Contract Documents For
Construction Of
Navajo Nation Municipal Pipeline
HDD Repair Project

Bureau of Reclamation

VOLUME 2
DRAFT Technical Specifications

November 2023

** See Volume 1 for Contract Documents, Appendices, and Exhibits*

DRAFT VOLUME 2

TECHNICAL SPECIFICATIONS

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1.2 CONTRACT DESCRIPTION

A. Work of the Project includes a total Hortizonal Directional Drill (HDD) length of roughly 0.68 miles (3,600 LF) of 24-inch diameter HDPE pipeline, tie in to existing NNMP with associated isolation valves, flush valves, and air valves.

B. Perform Work of Contract on a unit cost basis with Owner in accordance with Conditions of Contract.

1.3 SPECIAL CONSIDERATIONS

A. Contractor shall abide by all permit stipulations and requirements, including but not necessarily limited to BIA and Navajo Nation environmental and archaeological stipulations, utility pipeline encroachment agreements, San Juan County, and BIA-NRO Department of Transportation road crossing permits, regardless of whether such permits are obtained by the Owner, Engineer or Contractor.

1. Navajo Nation's environmental and cultural stipulations for the pipeline is provided in Appendix C. Encroachment agreements are provided in Appendix D. Road permits, if obtained by the Owner or Engineer, are included in Appendix E. Contractor shall comply with all of these stipulations, terms and conditions. Said compliance shall be considered incidental to the cost of the project.

B. It is the Contractor's responsibility to apply for and obtain all permits required for the Work that have not already been obtained by the Owner or Engineer. No additional compensation will be provided for obtaining permits and all costs will be considered incidental to the

Project. It is anticipated the Contractor will need to obtain, at a minimum, a 402 permit from U.S. EPA for pipeline flushing. Contractor is wholly responsible to determine what additional permits may be required.

C. Correspondence from the power line company are included in Appendix D to the Contract Documents. Contractor is responsible for compliance, including notifying Owner, Engineer and utility companies prior to crossings. Contractor shall adhere to all requirements of the electrical power line crossing permits, if required, and any special notes provided in design drawings, including notification requirements.

D. Cultural Resources Requirements:

1. Contractor must be familiar with and abide by the cultural resource stipulations included in Appendix C of the Contract Documents.

2. Contractor must allow archaeologist and/or Owner's representative to have access to the project site for examination of cultural resources. Contractor must allow archaeologist and/or Owner's representative to halt work, as necessary, to examine cultural resources in spoils and/or trenches. Contractor may move equipment to another location while archaeologist completes his/ her examination of cultural resources. Contractor shall not request additional compensation for any delays caused by archaeological examinations. However, such delays may be considered excused delays and not count toward Contractor's deadline for substantial completion, provided Contractor requests additional time within one (1) week of the delay.

3. Archaeological Discovery in the Presence or Absence of Archaeological Monitoring: During surface-disturbance actions within the vicinity of the culturally sensitive areas, if an any previously unidentified historic or prehistoric cultural resources are discovered, then all work within 100 feet of the discovery will be suspended and the discovery promptly reported to the Engineer and the appropriate agency—Navajo Nation Historic Preservation Department (for Navajo lands). If the discovery is evaluated as being significant, treatment of the discovery may be required prior to allowing the project to proceed. Further damage to significant cultural resources will not be allowed until any required treatment is completed.

E. Biological Resources Requirements:

1. The Owner will provide, at no cost to the Contractor, a qualified wildlife biologist to conduct pre-construction survey(s) for migratory bird nests if work is to be performed during the active bird breeding season between March 1 and August 15.

2. In the event an active bird nest or species habitat is discovered, the Owner's wildlife biologist will flag the required buffer zone around the nest. The buffer zone is typically a 165 ft radius around the nest. This buffer zone will not be barricaded by the Owner's surveyor.

3. The Owner's wildlife biologist will monitor the nest and notify the Contractor when work may commence within the buffer zone.

4. The Contractor shall not encroach within the flagged buffer zone until notified by the Owner's wildlife biologist.

5. The Contractor shall notify the Engineer at least 10 work days prior to commencing ground disturbing activities, and is responsible to coordinate scheduling with the wildlife biologist to perform the pre-construction surveys.

F. At all wash crossings, the contractor will adhere to all Clean Water Act Section 404 General Conditions, Regional Conditions, and Conditional Section 401 Certification for all approved Nationwide Permits, as well as any Special Conditions that may be determined by the U.S. Army Corps of Engineers (refer to URL given below for each document pertaining to the relevant Nationwide Permit process).

1. 2012 Nationwide Permits, Conditions, District Engineer's Decision, Further Information, and Definitions (with corrections): https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll7/id/6770 (page 1, pages 7 through 9 [up to but not including paragraph 14], page 28 [starting at C. Nationwide Permit General Conditions] through page 46)

2. 2012 Regional Conditions in New Mexico http://www.spa.usace.army.mil/Portals/16/docs/civilworks/regulatory/Regional%20Conditions/NM%20regional%20conditions%20FINAL.pdf (pages 1 through 2)

3. NMED conditional Water Quality Certification for Nationwide Permits http://www.spa.usace.army.mil/Portals/16/docs/civilworks/regulatory/Water%20Quality%20Certification/404%20NWP%20Final%20Certs.pdf (all pages)

G. Storm Water Pollution Prevention Plan (SWPPP): Contractor shall be wholly responsible for the preparation and implementation of the SWPPP, and any erosion / sediment practices described therein. Such implementation shall include, but not necessarily be limited to, obtaining any required NPDES permit(s) and submitting the contractor's Notice of Intent (NOI) to competent agencies prior to construction, implementation and maintenance of all Best Management Practices (BMPs) specified in the SWPPP, inspection of entire project site as specified in the SWPPP, maintaining and providing all documentation required in the SWPPP (including keeping up-to-date project maps and as-builts before, during and after construction), filing of a Notice of Termination (NOT) upon completion of the project and removal of BMPs upon the required time interval after completion of the project.

H. No reports or drawings relating to Hazardous Environmental Conditions at the site are known to the Owner.

I. Exhibit A to the Contract Documents contains geotechnical reports from test holes at various locations within the project area. Contractor is advised that test holes reveal information about only a very small area, and sub-surface conditions between the test holes may vary. Contractor is wholly responsible for any assumptions made about sub-surface conditions between the test holes. The results of the geotechnical reports are provided for Contractor's convenience only; they are not considered "Technical Data", as defined in Article 5.03 of the General Conditions, upon which the Contractor is entitled to base his/ her bid.

J. Contractor is advised that rock removal is incendential to bid.

K. Contractor is solely responsible for providing all water for the construction of the project and no guarantees are made by the Owner or Engineer as to the availability of any particular

water sources. All costs associated with purchase, permits, hauling, etc. for construction water shall be considered incidental.

L. The contractor is advised that a Water Import Permit is required for any construction water brought onto the Navajo Nation. The water import permit can be acquired from the Navajo Nation Water Code Administration. The import permit fee is a one-time fee.

M. Contractor must coordinate use of potable water for filling and flushing the pipeline, with Bureau of Reclamation, NTUA and Engineer at least 2 weeks prior to using water. Contractor must provide Reclamation, NTUA and Engineer with key information, such as desired maximum instantaneous flow rate (gpm), desired maximum daily flow rate (gpd), desired schedule of water use, and other information as required by Reclamation and NTUA.

N. Contractor is advised that a Water Use Permit from Navajo Nation Water Code Administration is required for use of the NTUA water. Contact Water Code Administration for more information.

O. Contractor may use the flush valves designed in the proposed pipeline to flush water out of the system. Flushed water may be disposed of in the natural waterways adjacent to the flush valves and drains, provided the rate of flushing does not damage the surrounding environment (i.e. by flooding, erosion, etc.). Do not flush water from designated flush valves prior to installing riprap at the flush valve outlets. Water chlorinated to levels above those normally associated with drinking water shall be neutralized prior to discharge.

1. Contractor shall obtain Clean Water Act 402 permits from U.S. EPA, as required, and shall abide by all stipulations of said permits.

P. No dedicated borrow area for fill material has been pre-determined for this project. Material may be borrowed from within the designated ROW, provided all conditions set forth in the specifications are met.

Q. Contractor is advised that compaction requirements shall be strictly enforced. In the event that the contractor is unable to meet compaction requirements for pipe embedment using select material, the Contractor shall have the option to use soil cement at no additional cost to the Owner.

R. Contractor is advised that the trench widths shown in the Drawings are minimum widths only. In the event that the Contractor is unable to meet pipe embedment and compaction specifications using the minimum trench width and needs to increase trench width in order to meet these specifications, such increase in trench width shall be provided at no additional cost to the Owner.

S. Contractor is advised that pipeline line and grade specifications will be strictly enforced. See Section 33 11 13 for specifications on horizontal and vertical pipe line and grade.

T. Contractor is advised that a 100’ wide permanent right-of-way easement is established along the proposed pipeline alignment, 50’ to each side of the centerline to which the Contractor must limit all construction activities.

1. Contractor is permitted to use any area within the approved right-of-way and temporary construction easement for staging and storage, provided such use does not disturb other land users or areas outside the ROW and TCE and that the staging areas are restored to their original condition prior to final completion.

a. Contractor is wholly responsible for location, set-up, security, and any required temporary utilities associated with staging and storage areas.

b. All staging and storage areas within the project area must be approved in advance by the Owner.

2. All areas disturbed during construction shall be reclaimed in accordance with the Contract Documents, regardless of whether they are part of the permanent ROW or TCE.

