements of ANSI/AWWA C111/A21.11, Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.

5. Lining

Interior lining for ductile-iron pipe and fittings shall conform to the requirements of ANSI/AWWA C104/A21.4, Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water.

6. Encasement

Encasement for ductile iron pipe and fittings shall conform to the requirements of ANSI/AWWA C105/A21.5, Polyethylene Encasement for Ductile Iron Pipe for Water and Other Liquids.

Material Specification 571—Slide Gates

1. Scope

This specification covers the quality of metal slide gates for water control.

2. Class and type of gate

The class of gate is expressed as a numerical symbol composed of the seating head and unseating head. The two numbers are separated by a hyphen with the seating head listed first. For this purpose, the heads must be expressed in terms of feet of water. Gates must be of the specified types as defined below:

Light duty

Type MLS-1 Cast iron with cast iron seat facings

Type MLS-2 Fabricated metal

Moderate duty

Type MMS-1 Cast iron with bronze seat facings, cast iron or galvanized structural steel guides, and galvanized steel, bronze, or stainless steel fasteners.

Type MMS-2 Cast iron with bronze seat facings, cast iron or stainless steel guides, and bronze or stainless steel fasteners. Guides and fasteners are stainless steel, when specified.

Heavy-duty

Type MHS-1 Gray cast iron slides, frames, guides, and yokes, fitted with bronze seat facings, bronze wedges and wedge blocks or wedge seat facings, and bronze stem blocks or thrust nuts, bronze or stainless steel fasteners, and cold-rolled steel stems except where stainless steel stems are specified.

Type MHS-2 Gray cast iron slides, frame, guides, and yokes, fitted with stainless steel seat facings, wedges, wedge seat facings, stems and fasteners and austenitic cast iron stem blocks or thrust nuts.

Type MHS-3 Austenitic gray cast iron slides, frames, guides, and yokes, fitted with nickel-copper alloy seat facings, wedges, wedge seat facings, stems and fasteners and austenitic cast iron stem blocks or thrust nuts.

3. Quality of material

Material for slide gates and appurtenances must conform to the requirements of the applicable specifications listed below for the alloy, grade, type, or class of material and the condition and finish appropriate to the structural and operational requirements.

Material	ASTM specification
Cast iron and gray cast iron.....	A48, Class 30 A126, Class B
Austenitic cast iron.....	A436
Structural steel shapes, plates.....	A36 and bars
Cold rolled steel.....	A108
Carbon steel bars.....	A108 or A575
Stainless steel.....	A167, A276, A582; Type 302, 303, 304, or 304L
Castings, nickel and nickel alloy.....	A494
Carbon steel sheets and strips.....	A1011
Zinc-coated carbon steel sheets.....	A653 or A924
Bronze bar, rods, shapes.....	B21 or B98
Naval bronze.....	B21
Phosphor bronze.....	B103 or B139
Manganese bronze.....	B138 or B584
Silicon bronze.....	B98 or B584
Cast bronze.....	B584
Nickel-copper alloy plate, sheet.....	B127 strip
Nickel-copper alloy rod or bar.....	B164
Rubber for gaskets and seals.....	D395, D412, D471, D572, or D2240

Galvanizing (zinc coating) must conform to the requirements of Material Specification 582.

4. Fabricated metal gates (light-duty gates)

Fabricated metal gates must be built to withstand the seating head expressed by the gate class designation. Unless otherwise specified, the gates must be galvanized steel with flat-back frames.

5. Cast iron gates (light-duty gates)

The frame must be cast iron of the specified type. The front face must be machined to receive the gate guides.

The gate slide must be cast iron and be fabricated to withstand the seating and unseating heads expressed by the gate class designation as defined in section 2 of this specification.

Grooves must be cast on the vertical sides of the slide to match the guide angles.

The gate guides must be galvanized structural steel and be fabricated to withstand the total thrust of the gate slide from water pressure and wedge action under maximum operating conditions.

Wedges and wedge seats must have smooth bearing surfaces. Wedges may be cast as integral parts of the slide. Removable wedges and wedge seats must be fastened to the slide, frame, or guides by means of suitable studs, screws, or bolts and be firmly locked in place after final adjustment. Each interacting set of wedge and wedge seat must be adjustable as needed to ensure accurate and effective contact. Adjusting bolts or screws must be bronze or galvanized steel.