U. Contractor shall restore fences to original condition or better, and shall install 10-ft wide lockable 'rancher-style' gates with H-braces on both sides within pipeline right-of-way at all fence crossings. Each post shall be embedded in 3,000 psi concrete 36-inch deep, 18-inch diameter. Attach wire to the H-braces prior to cutting the fence to prevent slacking of wire. Contract shall repair all gates and fences in a timely manner to prevent livestock ingress / egress.

V. Restore all open-cut driving surfaces, including parking lots, roads and driveways, to original condition or better, including replacement of base course, gravel or pavement as needed. Dirt roads and driveways shall be restored with compacted backfill as indicated in the drawings and specifications, plus surface material as specified. All restoration work for which no bid item is given shall be considered incidental.

W. Contractor is responsible for providing schedule and plans with locations for lane and shoulder closures to the Engineer, San Juan County and BIA-NRO Department of Transportation prior to starting work. Contractor shall obtain any required supplemental permits from the relevant agencies.

X. Excess dirt from cutting may be disposed of on-site, provided the finished grade and compaction meet specifications and are approved by the Engineer.

Y. For the present Project, Bidding Documents in electronic media format are furnished to bidding contractors for the sole purpose of preparing bids, and not for construction. The selected construction Contractor shall not rely on files provided in electronic media format for construction but rather hard copies of such data provided by the Engineer or Owner upon award of the Contract.

Z. Prior to beginning construction activities, the Contractor will furnish full-coverage photo or video documentation of the entire construction site per requirements set forth in Article 3.2.A of Section 33 11 13 of the Technical Specifications.

AA. Drawings in CAD (Civil3D-2018 and Land XML) format related to earthwork required at the tank sites are available from Souder, Miller & Associates at www.soudermiller.com. Any Bidder interested in obtaining access to the files must complete an 'Electronic Data File Transfer and Sharing Agreement' and submit to the office of the Engineer, Souder, Miller and Associates, attention Wacey Jodie, Project Manager Assistant, at wacey.jodie@soudermiller.com. Upon submittal of the attached form, the Bidder will receive instructions on how to access the files.

BB. Upon request, CAD files for the plan and profile sheets will be made available to the winning Contractor after Notice of Award. However, neither the Owner nor Engineer shall assume any liability for their use, nor shall use of any electronic files relieve the Contractor of his/her responsibility to meet the conditions of the Contract Documents, including the published Drawings. Contractor must submit an Electronic Data File Transfer and Sharing Agreement to the Engineer prior to receiving CAD files.

CC. In the event that a Navajo Nation Forestry Department (NNFD) tree cutting permit becomes required, any fees directly charged by NNFD may be covered under the testing allowance.

DD. Fusible PVC is not an acceptable substitution for HDPE. The use of Fusible PVC would significantly change the engineered design.

EE. Contractor shall provide two (2) copies of the safety plan to the Engineer prior to commencing construction (one shall be for Owner's files). Neither the Owner nor Engineer shall approve or comment on the Contractor's safety plan, nor shall the Owner or Engineer assume any responsibility for assuring compliance on the part of personnel on site, other than Owner's or Engineer's employees and representatives, as stipulated in Paragraph 7.12.D of the Standard General Conditions and Navajo Nation Supplemental Conditions (EJCDC C-700 NN).

FF. All materials must comply with Buy America Domestic Procurement Preference [Pub. L. No. 117-58, §§ 70901-52]. As required by Section 70914 of the Bipartisan Infrastructure Law (also known as the Infrastructure Investment and Jobs Act), P.L. 117-58, on or after May 14, 2022, none of the funds under a federal award that are part of Federal financial assistance program for infrastructure may be obligated for a project unless all of the iron, steel, manufactured products, and construction materials used in the project are produced in the United States, unless subject to an approved waiver. The requirements of this section must be included in all subawards, including all contracts and purchase orders for work or products under this program.

Recipients of an award of Federal financial assistance are hereby notified that none of the funds provided under this award may be used for a project for infrastructure unless:

- All iron and steel used in the project are produced in the United States--this means all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States;
- All manufactured products used in the project are produced in the United States—this means the manufactured product was manufactured in the United States; and the cost of the components of the manufactured product that are mined, produced, or manufactured in the United States is greater than 55 percent of the total cost of all components of the manufactured product, unless another standard for determining the minimum amount of domestic content of the manufactured product has been established under applicable law or regulation; and
- All construction materials are manufactured in the United States—this means that all manufacturing processes for the construction material occurred in the United States.

The Buy America preference only applies to articles, materials, and supplies that are consumed in, incorporated into, or affixed to an infrastructure project. As such, it does not apply to tools, equipment, and supplies, such as temporary scaffolding, brought to the construction site and removed at or before the completion of the infrastructure project. Nor does a Buy America preference apply to equipment and furnishings, such as movable chairs, desks, and portable computer equipment, that are used at or within the finished infrastructure project but are not an integral part of the structure or permanently affixed to the infrastructure project.

For further information on the Buy America preference, please visit www.doi.gov/grants/BuyAmerica. Additional information can also be found at the White House Made in America Office website: www.whitehouse.gov/omb/management/made-in-america/.

When necessary, recipients may apply for, and the Department of the Interior (DOI) may grant, a waiver from these requirements, subject to review by the Made in America Office. The DOI may waive the application of the domestic content procurement preference in any case in which it is determined that one of the below circumstances applies:

- Non-availability Waiver: the types of iron, steel, manufactured products, or construction materials are not produced in the United States in sufficient and reasonably available quantities or of a satisfactory quality;
- Unreasonable Cost Waiver: the inclusion of iron, steel, manufactured products, or construction materials produced in the United States will increase the cost of the overall project by more than 25 percent; or
- Public Interest Waiver: applying the domestic content procurement preference would be inconsistent with the public interest.

If contractor believes that one of the above circumstances applies to an product, a request to waive the application of the domestic content procurement preference may be submitted to the engineer in writing. Waiver requests shall include the below information. The waiver shall not include any Privacy Act information, sensitive data, or proprietary information within their waiver request. Waiver requests will be posted to www.doi.gov/grants/buyamerica and are subject to public comment periods of no less than 15 days. Waiver requests will also be reviewed by the Made in America Office.

- Type of waiver requested (non-availability, unreasonable cost, or public interest).
- Requesting entity and Unique Entity Identifier (UEI) submitting the request.
- Department of Interior Bureau or Office who issued the award.
- Federal financial assistance listing name and number (reference block 2 on DOI Notice of Award)
- Financial assistance title of project (reference block 8 on DOI Notice of Award).
- Federal Award Identification Number (FAIN).
- Federal funding amount (reference block 11.m. on DO Notice of Award).
- Total cost of Infrastructure expenditures (includes federal and non-federal funds to the extent known).
- Infrastructure project description(s) and location(s) (to the extent known).
- List of iron or steel item(s), manufactured goods, and construction material(s) the recipient seeks to waive from Buy America requirements. Include the name, cost, countries of origin (if known), and relevant PSC or NAICS code for each.
- A certification that the recipient made a good faith effort to solicit bids for domestic products supported by terms included in requests for proposals, contracts, and nonproprietary communications with the prime contractor.

- A statement of waiver justification, including a description of efforts made (e.g., market research, industry outreach) by the recipient, in an attempt to avoid the need for a waiver. Such a justification may cite, if applicable, the absence of any Buy America-compliant bids received in response to a solicitation.
- Anticipated impact if no waiver is issued.

1.4 WORK BY OWNER

A. Owner-provided Archaeologist:

1. The Owner shall provide the services of a qualified archaeologist at no cost to the Contractor. Refer to foregoing section for Contractor's responsibilities in these areas.

B. Owner-provided Wildlife Biologist:

1. The Owner shall provide the services of a qualified wildlife biologist at no cost to the Contractor. The Owner's wildlife biologist will perform pre-construction bird nest survey(s), delineate the required avoidance buffer around any discovered nests, and monitor any active nests until the nests are vacated. Refer to foregoing section for Contractor's responsibilities in these areas.

1.5 CONTRACTOR'S USE OF PREMISES

A. No work shall be done before 7:00 A.M. or after 7:00 P.M., local time on a working day, on Sundays, or on legal holidays, except as necessary for the proper care and protection of work already performed, or during emergencies. Any deviations from this specification shall require prior written approval by the Owner.

B. The Contractor shall make every effort to minimize noise caused by his operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise.

C. The Contractor shall restrict his operations as nearly as possible to the immediate site. Unnecessary cutting of vegetation adjacent to the site is prohibited. Every effort shall be made to minimize erosion during and after construction and the site shall be returned to its original condition, except where improvements are indicated or required.

D. The Contractor shall take affirmative action to prevent the misuse of the natural environment, wasting of natural resources, or destruction of natural values.

E. The Contractor shall conform to all requirements set forth in the latest edition of the "New Mexico Standard Specifications for Public Works Construction" with latest revision, and "Occupational Safety and Health Administration Regulations" for trenching, shoring and excavation.

1.6 SPECIFICATION CONVENTIONS

A. These specifications are written in imperative mood and streamlined form. This imperative language is directed to the Contractor, unless specifically noted otherwise. The words "shall be" are included by inference where a colon (:) is used within sentences or phrases.

B. The Contractor shall furnish all materials, labor, plant and equipment necessary to complete the contract work as called for by the Technical Specifications and as indicated on the Drawings. Material and work, either expressed or implied, necessary for the satisfactory completion of the contract work shall be considered an integral part thereof.

C. All standards incorporated herein by reference shall be the latest edition, unless otherwise specified. The abbreviations and applicable standards are described below:

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AIA	American Institute of Architects
ANSI	American National Standards Institute, Inc.
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
CID	Construction Industries Division of the NM Regulation and Licensing Department
EJCDC	Engineers Joint Contract Documents Committee
EPA	Environmental Protection Agency
ISO	International Organization for Standardization
MSJC	Masonry Standards Joint Committee
NACE	National Association of Corrosion Engineers
NAPF	National Association of Pipe Fabricators
NFPA	National Fire Protection Agency
NMDOT	New Mexico Department of Transportation
NMED	New Mexico Department of Environment
NNOLR	Navajo Nation Office of Labor Relations
NTUA	Navajo Tribal Utility Authority
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
SAE	Society of Automotive Engineers
SSPC	Society for Protective Coatings
IBC	International Building Code

1.7 MINIMUM WAGE RATE DETERMINATION

A. The Navajo Nation prevailing wage rates will apply to this project. The wage rate determination provided by the Navajo Office of Labor Relations (NOLR) is provided in Appendix B to the Contract Documents. It is wholly the responsibility of the Contractor to inform him/herself of and abide by all regulations and requirements set forth by the NOLR.

B. The Federal Davis-Bacon Act and the New Mexico Public Works Minimum Wage Act do not apply to the present project.

1.8 TESTING AND INSPECTION ALLOWANCES

A. Testing Allowance: The bid schedule includes a predetermined sum to cover the cost of testing and inspection services as required in the Contract Documents.

B. Costs Included in Allowance: Fees charged by testing firm performing the testing, including field and laboratory costs for compaction, concrete, and fusion joint testing only.

C. Costs Not Included in Allowance:

1. Incidental labor and facilities required to assist testing or inspection firm, such as preparation of test pits, surface preparation, provision of safe access for testing personnel, and other work performed by the Contractor to facilitate testing.
2. Work performed by the testing laboratory that is not part of actual testing.
3. Cost of disinfection of waterlines, chlorine tests, or bacteriological tests.
4. Costs of hydrostatic pressure testing or testing of material welds as called for in the Contract Documents.
5. Costs of failed tests as determined by Engineer.
6. Any other tests not specifically authorized in advance by the Engineer.

D. Costs will be drawn from testing allowance and paid based on invoice(s) submitted to Contractor by testing or inspection firm(s).

1.9 SCHEDULE OF VALUES

A. Submit schedule on EJCDC Form C-620, or on other form provided by Engineer. Contractor's standard form or electronic media printout will be considered.

B. Base structure of Schedule of Values on Bid Schedule with identical item numbering, quantities, and values.

C. Submit Schedule of Values in duplicate at least 15 days prior to first Progress Meeting.

1.10 APPLICATIONS FOR PAYMENT

A. Application for Payment is synonymous with Partial Payment Estimate.

B. Submit copies of each application on the Partial Payment Estimate form provided in the Contract Documents, together with updated Schedule of Values identifying fully the list of items in the Application for Payment.

C. The Application for Payment form shall be submitted to the Engineer and RPR electronically 15 days prior to the monthly progress meeting electronically as an Excel spreadsheet. Submit up-to-date revisions of the following documents every month with Application for Payment. Application for Payment will not be processed without these updated documents.

1. Record Drawings
2. Construction Schedule, including overall project schedule and look-ahead schedule
3. All relevant documentation of testing performed during the pay period, such as concrete testing, compaction testing, weld x-rays, PVC fusion joint testing, holiday and other coating testing, and any other testing specified in the Contract Documents
4. Fusion machine data logs
5. Any Stored Material Invoices

D. Payment Period: Monthly

1.11 CHANGE PROCEDURES

A. All Change Orders shall be prepared on the form provided in these Contract Documents.

B. Unit Price Change Order: For pre-determined unit prices and quantities, Change Order will be executed on fixed unit price basis. For unit costs or quantities of units of work not pre-determined, refer to Article 11 - Change of Contract Price; Change of Contract Times, of the Standard General Conditions (EJCDC C-700 NN Standard General Conditions and Navajo Nation Supplemental Conditions of the Construction Contract).

1.12 UNIT PRICES

A. Engineer will take measurements and compute quantities accordingly. The Contractor will assist in taking of measurements and determination of work completed prior to preparation of corresponding Application for Payment.

1.13 ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option.

B. Coordinate related Work and modify surrounding Work as required.

C. The Schedule of Alternates below describe each Bid Alternate item which, if included, will replace their counterparts from the Base Bid, as described in Article 5 of the Bid Form.

1.14 COORDINATION

A. Coordinate scheduling, submittals, and Work of various sections of specifications to ensure efficient and orderly sequence of installation of interdependent construction elements.

B. Verify utility requirement characteristics of operating equipment are compatible with building utilities.

C. Abide by Traffic Control Plan provided by Engineer and coordinate all lane closures and other traffic control activities with relevant agencies, as described above.

D. Contractor shall obtain permits from San Juan County and BIA-NRO Department of Transportation prior to encroaching on any county or BIA roads, except for permits already obtained by the Owner or the Engineer.

1. Contractor shall notify the BIA-NRO Department of Transportation and the Engineer at least five (5) working days prior to working within the ROW of any BIA road.

E. Contractor must coordinate use of potable water, such as for filling and flushing the pipeline, with Bureau of Reclamation and NTUA at least two (2) weeks prior to using water. Contractor must provide Bureau of Reclamation and NTUA with key information, such as maximum instantaneous flow rate (gpm), maximum daily flow rate (gpd), schedule of water use, and other information as required by Bureau of Reclamation and NTUA. Bureau of Reclamation and NTUA will advise Contractor of flow rate available for pipeline filling and flushing.

1. Contractor must not infringe on NTUA’s ability to serve its existing customers by excessive water use. Contractor shall limit water use to avoid such infringement.

2. Contractor is advised that actual flow rate of Bureau of Reclamation and NTUA water available for line filling and flushing may be significantly less than the maximum allowable flow rate specified in the Technical Specifications. Contractor shall adjust construction schedule based on actual available flow rate.

F. Bureau of Reclamation and NTUA will not be the owner's RPR for the project; however, Bureau of Reclamation and NTUA will be on the job site periodically to inspect work.

G. All hydrostatic pressure tests must be witnessed by Bureau of Reclamation and NTUA personnel. Contractor is responsible for coordination of testing schedule with Bureau of Reclamation and NTUA to allow representatives to be present.

H. The tie-ins to the existing NNMP waterline at the beginning of the project shall be cut-in tees or crosses, not wet taps. Contractor must also notify Bureau of Reclamation at least two (2) weeks prior to tapping any existing Bureau of Reclamation water facility.

1. Contractor shall coordinate all tapping activities with Bureau of Reclamation and must receive Bureau of Reclamation approval prior to tapping any Bureau of Reclamation facility.

I. Contractor must also notify NTUA at least two (2) weeks prior to tapping any existing NTUA water facility or crossing existing NTUA waterlines with proposed waterlines. Connections to existing tanks shall be floor penetrations.

1. Contractor shall coordinate all tapping activities with NTUA and must receive NTUA approval prior to tapping any NTUA facility.

2. Contractor may be required to provide temporary tanks to maintain water service to NTUA's existing customers while tapping tanks. Such temporary tanks, if required, shall be provided at no additional cost to the Owner.

J. Contractor is responsible for coordination with Bureau of Reclamation of final project inspection by Bureau of Reclamation personnel. Bureau of Reclamation typically requires 21 days notice prior to final inspection.

K. Contractor is responsible for coordination with NTUA of final project inspection by NTUA personnel prior to NTUA acceptance and the issuance of the Affidavit of Punch List Completion of project to NTUA. NTUA typically requires 21 days notice prior to final inspection. NTUA requires that all bacteriological samples be obtained with passing results within 30 days or less prior to system issuance of Affidavit of Punch List Completion. Any bacteriological tests performed more than 30 days prior to final acceptance and signature of the Affidavit of Punch List Completion by NTUA shall not be considered valid and shall be re-tested at no additional cost to the Owner.

L. Contractor must notify the Engineer at least five (5) working days prior to performing work within 100 feet of any culturally or paleontologically sensitive area, as designated on the Drawings.

M. The Contractor is responsible for obtaining all applicable local, county, state and tribal building and development permits not previously obtained by Engineer or Owner. This includes permits from the Construction Industries Division of the Regulation and Licensing Department of the State of New Mexico, and any other regulatory agency having jurisdiction.

N. Contractor is responsible for timely scheduling of any pertinent inspections with local, county, state and tribal agencies with jurisdiction, and as required by the permits.

O. Coordinate space requirements and installation of mechanical and electrical work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable.

P. All notices, demands, requests, instructions, approvals, proposals and claims must be in writing or email. Official email address(es) for notices will be designated during the pre-construction conference. Documents requiring written notice will be delineated at the pre-construction conference.

1. Any notice to or demand upon the Contractor shall be sufficiently given if delivered at the office of the Contractor stated on the signature page of the Agreement or to the official contact email address designated at the pre-construction conference.

2. All papers required to be delivered to the Owner shall, unless otherwise specified in writing to the Contractor, be delivered to the Owner at the address stated on the signature page of the Agreement, and a copy shall be delivered to the Engineer at 5454 Venice Ave. NE, Suite D, Albuquerque, NM 87113.

3. Any such notice shall be deemed to have been given as of the time of actual delivery, in the case of mailing, when the same should have been received in due course of post, or in the case of telegrams, certified mail, or telephone facsimiles, at the time of actual receipt as the case may be.