Seat facings must be machined to a smooth finish to ensure proper watertight contact.

6. Frame or seat (moderate- and heavy-duty gates)

The frame must be cast iron and of the specified type. The front face must be machined to receive the gates guides, and the rear face must be machined as required to match the specified attaching means. For heavy-duty gates, a dovetailed groove must be machined on the perimeter of the front face to receive the seat facing.

7. Gate slide (moderate- and heavy-duty gates)

The gate slide must be cast iron, rectangular in shape, and have horizontal and vertical stiffening ribs of sufficient section to withstand the seating and unseating heads expressed by the gate class designation as defined in section 2 of this specification. For heavy-duty gates, a dovetailed groove must be machined on the perimeter of the slide face to receive the seat facing.

Tongues must be machined on the vertical sides of the slide along its entire height to match the guide grooves and angles with a maximum clearance of 1/16 inch for gates smaller than 54 inches by 54 inches, and 1/8 inch for larger gates.

A nut pocket with reinforcing ribs must be integrally cast on the vertical centerline and above the horizontal centerline of the slide. The pocket must be of a shape adequate to receive a flat-backed thrust nut or stem block and be built to withstand the opening and closing thrust of the stem.

8. Gate guides (moderate- and heavy-duty gates)

The gate guides must be built to withstand the total thrust of the gate slide from water pressure and wedge action. The gate guides must be cast iron for heavy-duty gates.

Grooves must be machined-in cast iron guides to receive the tongue on the gate slide throughout the entire length of the guide.

The guides must be of adequate length to retain a minimum of one-half the height of the gate slide when the gate is fully opened.

9. Wedges and wedge seats (moderate- and heavy-duty gates)

Pads for supporting wedges, wedge seats (or blocks), and wedge loops (or stirrups) must be cast as integral parts of the gate frame, slide, or guides and be accurately machined to receive those parts. Wedges and wedge seats must have smooth bearing surfaces for moderate-duty gates and have machine finish bearing surfaces for heavy-duty gates. Removable wedges may be cast as integral parts of the slide for moderate-duty gates. Wedges must be fastened to the gate slide, frame, or guides with suitable studs, screws, or bolts and be firmly locked in place after final adjustment. Each interacting set of wedge and wedge seat must be adjustable as needed to ensure accurate and effective contact.

10. Seat facing

Moderate-duty gates—Seat facings must be machined to a smooth finish to ensure proper

watertight contact. Bronze facings must be securely attached by welding or other approved methods.

Heavy-duty gates—Seat facings must be pressed or impacted into the machined dovetailed grooves on the gate slide and frame and machined to a smooth finish to ensure proper watertight contact.

11. Yoke

When a self-contained gate is specified, the yoke must be of such design as to withstand the loads resulting from normal operation of the gate. For moderate- and heavy-duty gates, cast iron yokes must be provided with machined pads for connecting to the ends of gate guides and to receive the stem thrust cap or hand-wheel lift.

12. Flush bottom seal (heavy-duty gate)

When a flush bottom sealing gate is specified, a solid, square-corner type rubber seal must be provided at the bottom of the gate opening. It must be securely attached either to the bottom of the slide or to the frame. Metal surfaces bearing on the rubber seal must be smooth and rounded as necessary to prevent damage to the seal during gate operation.

13. Gate stem and lift (or hoist)

The gate stem and lift or hoist must be of the specified type, size, and capacity. If hand operated, it must be capable of moving the gate slide under normal conditions with the specified seating and/or unseating head of water against the gate, following unseating from the wedging device, with a pull on the hand-wheel or crank of not more than 25 pounds.

Unless otherwise specified, the stem must be carbon steel and be furnished in sections as necessary to permit reasonable ease of installation. Couplings must be bolted, pinned, or keyed to the stem. The stem must be furnished with rolled or machine-cut 29-degree Acme threads of sufficient length to completely open the gate. The threads must be smooth and of uniform lead and cross-section, such that the nut can travel the full length without binding or excessive friction. For moderate- and heavy-duty gates, the stem must be threaded for connection to the stem block or thrust nut on the gate slide.