Q. Coordination with Owner's Surveyor: Refer to Section 02 21 13 – Surveying.

R. Contractor shall coordinate seeding dates to coincide with the dates stipulated in the NNAD re-vegetation requirements and stipulations, provided in Appendix C.

1. Contractor shall indicate exact proposed re-seeding dates in project schedule and shall notify the Engineer as early as possible of any deviations from this proposed seeding schedule.

S. Contractor shall provide on-site office space/ work area for Resident Project Representative and other supervisory staff provided by Owner. Such office space may consist of a reasonably-sized room within the Contractor's project office trailer. The office is required to have a desk and power service.

1.15 SUSPENSION OF WORK

A. The Owner may order suspension of work due to seasonal or other conditions unsuitable for construction work.

B. Maintenance during suspension: Prior to suspension for any cause, the Contractor shall take necessary precautions to protect the work during the period of suspension from any factors which would contribute to its deterioration.

C. Time elapsed during suspension of the work shall not count as contract time. The Contractor shall make no claim for damages due to delay, additional mobilization charges, nor any additional costs that may be incurred solely due to suspension of work.

D. Requests for additional time to be added after the "contract completion date" due to delays or extra work shall be made to the Owner in writing by the Contractor within ten (10) days after the time of the occurrence of the delay or receipt of a Change Order for extra work. Such requests shall set forth the justification for the additional time.

E. Upon approval, the additional contract time shall then be in full force and effect, the same as though it were the original date for completion and will be shown as the completion date plus an amount of additional working days. Any time required to complete the work beyond the contract time or additional contract time will result in the assessment of liquidated damages, as specified in the Contract Documents. Failure to make such requests

within the above limits will be considered as a waiver on the part of the Contractor as to the need for additional contract time.

1.16 FIELD ENGINEERING

A. Establish elevations, lines, and levels and certify elevations and locations of the Work conforming with the Contract Documents.

B. Verify field measurements are as indicated on shop drawings or as instructed by manufacturer.

C. From the information provided by the Owner, the Contractor shall develop and make all detail surveys needed for construction such as slope stakes, batter boards, easement alignments, stakes for pipe locations and other working points, lines, elevations and cut sheets.

1.17 PRE-CONSTRUCTION CONFERENCE

A. Engineer will schedule Pre-Construction Conference after Notice of Award for affected parties.

B. The Contractor, or his duly authorized representative, and subcontractor representatives will attend the meeting.

1.18 PROGRESS MEETINGS

A. Schedule in coordination with the Engineer at maximum monthly intervals and attend all Progress Meetings throughout progress of the Work.

B. The purpose of the meetings will be to review the following:

1. Work progress since previous meetings.
2. Field observations, problems, conflicts.
3. Problems which impede construction schedule.
4. Corrective measures and procedures to regain projected schedule.
5. Revisions to construction schedule.
6. Plan progress and schedule during succeeding work period.
7. Coordination of schedules.
8. Off-site fabrication and delivery schedules.
9. Maintenance of quality standards.
10. Proposed changes, construction schedule and completion date.
11. Coordination of separate contracts.
12. Record or “as-built” drawings of completed work.
13. Other business as required.
14. Regulatory requirements including OSHA, New Mexico Board of Labor, and others as applicable.
15. Funding requirements including Bureau of Reclamtion and others as applicable.

C. During each meeting, the Contractor is required to present any issues which may impact his Work, with a plan to resolve these issues expeditiously.

1.19 CUTTING AND PATCHING

A. Submit written request in advance of cutting or altering elements with possible detrimental effects.

B. Execute Work by methods to avoid damage to other Work and to provide proper surfaces to receive patching and finishing.

C. Restore Work with new products according to requirements of Contract Documents.

D. Fit Work tight to pipes, sleeves, ducts, conduits, and other penetrations through surfaces. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

E. Refinish surfaces to match adjacent finishes.

1.20 SUBMITTAL PROCEDURES

A. Identify Project, Contractor, subcontractor and supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.

B. Apply Contractor's stamp, signed or initialed, certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.

C. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of completed Work.

D. Revise and resubmit submittals as required by the Engineer; identify changes made since previous submittal.

E. Submit number of hardcopies Contractor requires, plus two hardcopies Engineer will retain, at a minimum, unless otherwise indicated at the Pre-Construction Conference. In addition, Contractor shall provide all submittals electronically in PDF format, unless otherwise directed by the Engineer.

F. Transmit each submittal with Engineer accepted form.

G. Provide a separate submittal for each item. Do not combine multiple distinct items into a single submittal without prior approval of Engineer. Improperly combined submittals shall be rejected.

H. Provide updated submittal log with each submittal. If multiple submittals are submitted concurrently, only one updated log needs to be provided with submittal package.

I. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

1.21 CONSTRUCTION PROGRESS SCHEDULES

A. Submit initial progress schedule in duplicate within fifteen [15] days after date of Owner-Contractor Agreement for Engineer review.

B. Submit revised schedules with each Application for Payment, identifying changes since previous version. Indicate estimated percentage of completion for each item of Work at each submission. Interim applications for payment shall not be processed without updated schedules.

C. Distribute copies of reviewed schedules to Project site file, subcontractors, suppliers, and other concerned parties.

D. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate early and late start, early and late finish, float dates, and duration.

1.22 PROPOSED PRODUCTS LIST

A. Upon submittal of Bid Form, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.23 PRODUCT DATA

A. Product Data: Submit to Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Submit copies and distribute in accordance with Submittal Procedures article.

C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

1.24 SHOP DRAWINGS

A. Shop Drawings:

1. Submitted to Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

2. Include detail design calculations, shop drawings, fabrication, and installation drawings, erection drawings, list, graphs, catalog sheets, data sheets, and similar items.

3. Design calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state wherein the project is to be built, unless otherwise directed.

4. After review, provide copies and distribute in accordance with Submittal Procedures article and for record documents purposes as specified.

5. Except as may otherwise be indicated herein, the Engineer will return copies of each submittal to the Contractor with comments noted thereon, within 30 calendar days following their receipt by the Engineer.

B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Submit number of opaque reproductions Contractor requires, plus two copies Engineer will retain.

1.25 TEST REPORTS

A. Submit for Engineer's knowledge as contract administrator or for Owner.

B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.26 MANUFACTURER'S INSTRUCTIONS AND CERTIFICATES

A. When specified in individual specification sections, submit manufacturer printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Engineer for delivery to Owner in quantities specified for Product Data.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

C. When specified in individual specifications sections, submit certifications by manufacturer to Engineer, in quantities specified for Product Data.

D. Indicate material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

E. Certificates may be recent or previous test results on material or Product, but must be acceptable to Engineer.

1.27 QUALITY CONTROL

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturer's instructions.

C. Comply with specified standards as minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

1.28 TOLERANCES

A. Monitor fabrication and installation tolerance control of installed products over suppliers, manufacturers, products, site conditions, and workmanship, to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply fully with manufacturer's tolerances.

1.29 REFERENCES

A. Conform to reference standards by date of issue current as of date of Contract Documents.

B. When specified reference standard conflict with Contract Documents, request clarification from Engineer before proceeding.

1.30 MANUFACTURER'S FIELD SERVICES AND REPORTS

A. When specified in individual specification sections, require material or product suppliers or manufacturers to furnish qualified staff personnel to observe site conditions and to initiate instructions when necessary.

B. Report observations and site decisions or instructions that are supplemental or contrary to manufacturer's written instructions.

1.31 EXAMINATION

A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Verify utility services are available, of correct characteristics, and in correct location.

C. Contractor is solely responsible for utility location, protection and verification. Contractor must notify New Mexico One Call System Inc., at 811, and all local utility providers (including NTUA's Call before you dig program 928-729-5721), at least three (3) days before starting utility line construction. Additional notice may be required for certain utilities, as noted on the Drawings and Specifications.

D. It shall be the responsibility of the Contractor to become acquainted with the location of all underground structures which may be encountered, or which may affect the Work hereunder.

1.32 TEMPORARY SERVICES

A. Provide, maintain and pay for suitable quality water service as required.

B. Maintain uninterrupted water and electric service to all properties adjoining the Work, including existing NTUA customers, at all times, except where specifically approved by the authority having jurisdiction. Services damaged by the Contractor shall be immediately and permanently repaired or replaced at the expense of the Contractor. Give a minimum of 48-hour advance notice to occupants of adjacent properties, including all existing NTUA customers, before interrupting any service. Any interruption of service shall be kept to the minimum length of time possible.

1. Contractor shall take necessary measures, including provision of temporary tanks and piping, to maintain uninterrupted water service until new tanks can be put back into service. Such temporary tanks, if needed, shall be provided at no additional cost to the Owner.

C. Until final inspection and approval of the Work and issuance of the Certificate of Substantial Completion, the Contractor is responsible for all Work directly or indirectly affected by the Contractor's activities. Such responsibility continues for all Work detailed on the punch list that may accompany the Certificate of Substantial Completion, until satisfactorily completed by the Contractor and approved by the Owner and Engineer.

D. Furnish, install and maintain any temporary water storage structures, electrical connections, meters, wiring, outlets, switches, lamps, etc., as necessary for the work. The Contractor shall provide such temporary heat as may be necessary for the prevention of injury to the work or material through dampness or cold. All temporary connections, installations, facilities and supplies furnished or installed as specified in this paragraph, shall be removed prior to the completion of the Contract, and the premises left perfectly clean and satisfactory to the Owner.

E. Maintain ambient temperature above freezing in enclosed/occupied areas where construction is in progress, unless indicated otherwise in specifications.

F. Provide and maintain required sanitary facilities and enclosures in clean and sanitary condition.

G. All temporary power costs/bills shall be borne by the Contractor until final project acceptance and signature of the Affidavit of Punch List Completion by NTUA.

1.33 ACCESS ROADS

A. The project right-of-way and temporary construction easement may be used for construction traffic. Do not construct any new roads. All trafficked areas must be restored to original condition prior to final completion of the project.

B. Existing on-site roads, designated by the Owner, may be used for construction traffic, provided the roads are not damaged and access to roads by local land users is not affected. Existing roads must be restored to original condition prior to final completion of the project.

1.34 PROGRESS CLEANING AND WASTE REMOVAL

A. Collect and maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.

B. Maintain new and existing structures free of dust and construction debris at all times.

C. Remove waste and surplus materials, rubbish, and construction facilities from site. Restore all job sites and adjoining areas, including roads and driveways, to a condition equal to or better than the original status. Special attention will be made to not disturb unimproved roads by placing any excavated material to the sides of these roads when water lines are located along the right-of-way.

D. Brush and trees shall be felled parallel to the right-of-way to minimize damage to trees and structures on adjacent property. All brush, tree tops, stumps and other debris shall be removed from the right-of-way and disposed of by the Contractor, subject to and in conformity with the special provisions applying to the tract of land involved (if any). The Contractor shall not destroy nor remove any trees, shrubbery, nor any other improvements, without permission of the Owner.

E. The Contractor shall not dispose of debris, refuse or sanitary wastes in an open dump or in a natural watercourse, whether on public or private property, or in such places that undesirable wastes can eventually be exposed or carried to a natural watercourse.

F. Removal of obstructions required for completion of the project, whether specifically listed or not, shall be considered incidental to the work.

1. The Contractor shall remove and supply all usable materials to the Owner at a site designated by the Owner.

2. The Contractor shall remove and dispose of all unusable materials in accordance with relevant environmental regulations.

1.35 PROJECT IDENTIFICATION

A. Project sign requirements: None.

B. The Contractor shall not erect or permit the erection of advertising signs. Only minimal identification and direction signs shall be permitted on the site. Unnecessary or obnoxious posters, pictures, signs, symbols, drawings or writing on work, material or equipment, resulting from vandalism or other causes, shall be covered or removed by the Contractor.

1.36 BARRIERS AND FENCING

A. Provide barriers or fencing to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage.

1.37 PROTECTION OF INSTALLED WORK

A. Protect installed Work and provide special protection where specified in individual specification sections.

B. Contractor shall remain wholly responsible for protection of all stored materials and installed work until final acceptance of the project by the Owner and signed Affidavit of Punchlist Completion by NTUA.

1.38 SECURITY

A. Provide security and facilities to protect Work and existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

B. Security of Contractor's equipment, stored materials, work, and staging areas shall be entirely the responsibility of the Contractor. The Owner assumes no liability for any damage, vandalism, or theft of Contractor's property.

1.39 WATER CONTROL

A. Provide erosion control.

B. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

C. Contractor must abide by all stipulations and requirements within the Storm Water Pollution Prevention Plan (SWPPP) to be provided by the Contractor throughout all construction phases, including all proposed pollution prevention and sediment control measures. This shall be done in accordance with the National Pollution Discharge Elimination System (NPDES) general permit requirements for all construction activities and shall include all required reporting. If the Bid Form does not include an item for preparation and implementation of the SWPPP, the cost thereof will be considered incidental to related work.

D. The Contractor shall conduct his operations to minimize damage to natural watercourses, and shall not permit petroleum products, volatile fluid wastes, or any other wastes which are prohibited by local ordinances, or excessive amounts of silt, clay, or mud to enter any drainage system. The bed of natural watercourses or man-made irrigation ditches shall be restored to normal gradient and cross-section after being disturbed.

E. Do not fill in any natural washes or drainages or impede natural water flow unless otherwise indicated in the plans or specifications, or directed by the Engineer in the field.

1.40 POLLUTION AND ENVIRONMENTAL CONTROL

A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

B. Provide dust control, erosion and sediment control, noise control, pest control and rodent control to allow for proper execution of the Work. Motor equipment shall be kept in repair and equipped with anti-pollution devices, if possible, to cut down on exhaust emissions. Burning as a method of cleaning or disposal will not be permitted without approval of the proper authorities. Short term effects of dust produced by equipment will be mitigated by sprinkling traffic areas with water.

C. Comply with all applicable standards, orders, or regulations issued pursuant to the Clean Air Act of 1970 (42 U.S.C. 1251 et seq.) as amended. Violations shall be reported to the New Mexico Environment Department.

D. The Contractor shall be responsible for the reporting and the cleanup of spills associated with project construction and shall report and respond to spills of hazardous materials such

as gasoline, diesel, motor oil, solvents, chemicals, toxic and corrosive substances, and other materials which may be a threat to the public health or the environment.

E. The Contractor shall be responsible for reporting past spills encountered during construction and of current spills not associated with construction. Reports shall be made to the New Mexico State Police at 575-289-3443 or 505-334-6622, or call the New Mexico Environment Department Emergency Response Team at 505-827-9329 and to the Owner's Representative.

F. The Contractor shall clean up any unreported spills associated with project construction identified after construction.

G. Fuel, oil, hydraulic fluid, lubricants, and other petrochemicals must not be stored within the 100-year floodplain or within 100 ft of any wash and must have a secondary containment system to prevent spills.

H. Do not change or add oil, hydraulic fluid, or other petrochemical-based fluids to any piece of machinery within the 100-year floodplain or within 100 ft of any wash.

I. Appropriate spill clean-up materials such as brooms and absorbent pads must be available where materials are stored or equipment is working at all times.

1.41 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, and materials, prior to Substantial Completion review.

B. Clean and repair damage caused by installation or use of temporary work.

C. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

1.42 PRODUCTS

A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work, but does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components specifically identified for reuse.

B. Do not use materials and equipment removed from existing premises, except as specifically identified or allowed by the Contract Documents.

C. Provide interchangeable components of same manufacture for components being replaced.

1.43 DELIVERY, HANDLING, STORAGE, AND PROTECTION

A. Deliver, handle, store, and protect Products in accordance with manufacturer's instructions.

1.44 SUBSTITUTIONS

A. Substitutions will only be considered when Product becomes unavailable through no fault of Contractor.

B. Specific manufacturers may be required for certain items in order to maintain consistency with the Owner's existing inventory. In such cases, substitutions may not be allowed.

C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

D. Submit three [3] copies of request for Substitution to the Engineer for consideration. Limit each request to one proposed Substitution.

1.45 CLOSEOUT PROCEDURES

A. Submit written certification Contract Documents have been reviewed, Work has been inspected, and Work is complete in accordance with Contract Documents and ready for Engineer's inspection.

B. Submit final Application for Payment identifying total adjusted Contract Price, previous payments, and amount remaining due.

C. Project closeout submittals shall include, but not necessarily be limited to:

1. Affidavit of Punch List Completion
2. Project Record Documents
3. Operations and Maintenance Data
4. Spare Parts and Maintenance Materials
5. Extended Warranties
6. Release of Liens
7. Consent of Surety
8. Certification of Labor Standards
9. Complete packages of all testing results, start-up reports and data logs, including: manufacturer’s testing data, pipe fusion data logs, fusible PVC fusion tests, line purge records, bacteriological tests, pressure tests, concrete tests, compaction tests, weld x-rays, cathodic protection start-up reports, and other quality control/ quality assurance documentation required in the Specifications.

D. Affidavit of Punch List Completion must be signed by NTUA prior to Final Completion.
1. Final payment will not be processed until Affidavit of Punch List Completion is accepted by NTUA.
2. Warrantee period shall commence upon execution of Affidavit of Punch List Completion by NTUA.

1.46 FINAL CLEANING

A. Execute final cleaning prior to final inspection.

B. Upon completion of the work under this contract, thoroughly clean and make any needed repairs caused by damage during construction to any existing utilities or other structures on the site.

C. Notify the Engineer in writing once final cleaning is complete. The final payment will not be made until the Contractor has complied with all requirements set forth and the Engineer has made his final inspection of the entire work and is satisfied that it is properly constructed and the site properly cleaned.

D. All costs related to cleaning shall be considered incidental to the project.

1.47 STARTING OF SYSTEMS

A. Provide at least seven [7] days notification prior to start-up of each item. Contractor shall coordinate scheduling of such start-up services with the manufacturer and Engineer.

B. Ensure each piece of equipment or system is ready for operation.

C. Execute start-up under supervision of responsible persons in accordance with manufacturer's instructions.

D. Submit written report stating equipment or system has been properly installed and is functioning correctly.

1.48 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of Products to Owner's personnel two weeks prior to date of Substantial Completion.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six [6] months.

C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed-upon times, at designated location.

1.49 TESTING, ADJUSTING, AND BALANCING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

B. Owner retains the right to appoint, employ, and pay for services of independent firm to perform testing, adjusting, and balancing. Reports will be submitted by independent firm to Engineer indicating observations and results of tests and indicating compliance or non-compliance with specified requirements and with requirements of Contract Documents.

C. Contractor will cooperate with independent firm; furnish assistance as requested.

D. Re-testing required because of non-conformance to specified requirements will be charged to Contractor.

1.50 PROTECTING INSTALLED CONSTRUCTION

A. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

B. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

C. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

D. Prohibit traffic from landscaped areas.

1.51 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of Contract Documents to be utilized for record documents.