The lift must be compatible with the type of stem furnished. Unless otherwise specified, the lift nut must be cast bronze for light- and moderate-duty gates and cast manganese bronze for heavy-duty gates and be fitted with ball or roller thrust bearings designed to withstand the normal thrust developed during opening and closing of the gate at the maximum operating heads. All gears, sprockets, and pinions must be machine-cut, with ratios and strength adequate to withstand expected operating loads. Sufficient grease fittings must be provided to allow lubrication of all moving parts. An arrow and the word "open" must be cast on the rim of the hand-wheel or on the lift housing to indicate the direction of gate opening. Unless otherwise specified, the lift for the nonrising-stem gate must be provided with an indicator capable of showing both when the gate is fully open and when it is fully closed for the moderate- and heavy-duty gates.

Provisions must be made to prevent stem rotation within the stem block or thrust nut or at the connection of the gate slide.

Stop collars must be provided to prevent over-travel in opening and closing the gate.

14. Stem guides

Unless otherwise specified, stem guides must be cast iron for light-duty gates and cast iron with bronze bushed collars for moderate- and heavy-duty gates. They must be fully adjustable in two directions.

15. Wall thimble (moderate- and heavy-duty gates)

When a wall thimble is specified, it must be of the same cast iron used in the gate frame and of the section, type, and depth specified. The front flange must be machined to match the gate frame and drilled and tapped to accurately receive the gate attachment studs.

Gaskets or mastic to be installed between the thimble and the gate frame must conform to the recommendations of the gate manufacturer and be furnished with the thimble.

16. Fasteners

Unless otherwise specified, all anchor bolts and other fasteners must be galvanized steel or bronze for light-duty gates, galvanized steel or stainless steel or bronze for moderate-duty gates, and of the quality and size recommended by the gate manufacturer for heavy-duty gates. All anchor bolts, assembly bolts, screws, nuts, and other fasteners must be of ample section to withstand the forces created by operation of the gate while subjected to the specified seating and unseating heads. Anchor bolts must be furnished with two nuts to facilitate installation.

17. Installation instructions

Before installation, provide the engineer with the manufacturer's complete installation data, instructions for adjustments, and drawings or templates showing the location of all anchor bolts for each gate.

18. Painting

When specified, gates and accessories must be painted by the designated paint system.

19. Certification

The supporting data submitted to the engineer must include the name of the manufacturer, the manufacturer's model number (for standard catalogue items), or the seating and unseating heads for which the gate is designed. Include any drawings and specifications necessary to show that the gate conforms to the requirements of this specification.

Material Specification 581—Metal

1. Scope

This specification covers the quality of steel and aluminum alloys.

2. Structural steel

- Structural steel shall conform to the requirements of ASTM A 36.
- High-strength low-alloy structural steel shall conform to ASTM A 242 or A 588.
- Carbon steel plates of structural quality to be bent, formed, or shaped cold shall conform the ASTM A 283, Grade C.
- Carbon steel sheets of structural quality shall conform to ASTM Standard A 1011, Grade 40, or A 1008, Grade 40.
- Carbon steel strip of structural quality shall conform to ASTM Standard A 1011, Grade 36.

3. Commercial or merchant quality steel

Commercial or merchant quality steel shall conform to the requirements of the applicable ASTM listed below:

Product	ASTM standards
Carbon steel bars.....	A 575, Grade M 1015 to Grade M 1031
Carbon steel sheets	A 1011
Carbon steel strips.....	A 1011
Zinc-coated carbon steel sheets.....	A 653 or A 924

4. Aluminum alloy

Aluminum alloy products shall conform to the requirements of the applicable ASTM standard listed below. Unless otherwise specified, alloy 6061-T6 shall be used.

Product	ASTM standards
Standard structural shape	B 308
Extruded structural pipe and tube	B 429
Extruded bars, rods, shapes, and tubes.....	B 221
Drawn seamless tubes	B 210
Rolled or cold-finished bars, rods, and wire	B 211
Sheet and plate.....	B 209

5. Bolts

Steel bolts shall conform to the requirements of ASTM Standard A 307. If high-strength bolts are specified, they shall conform to the requirements of ASTM A 325.

When galvanized or zinc-coated bolts are specified, the zinc coating shall conform to the requirements of ASTM Standard A 153 except that bolts 0.5 inch or less in diameter may be coated with electro-deposited zinc or cadmium coating conforming to the requirements of ASTM Standard B 633, Service Condition SC 3, or ASTM B 766, unless otherwise specified.

6. Rivets

Unless otherwise specified, steel rivets shall conform to the requirements of ASTM Specification A 31, Grade B. Unless otherwise specified, aluminum alloy rivets shall be Alloy 6061 conforming to the requirements of ASTM Standard B 316.

7. Welding electrodes

Steel welding electrodes shall conform to the requirements of American Welding Society Specification AWS A5.1, "Specification for Mild Steel Covered Arc-Welding Electrodes," except that they shall be uniformly and heavily coated (not washed) and shall be of such a nature that the coating does not chip or peel while being used with the maximum amperage specified by the manufacturer.

Aluminum welding electrodes shall conform to the requirements of American Welding Society Specification AWS A5.10, "Specification for Aluminum and Aluminum-Alloy Welding Rods and Bare Electrodes."

Material Specification 582—Galvanizing

1. Scope

This specification covers the quality of zinc coatings applied to iron and steel productions.

2. Quality

Zinc coatings shall conform to the requirements of ASTM A 123 for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products or as otherwise specified in the items of work and construction details of the Construction Specification.

ASTM A 123 covers both fabricated and nonfabricated products; e.g., assembled steel products, structural steel fabrications, large tubes already bent or welded

before galvanizing, and wire work fabricated from noncoated steel wire. It also covers steel forgings and iron castings incorporated into pieces fabricated before galvanizing or which are too large to be centrifuged (or otherwise handled to remove excess galvanizing bath metal).

Items to be centrifuged or otherwise handled to remove excess zinc shall meet the requirements of ASTM A 153, except bolts, screws, and other fasteners 0.5 inch or less in diameter may be coated with electro-deposited zinc or cadmium coating conforming to the requirements of ASTM B 766, coating thickness Class 5, Type III, or ASTM B 633, Service Condition SC-3, unless otherwise specified.

Material Specification 591—Field Fencing Material

1. Scope

This specification provides the minimum quality requirements for the material used in the construction of field fences.

2. Wire gauge

When the size of steel wire is designated by gage number, the diameter must be as defined for U.S. Steel Wire Gauge.

3. Fencing

Fencing material must conform to the requirements of ASTM A121 for barbed wire, ASTM A16 for woven wire, ASTM A390 for poultry fence or netting, and ASTM A854 for high-tensile wire¹. Barbed wire and woven wire must be class-3 zinc coated as specified in ASTM A641 unless otherwise specified. High-tensile wire must have type-I zinc coating unless otherwise specified.

4. Stays, fasteners, and tension wire

Stays and fasteners must conform to the requirements of the specified ASTM for the fencing material. Tension wires must have a tensile strength not less than 58,000 pounds per square inch. Stays, fasteners, and tension wire must have class-3 zinc coating as specified in ASTM A641 unless otherwise specified.

5. Wood fence posts and braces

Unless otherwise specified, wood posts must be naturally rot resistant, preservative-treated, or other wood of equal life and strength. At least half the diameter or diagonal dimension of naturally rot resistant posts must be in heartwood. Provide new wood posts that are sound, free from decay with all limbs trimmed substantially flush with the body. All posts must be substantially straight throughout their full length.

Make tops convex rounded or inclined. Provide posts free of ring shake, season cracks more than ¼-inch wide, splits in the end, and unsound knots. Pine must be pressure treated in conformance with Material Specification 585, Wood Preservatives and Treatment. Wood braces must be of wood material equal to or better than construction grade Douglas fir. Wood braces must be pressure treated in conformance with Material Specification 585.

6. Steel fence posts and braces

Steel fence posts must conform to the requirements of ASTM A702. Posts with punched tabs for fastening the wires must not be installed. Bracing pipes must conform to the requirements of ASTM A53 except that the A53 requirements for hydrostatic test will not apply.

7. Concrete fence posts

Concrete fence posts must be manufactured to the specified requirements of size, shape, and strength.

8. Panel gates

Panel gates must be the specified types, sizes, and quality and include the necessary fittings required for installation. Gates must be of rigid construction free from sag or twist. The fittings must consist of not less than two hinges and one latch or galvanized chain for fastening. Latches must be of such design that a padlock may be used for locking. All fittings must be of equal or greater quality than the gate manufacturer's standard.

9. Wire gates

Wire gates must be the type shown on the drawings, constructed in accordance with specifications, at the locations, and to the dimensions shown on the drawings. The material must conform to the kinds, grades, and sizes specified for new fence, and must include the necessary fittings and stays.