B. Record actual revisions to the Work. Record information concurrent with construction progress.

C. Specifications: Legibly mark and record at each Product section description of actual Products installed.

D. Record Documents and Shop Drawings (As-Built Drawings):

1. Legibly mark each item to record actual construction.

E. If any surveying is provided by the Contractor to supplement Owner-provided surveying, submit records and digital survey data.

F. Submit updated record documents to Engineer together with claims for interim Application for Payment. Interim and final applications for payment shall not be processed without updated record documents.

G. All mapping and other documentation requirements associated with the Contractor's SWPPP shall be the responsibility of the Contractor.

1.52 OPERATION AND MAINTENANCE DATA

A. Submit 3 sets prior to final inspection, bound in 8-1/2 x 11 inch text pages, 3 D side ring binders with durable plastic covers.

B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS" and title of project.

C. Internally subdivide binder contents with permanent page dividers, logically organized.

D. Contents:

1. Part 1: Directory

a. List names, addresses, and telephone numbers of Engineer, Contractor, subcontractors, and major equipment suppliers.

2. Part 2: Operation and maintenance instructions, arranged by system:

a. Equipment summary, operational procedures, preventive maintenance procedures and schedules, parts list, shop drawings, safety issues.

3. Part 3: Project documents and certificates.

a. All equipment warranties, affidavits, and certifications required by the Technical Specifications shall be placed in this part.

1.53 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification sections.

B. Deliver to project site and place in location as directed by Engineer; obtain receipt prior to final payment.

1.54 WARRANTIES

A. Contractor warrants to Owner that all materials and workmanship covered by this Agreement, collectively referred to as the Work, supplied or performed by the Contractor, Contractor's sub-contractors, or Contractor's suppliers, will conform with the specifications, drawings, and other descriptions supplied or adopted by Owner and will be new, fit, and sufficient for the purposes for which they are intended as evidenced in this Agreement and in the drawings and specifications referred to therein, of good material,

design and workmanship, free from defects, and will fulfill satisfactorily the operating conditions specified herein.

B. Contractor shall execute and assemble transferable warranty documents from subcontractors, suppliers, and manufacturers for all products with extended warranties beyond one (1) year.

C. Contractor shall submit all warranty documentation prior to final Application for Payment.

D. All warranty periods shall commence upon the date of final acceptance of the work and execution of the Affidavit of Punch List Completion by NTUA.

E. If during the warranty period, any Work fails to conform with the foregoing guarantees, the defective Work shall be promptly repaired or replaced per these specifications and to the satisfaction of the Owner, at no cost to the Owner, including but not limited to prepayment of all packing and transportation costs; the cost of excavation, removal, and replacement of the defective material and all other adjacent materials affected by these actions; the cost of bedding and compaction and all required testing; as well as the costs of construction oversight, management and testing of materials by the Engineer.

F. Contractor will not be chargeable for repairs made by Owner to correct such failure within the foregoing warranty unless Contractor has been given written notice of such failure and thereafter has failed to take prompt and effective action to correct the failure in accordance with the foregoing.

1.55 RESIDENT PROJECT REPRESENTATIVE

A. The Owner shall provide a Resident Project Representative (RPR) to observe construction of the project.

B. The RPR shall:

1. Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences and other project-related meetings.

2. Serve as Engineer's liaison with Contractor, working principally through Contractor's authorized representative, assist in providing information regarding the intent of the Contract Documents.

3. Receive Samples which are furnished at the Site by Contractor, and notify Engineer of availability of Samples for examination.

4. Conduct on-Site observations of Contractor's work in progress to assist Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.

5. Verify that tests, equipment, and systems start-ups and operating and maintenance training are conducted in the presence of appropriate Owner's personnel, and that Contractor maintains adequate records thereof.

6. Review Applications for Payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the schedule of values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.

7. During the course of the Work, verify that materials and equipment certificates, operation and maintenance manuals and other data required by the Specifications to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have these documents delivered to Engineer for review and forwarding to Owner prior to payment for that part of the Work.
8. Participate in a Substantial Completion inspection, assist in the determination of Substantial Completion and preparation of punch lists.
9. Participate in a final inspection in the company of Engineer, Owner, and Contractor and prepare a final list of items to be completed and deficiencies to be remedied.

C. The RPR shall not:

1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including “or-equal” items).
2. Exceed limitations of Engineer’s authority as set forth in the Contract Documents.
3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.
4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of Contractor’s work.
5. Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.
6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.
7. Accept Shop Drawing or Sample submittals from anyone other than Contractor.
8. Authorize Owner to occupy the Project in whole or in part.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 02 21 13

SURVEYING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Surveying services to be provided by Contractor related to establishment of elevations, lines, and levels and certification of elevations and locations of the Work conforming to the Contract Documents.

B. Related Sections:

1. Section 01 00 00 - Basic Requirements: Field Engineering.
2. Section 31 23 17 - Trenching: Execution requirements for trenching.
3. Section 31 23 23 - Backfill.
4. Section 33 11 13 - Public Water Transmission Systems.

1.2 PRIMARY CONTROL

A. The Engineer will establish primary control to be used for establishing work lines and grades.

B. Primary control will consist of benchmarks and horizontal control points in work vicinity.

C. Contractor shall preserve and maintain primary control points until otherwise authorized. Engineer may reestablish damaged or destroyed primary control points and back charge cost to the Contractor.

1.3 RIGHT-OF-WAY AND TEMPORARY CONSTRUCTION EASEMENT

A. Contractor is advised that 300’ x 200’ staging areas are located at the entry and exit pits and a 100’ wide permanent right-of-way (ROW) easement is established along the proposed pipeline alignment to which the Contractor must limit all construction activities, staging, and construction traffic.

B. Contractor is advised that at certain locations the temporary construction easement is truncated on one side or both sides to avoid encroaching on culturally sensitive areas or adjacent properties. These truncated areas are indicated on the Drawings and will be barricaded by the Surveyor. Contractor shall not encroach beyond the established work space in these areas.

C. Contractor shall not work in any area where the designated work area has not been staked by Surveyor.

D. Contractor shall be wholly liable for any damage caused by working in areas that have not been staked, or by encroaching outside the staked work area.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 SURVEY SERVICES

The Surveyor (herein defined as New Mexico-licensed Professional Surveyor or his designated field representative) shall provide the following services at no cost to the Contractor:

A. Construction Staking:

1. ROW/ TCE limit Staking:

a. Surveyor will stake the TCE boundaries every 100 feet and at all horizontal points of inflection.

b. Where the temporary construction easement is truncated to avoid culturally sensitive or restricted areas, the Surveyor will barricade the truncated ends of the temporary construction easement with multiple stakes spaced no more than 10 ft apart to protect against inadvertent encroachment outside the designated work area by construction personnel or others.

2. Pipe Centerline and Profile Staking:

a. Surveyor will stake the pipe centerline, with offsets as requested by Contractor, at the following intervals:

1) Every 50(+/-) feet

2) All vertical points of inflection

3) At all horizontal points of inflection

4) At all valves, fittings, and other appurtenances, as shown on the Drawings

5) At all locations with additional minimum cover specified on the Drawings

b. Offset between pipe profile stakes and pipe horizontal centerline to be specified in writing by Contractor.

c. Stakes will provide vertical depth from hub to pipe.

1) Contractor shall specify in writing if vertical depths on pipe profile stakes are desired to be measured to top of pipe, pipe vertical centerline, or pipe invert. This measurement convention shall be used consistently throughout the entire project.

3. Structures and Site Staking:

a. Surveyor will provide the following staking for the pump station site:

1) Rough grading/ slope stakes, for pads and driveways

2) Sub-grade/ base course fine grading hubs, for pads and driveways

3) Site improvement stakes

a) Building foundations

b) Vaults and manholes

c) Valves (center of valve)

d) Site piping and appurtenances

e) Storm drains

f) Fencing

g) Driveways

4) Temporary benchmarks for all Contractor's use

b. Contractor shall be wholly responsible for proper alignment of all pipes, utilities, foundations and buildings in the field, including flange locations and elevations of pipe risers at buildings.

4. Roads:

a. Slope stakes every 100 feet, left and right side.

b. Fine grading hubs every 50 feet on tangent and every 25 feet on curves.

c. Stake culverts.

B. As-builts:

1. Pipe:

a. For open cut piping: The centerline of pipe shall be surveyed after laying and embedment of pipe in trench but prior to placing backfill over the top of the pipe or other features to be surveyed.

b. Any pipe that is backfilled prior to as-built surveying shall be uncovered at Contractor's sole expense to allow for surveying.

c. If the pipe is found to be outside of the line and grade specifications established in Section 33 11 13 - Public Water Transmission Systems, Contractor will be required to correct line and grade and have the corrected work re-surveyed at Contractor's sole expense.

d. If the Engineer suspects that the pipe has floated, shifted during placement or compaction of embedment, or otherwise moved after as-built surveying, the affected portion shall be re-surveyed as directed by the Engineer.

e. Only actual measurement of top of the pipe shall be accepted. No as-built reference points shall be accepted, without prior approval by the Engineer.

2. Structures and sites:

a. Surveyor shall survey all valves, vaults, fence corners, culverts, key drainage features, drain pipe outfalls, and other features within the sites.

b. Surveyor shall survey pressure pipes and drain pipes within the pump station site to ensure compliance with minimum slope requirements.

3. Roads:

a. Surveyor shall provide as-built surveying for all culvert ends.

b. As-builts for road surface and associated drainage ditch shall be based on the blue tops provided by the Surveyor.

c. In the event that actual construction differs from the blue tops, the road shall be as-built surveyed at the Contractor's expense.

4. Existing utilities:

a. Any existing utilities, such as existing gas lines or water lines crossed by the project, shall be surveyed by the Surveyor after being potholed by the Contractor.

5. As-built surveying intervals:

a. Pipeline:

1) Every 50(+/-) feet along main pipeline

a) For site piping, closer spacing may be required to ensure adequate slope

2) All vertical points of inflection

3) At all horizontal points of inflection

4) At all valves, fittings, and other appurtenances, as shown on the Drawings

5) At all locations with additional minimum cover specified on the Drawings

b. Valves and pipe fittings:

1) Centerline of pipe at all risers for air valves

2) Centerline of all in-line valves

a) For butterfly valves survey operating nut as well as center of valve

3) Centerline of all fittings, such as tees, wyes and ells

4) For flush valves, centerline of all valves, risers, horizontal and vertical points of inflection, and outfalls

c. Structures:

1) Center of rims for all manholes and vaults

3.2 CONTRACTOR SUPPORT AND COORDINATION

A. Contractor shall provide Surveyor with a minimum of 48 business hours notice to commence any surveying activity, such as construction staking or as-built surveying,

1. Contractor shall use the "Survey Request Form" (for survey work) or the "Authorization Form for Contractor Reimbursed Work" (for Additional Surveying Services). The Contractor shall also execute the "Acknowledgement of Contractor Reimbursed Standby Time" in the event that Surveyor standby time is required. These forms are provided in Appendix F to the Contract Documents to request all surveying work.
2. Contractor shall not bury any Work requiring as-built survey prior to being surveyed.
3. If, and only if, the Surveyor is not available to provide as-built surveying within 48 business hours, or if the Work must be backfilled in less than 48 business hours due to unforeseeable circumstances beyond the Contractor's control, then the Contractor will be allowed to backfill the Work under one of the following conditions, subject to Engineer's approval:
    a. Contractor sets reference points at station, offset, and cut or fill to the top of pipe every 50 feet and at all high and low points, or
    b. Contractor potholes the Work at a later date

B. Contractor responsible to coordinate schedule and pace of work with Surveyor, and pace work accordingly.

C. Contractor shall provide safe access for Surveyor to survey as-built facilities in accordance with this section, including pipe within uncovered trenches. All locations which Surveyor must access must meet OSHA safety standards for the Surveyor, as judged by the Surveyor. The Surveyor reserves the right to refuse to enter any location he or she deems to be unsafe, in which case it shall be the Contractor's responsibility to provide the Surveyor safe access to the locations that must be surveyed. In case of any dispute as to the safety of a particular location for the Surveyor to enter, the Owner reserves the right to contact OSHA for a determination.

1. Neither the Owner, nor the Engineer, nor the Surveyor will make any determination or assume any responsibility regarding the safety of any aspect of the project for the Contractor's own personnel or sub-contractors.
2. Beyond provision of safe access to facilities requiring survey, Contractor assumes no responsibility for Surveyor's, Engineer's, or safety.

D. Contractor shall coordinate with Surveyor regarding desired location of benchmarks.

3.3 RE-STAKING AND CORRECTION OF SUB-STANDARD WORK

A. Any stake removed, damaged beyond usability, or moved from its original location shall be replaced by the Surveyor at Contractor's expense.

B. In the event that any pipe or other facility moves after it has been surveyed for as-builts, it shall be re-surveyed at Contractor's expense.

C. Any sub-standard work that needs to be re-installed shall be re-surveyed at Contractor's sole expense.

1. In the case of pipeline that fails to meet line and grade requirements, the Contactor shall be responsible for the cost of re-excavation, re-installation, re-embedment,

re-compaction, re-surveying and re-testing of any embedment material that must be removed in order to correct pipe line and grade.

3.4 ADDITIONAL SURVEYING SERVICES

A. Additional Surveying Services include:

1. Re-staking
2. Re-surveying of sub-standard work
3. Re-surveying of work that has moved subsequent to as-built surveying
4. Any surveying associated with Best Management Practices (BMPs) included in the Contractor's SWPPP
5. Any surveying services not specifically delineated in this Section

3.5 ACCURACY

A. Degree of accuracy of surveying:

1. Horizontal and vertical alignment of pipeline tangents and curves: Within 0.10 ft.
2. Structure Points: Set within 0.03 foot, except where installation or operation considerations require tighter tolerances.
3. Blue Tops: Set within 0.03 foot.
4. Cross-Section Points: Locate within 0.10 foot, horizontally and vertically.
5. Benchmarks: Set within 0.08 foot, horizontally and vertically.

3.6 DISCREPANCIES

A. Contractor, Engineer, and Surveyor shall notify each other immediate upon the discovery of any discrepancies in the plans, surveys, or staking. The Engineer, in consultation with the Contractor and Surveyor, shall promptly review the discrepancies and issue corrections or clarification. If the Contractor elects to proceed with construction before such corrections or clarifications are made, Contractor shall do so at Contractor's own risk and expense.

B. Any claims by the Contractor against the Surveyor of inaccurate construction stakes must be substantiated based on the original, intact stakes. The Contractor shall not make any claim against the Surveyor of alleged inaccurate construction stakes unless all survey stakes set by the Surveyor are maintained and can be verified as to their origin.

END OF SECTION

SECTION 03 10 00

CONCRETE FORMS AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. The Contractor shall furnish all materials for concrete formwork, bracing, shoring and supports and shall design and construct all forms, bracing, shoring and falsework, all in accordance with the requirements of the Contract Documents.

B. Section Includes:

1. Formwork for cast-in place concrete.
2. Shoring, bracing, and anchorage.
3. Form accessories.
4. Form stripping.

C. Related Sections:

1. Section 03 20 00 - Concrete Reinforcement.
2. Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

A. International Building Code (IBC), as referenced herein, shall be the most recent New Mexico Construction Industries Division (CID) adopted edition

B. American Concrete Institute:

1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 - Specifications for Structural Concrete.
3. ACI 318 - Building Code Requirements for Structural Concrete.
4. ACI 347 - Guide to Formwork for Concrete.

C. Government Standards:

1. PS 1-74 U.S. Product Standard for Concrete Forms, Class I.

D. American Forest and Paper Association:

1. AF&PA - National Design Specifications for Wood Construction.

E. The Engineered Wood Association:

1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.

F. ASTM International:

1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

2. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

1.3 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. List of form materials and locations of use.

2. Form release agent with EPA Certification.

1.4 QUALITY ASSURANCE

A. Tolerances: The variation from established lines and grades shall not exceed 1/4-inch in ten (10) feet and there shall be no offsets or visible waviness in the finished surface. All other tolerances shall be within the "Suggested Tolerances" specified in Section 3.3 and 3.4 of ACI 347.

PART 2 PRODUCTS

2.1 FORM MATERIALS

A. Except as otherwise expressly accepted by the Engineer, all lumber brought on the job site for use as forms, shoring or bracing shall be new material. All forms shall be smooth surface forms and shall be of the following materials:

1. Walls: Steel or plywood panel

2. All Other Work: Steel panels, plywood or tongue and groove lumber

2.2 FORM TIES

A. Form ties with Integral water stops shall be provided with a plastic cone or other suitable means for forming a conical hole to ensure that the form tie may be broken off back of the face of the concrete.

1. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 1-inch and all such fasteners shall be such as to leave holes of regular shape for reaming.

2. Form ties for water-retaining structures shall have integral water stops. Removable taper ties may be used when approved by the Engineer. A preformed neoprene or polyurethane tapered plug sized to seat at the center of the wall shall be inserted in the hole left by the removal of the taper tie.

2.3 FORM AND FALSEWORK MATERIALS

A. Materials for concrete forms, formwork and falsework shall conform to the following requirements:

1. Lumber shall be Douglas Fir or Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS10.

2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine plywood manufactured especially for concrete formwork and shall conform to the requirements for PS 1 for Concrete Forms, Class I, and shall be edge sealed.

3. Form materials shall be metal, wood, plywood or other approved material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line and grade shown. Metal forms shall be an approved type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.

B. Unless otherwise shown, exterior corners in concrete members shall be provided with 3/4-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise shown.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Coordination and project conditions.

B. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.

C. When formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement before proceeding, request instructions from Engineer.

3.2 GENERAL

A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The Contractor shall assume full responsibility for the adequate design of all forms. Forms which are unsafe or inadequate in any respect shall promptly be removed from the Work and replaced at the Contractor's expense. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms, falsework and shoring shall comply with applicable Local, State and Federal regulations. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by Contractor's personnel and by the Engineer and shall be in sufficient number and properly installed. During concrete placement the Contractor shall continually monitor plumb and string line form positions and immediately correct deficiencies.

B. Concrete forms shall conform to the shape, lines and dimensions of structural components as called for on the Drawings and shall be free from surface defects and sufficiently tight to prevent leakage.

3.3 FORM DESIGN

A. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade and shall be of sufficient strength and rigidity to maintain

their position and shape under the loads and operations incident to placing and vibrating the concrete.

B. Suitable and effective means shall be provided on all forms for holding adjacent edges and end of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets or similar surface defects in the finished concrete.

C. Plywood, 5/8-inch and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete. The form joints shall be tight so as to prevent the loss of water, cement and fines during the placing and vibrating of the concrete. The bottom of the wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Adequate cleanout holes shall be provided at the bottom of each lift of forms.