10. Staples

Staples required to secure the fence wire to wood posts must be 9-gauge galvanized wire with a minimum length of 1.5 inches for soft woods and a minimum length of 1 inch for close-grain hardwoods.

11. Galvanizing

All iron and steel fencing material, except as otherwise specified, must be zinc coated by the hot dip process meeting the requirements of Material Specification 582. Clips, bolts, and other small hardware must be protected by hot-dipped galvanizing, electro-deposited zinc, or cadmium coating.

Material Specification 592—Geotextile

1. Scope

This specification covers the quality of geotextile, including geotextile for temporary silt fence.

2. General Requirements

Fiber (thread and yarn) used in the manufacture of geotextile must consist of synthetic polymer composed of a minimum of 85 percent by weight polypropylene, polyester, polyamide, polyethylene, polyolefin, or polyvinylchloride. The fiber must be formed into a stable network of filaments retaining dimensional stability relative to each other. The geotextile must be free of defects such as holes, tears, and abrasions. The geotextile must be free of any chemical treatment or coating that significantly reduces its porosity. Fibers must contain stabilizers, inhibitors, or both to enhance resistance to ultraviolet light. Geotextile, other than that used for temporary silt fence, must conform to the requirements in tables 592-1 or 592-2, as applicable. Geotextile used for temporary silt fence must conform to ASTM D6461.

Thread used for factory or field sewing must be of a color contrasting to the color of the fabric and made of high-strength polypropylene, polyester, or polyamide material. It must be as resistant to ultraviolet light as the geotextile being sewn.

3. Classification

There are two geotextile classifications, woven and nonwoven. Geotextile for temporary silt fence may be either woven or nonwoven. Slit film woven geotextile may not be used except for temporary silt fence.

Woven geotextiles are made from fabric that is formed by the uniform and regular interweaving of the threads or yarns in two directions. Woven fabrics must be manufactured from monofilament yarn formed into a uniform pattern with distinct and measurable openings, retaining their position relative to each other. The fabric must have a selvedge edge or otherwise be finished to prevent unraveling.

Nonwoven geotextiles are made from fabric that is formed by a random placement of threads in a mat and bonded by needle punching, heat bonding, or resin bonding. Nonwoven geotextile must have distinct but variable small openings, retaining their position relative to each other when bonded. The use of heat- or resin-bonded nonwovens is restricted as specified in note 2 of table 592-2.

4. Sampling and Testing

The geotextile must conform to tables 592-1, 592-2, or ASTM D6461 as applicable for the product type shown on the label. Documentation described in either a. or b. below is required to verify the product meets the specified requirements:

- a. Product properties as listed in the latest edition of the "Specifiers Guide," Geosynthetics (Industrial Fabrics Association International, 1801 County Road B, West Roseville, MN 55113-4061 or at <http://www.geosindex.com>), and that represent average roll values, are acceptable.
- b. Test data from the geotextile production run for each of the specified tests listed in tables 592-1, 592-2, or ASTM D6461, as applicable.

5. Shipping and Storage

Each roll of geotextile must be labeled or tagged to clearly identify the brand, class, and the individual production run in accordance with ASTM D4873. The geotextile must be shipped and transported in rolls wrapped with a cover for protection from moisture, dust, dirt, debris, and ultraviolet light. The cover must be maintained undisturbed to the maximum extent possible before replacement.

Material Specification 592 Geotextile (continued)**Table 592–1** Requirements for woven geotextiles ^{1/}

Property	Test method	Class I	Class II	Class III	Class IV
Grab tensile strength (lb)	ASTM D4632	247 minimum	180 minimum	180 minimum	315
Elongation at failure (%)	ASTM D4632	<50	<50	<50	<50
Trapezoidal tear strength (lb)	ASTM D4533	90 minimum	67 minimum	67 minimum	112 minimum
Puncture strength (lb)	ASTM D6241	495 minimum	371 minimum	371 minimum	618 minimum
Ultraviolet stability (% retained strength)	ASTM D4355	50 minimum	50 minimum	50 minimum	70 minimum
Permittivity (sec ⁻¹)	ASTM D4491		as specified		
Apparent opening size (AOS) ^{2/}	ASTM D4751		as specified		
Percent open area (POA) (%)	USACE ^{3/} CWO-02215-86		as specified		

1/ All values are minimum average roll values (MARV) in the weakest principal direction, unless otherwise noted.

2/ Maximum average roll value.

3/ Note: CWO is a USACE reference.

Material Specification 592 Geotextile (continued)**Table 592–2** Requirements for nonwoven geotextiles ^{1/}

Property	Test method	Class I ^{2/}	Class II ^{2/}	Class III ^{2/}	Class IV ^{2/}
Grab tensile strength (lb)	ASTM D4632 grab test	202 minimum	157 minimum	112 minimum	202 minimum
Elongation at failure (%)	ASTM D4632	50 minimum	50 minimum	50 minimum	50 minimum
Trapezoidal tear strength (lb)	ASTM D4533	79 minimum	56 minimum	40 minimum	79 minimum
Puncture strength (lb)	ASTM D6241	433 minimum	309 minimum	223 minimum	433 minimum
Ultraviolet light (retained strength) (%)	ASTM D4355	50 minimum	50 minimum	50 minimum	50 minimum
Permittivity sec ⁻¹	ASTM D4491		0.70 minimum or as specified		
Apparent opening size (AOS) (mm) ^{3/}	ASTM D4751		0.22 maximum or as specified		

1/ All values are minimum average roll values (MARV) in the weakest principal direction, unless otherwise noted.

2/ Needle punched geotextiles may be used for all classes. Heat-bonded or resin-bonded geotextiles may be used for class IV only.

3/ Maximum average roll value.

PART VI

PREVAILING WAGE RATES DETERMINATION

Per PART III – Supplemental Conditions

Article 8 – Wages / Benefits

PART VI
PREVAILING WAGE RATES DETERMINATION
[Per PART III – Supplemental Conditions, Article 8 – Wages / Benefits]
Heavy & Highway Construction (includes Hays County, Texas)

Occupation	Rate	Occupation	Rate
Cement Mason/Concrete Finisher (Paving and Structures)	\$12.56	POWER EQUIPMENT OPERATOR	
		Front End Loader, 3 CY or less	\$13.04
Electrician	26.35	Front End Loader, over 3 CY	13.21
Form Builder/Setter (Paving & Curb)	12.94	Loader / Backhoe	14.12
Form Builder/Setter (Structures)	12.87	Mechanic	17.10
Laborer: Asphalt Raker	12.12	Milling Machine	14.18
Laborer: Flagger	* 9.45	Motor Grader, Fine Grade	18.51
Laborer: Common	*10.50	Motor Grader, Rough	14.63
Laborer: Utility	12.27	Pavement Marking Machine	19.17
Laborer: Pipelayer	12.79	Reclaimer / Pulverizer	12.88
Laborer: Work Zone Barricade Servicer	11.85	Roller, Asphalt	12.78
Painter (Structures)	18.34	Roller, Other	*10.50
POWER EQUIPMENT OPERATOR		Scraper	12.27
Agricultural Tractor	12.69	Spreader Box	14.04
Asphalt Distributor	15.55	Trenching Machine, Heavy	18.48
Asphalt Paving Machine	14.36	Servicer	14.51
Boom Truck	18.36	STEEL WORKER	
Broom or Sweeper	11.04	Reinforcing	14.00
Concrete Pavement Finishing Machine	15.48	Structural	19.29
Crane, Hydraulic 80 tons or less	18.36	TRAFFIC SIGNAL INSTALLER	
Crane, Lattice Boom 80 tons or less	15.87	Traffic Signal/Light Pole Worker	16.00
Crane, Lattice Boom over 80 tons	19.38	TRUCK DRIVER	
Crawler Tractor	15.67	Lowboy-Float	15.66
Directional Drilling Locator	11.67	Off Road Hauler	11.88
Directional Drilling Operator	17.24	Single Axle	11.79
Excavator 50,000 lbs. or less	12.88	Single or Tandem Axel Dump Truck	11.68
Excavator over 50,000 lbs.	17.71	Tandem Axel Trailer w/Semi Trailer	12.81
Foundation Drill, Truck Mounted	16.93	Welder	15.97

Notes: * Per Executive Order 13658, hourly minimum wage for calendar year 2021 is **\$10.95 per hour**.

Welders receive rate prescribed for craft performing operation to which welding is incidental.