3.4 INSTALLATION

A. Formwork - General:

1. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
2. All vertical surfaces of concrete members shall be formed.
3. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
4. Complete wedging and bracing before placing concrete.

B. Forms for Smooth Finish Concrete:

1. Use steel, plywood or lined board forms.
2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
3. Install form lining with close-fitting square joints between separate sheets without springing into place.
4. Use full size sheets of form lines and plywood wherever possible.
5. Tape joints to prevent protrusions in concrete.
6. Use care in forming and stripping wood forms to protect corners and edges.
7. Level and continue horizontal joints.
8. Keep wood forms wet until stripped.

C. Forms for Surfaces to Receive Membrane Waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.

D. Framing, Studding and Bracing:

1. Size framing, bracing, centering, and supporting members with sufficient strength to maintain shape and position under imposed loads from construction operations.
2. Distribute bracing loads over base area on which bracing is erected.

3. When placed on ground, protect against undermining, settlement or accidental impact.

E. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301.

F. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

G. Obtain Engineer's approval before framing openings in structural members not indicated on Drawings.

H. Install fillet and chamfer strips on external corners of beams, joists, and/or columns, as called for on the Drawings.

I. Install void forms in accordance with manufacturer's recommendations.

3.5 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer's specifications. Do not coat forms for concrete indicated to receive "scored finish". Apply form coatings before placing reinforcing steel.

3.6 INSTALLATION - INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Install formed openings for items to be embedded in or passing through concrete work.

B. Locate and set in place items required to be cast directly into concrete.

C. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.

D. Install water stops continuous without displacing reinforcement.

E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

G. Form Ties:

1. Use sufficient strength and sufficient quantity to prevent spreading of forms.

2. Leave inner rods in concrete when forms are stripped.

3. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.

4. Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as specified for "Finish of Concrete Surfaces" in Section 03 30 00 - Cast-In-Place Concrete.

5. Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spalling of the concrete form stripping or tie removal will not be permitted.

6. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1-inch back from the formed face or faces of the concrete.

H. Removable Ties:

1. Where taper ties are approved for use, the larger end of the taper tie shall be on the wet side of walls in water retaining structures. After the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond.

2. A precast neoprene or polyurethane taped plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink grout for water bearing and below-grade walls. The hole shall be completely filled with non-shrink grout for above-grade walls that are dry on both sides.

3. Exposed faces of walls shall have the outer 2-inches of the exposed face filled with a cement grout which shall match the color and texture of the surrounding wall surface.

I. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

J. Construction Joints:

1. Concrete construction joints will not be permitted at locations other than those shown or specified, except as may be acceptable to the Engineer.

2. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.

3. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.

4. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.

5. Arrange joints in continuous line straight, true and sharp.

K. Embedded Items:

1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.

2. Do not embed wood or uncoated aluminum in concrete.

3. Obtain installation and setting information for embedded items furnished under other Specification sections.

4. Securely anchor embedded items in correct location and alignment prior to placing concrete.

5. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 for size and location limitations.

L. Openings for Items Passing Through Concrete:

1. Frame openings in concrete where indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.

2. Coordinate work to avoid cutting and patching of concrete after placement.

3. Perform cutting and repairing of concrete required as result of failure to provide required openings.

M. Screeds:

1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.

2. Slope slabs to drain where required or as shown on Drawings.

3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.

N. Screed Supports:

1. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad or base type screed supports which will not puncture membrane.

2. Staking through membrane is not permitted.

O. Cleanouts and Access Panels:

1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.

2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

3.7 MAINTENANCE OF FORMS

A. Forms shall be maintained at all times in good condition, particularly as to cleanliness, strength, rigidity, tightness and smoothness of surface. After forms have been removed from a concrete placement they shall be immediately and thoroughly cleaned and repaired and surface treated before reuse.

B. The form surfaces shall be treated with a non-staining mineral oil or other lubricant acceptable to the Engineer. Any excess lubricant shall be satisfactorily removed before placing the concrete. Oil shall be kept off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

3.8 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and removal has been approved by Engineer.

B. No forms shall be disturbed or removed under an individual panel or unit before the concrete in the adjacent panel or unit has attained seventy-five percent (75%) of the specified 28-day strength and has been in place for a minimum of seven (7) days. Forms for all vertical walls and columns shall remain in place at least forty-eight (48) hours after the concrete has been placed, except for periods of cold weather when forms shall remain in place at least seventy-two (72) hours after concrete has been placed.

C. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

D. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

E. Leave forms in place for minimum number of days as specified in ACI 347.

3.9 REUSE OF FORMS

A. Forms may be reused only if in good condition and only if acceptable to the Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces that are permanently exposed to view.

3.10 FALSEWORK

A. The Contractor shall be responsible for the design, engineering, construction, maintenance and safety of all falsework, including staging, walkways, forms, ladders and similar appurtenances, which shall equal or exceed the applicable requirements of the provisions of the OSHA Safety and Health Standards for Construction, and the requirements specified herein.

B. All falsework shall be designed and constructed to provide the necessary rigidity and to support the required dead load plus a minimum of 40 psf live load. Falsework for the support of a superstructure shall be designed to support the loads that would be imposed if the entire superstructure were placed at one time. Falsework shall be placed upon a solid footing, safe against undermining and protected from softening. When falsework is supported on any portion of the structure that is already constructed, the load imposed by the falsework shall be spread, distributed and braced in such a way as to avoid any possibility of damage to the structure. Falsework supported off finished floor slabs shall be set in such a way to protect the finish floor surface from being scarred, chipped or gouged.

3.11 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

C. Notify Engineer after placement of reinforcing steel in forms, but prior to placing concrete.

D. Schedule concrete placement to permit formwork inspection before placing concrete.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SUMMARY

A. The Contractor shall furnish, fabricate and place all concrete and masonry reinforcement steel, including all the tie wires, clips, supports, chairs, spacers and other accessories, all as shown and specified in the Contract Documents. All requirements included on the Drawings shall apply and shall take precedent over any indications in the present Section of the technical specifications in the case of contradictions.

B. Related Sections:

1. Section 03 10 00 - Concrete Forms and Accessories.

2. Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

A. Codes:

1. The International Building Code, as referenced herein, shall be the most recent New Mexico Construction Industries Division (CID) adopted edition of International Building Code (IBC).

B. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.

2. ACI 315 - Details and Detailing of Concrete Reinforcement.

3. ACI 318 - Building Code Requirements for Structural Concrete.

4. ACI SP-66 - ACI Detailing Manual.

C. ASTM International:

1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

2. ASTM A184/A184M - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.

3. ASTM A185 - Specification for Welded Steel Wire Fabric (Latest Edition) for Concrete Reinforcement.

4. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.

5. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.

6. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

7. ASTM A934/A934M - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
8. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
9. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Reinforcing Steel Bars.

D. American Welding Society:

1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

E. Concrete Reinforcing Steel Institute:

1. CRSI - Manual of Standard Practice (Latest Edition).
2. CRSI - Placing Reinforcing Bars (Latest Edition).

F. Wire Reinforcement Institute:

1. Manual of Standard Practice for Welded Wire Fabric.

1.3 SUBMITTALS

A. The Contractor shall furnish to the Engineer reinforcing steel placing drawings. These drawings shall show the number, grade, size, length, mark, location and bending diagrams for all reinforcing steel and related products, together with lists of bent and straight bars in accordance with the ACI Detailing Manual (latest edition) of the American Concrete Institute and the requirements specified herein and shown on the Contract Drawings. The Engineer may or may not review the placement drawings. Any review of the placement drawings by the Engineer will be limited to general compliance with the Contract Documents and will not be returned to the Contractor. Reinforcing steel placement will be checked in the field using the design drawings. Any discrepancies, errors or omissions from the requirements of the Contract Documents shall be corrected prior to placement of concrete and at the sole expense of the Contractor.

1.4 QUALITY ASSURANCE

A. When required by any applicable permits, such as CID permits, Contractor shall have reinforcement inspected by the agency with jurisdiction prior to placement of concrete.

B. If requested by the Engineer, the Contractor shall provide a certified copy of the mill test report showing physical and chemical analysis for each heat of reinforcement steel delivered.

PART 2 PRODUCTS

2.1 REINFORCEMENT STEEL

A. Reinforcement steel for all cast-in-place reinforced concrete construction shall conform to the following requirements:

1. Bar reinforcement shall conform to the requirements of ASTM A615 for Grade 60 Billet Steel Reinforcement.

2. Welded wire fabric reinforcement shall conform to the requirements of ASTM A185 and the details shown. Welded wire fabric with longitudinal wire equal to or less than 4.0 size wire shall be either furnished in flat sheets or in rolls with a core diameter or not less than 10-inches. Welded wire fabric with longitudinal wires larger than 4.0 size shall be furnished in flat sheets only.

B. Accessories:

1. The Contractor shall furnish and install all accessories including necessary chairs or bolsters, concrete blocks (dobies), tie wires, supports, spacers and other devices to position reinforcement during concrete placement.

2. Wire bar supports shall be made of plain cold-drawn steel wire with pre-molded, gray-colored, plastic tips to the legs of the support. The plastic shall have a thickness of 1/8-inch or greater at points of contact with formwork and extend upward on the wire a minimum of 1/2-inch. Wire sizes and geometric dimensions shall be made in accordance with Table II of the latest edition of CRSI Manual of Standard Practice.

3. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Where the concrete blocks are used on concrete surfaces exposed to view, the color and texture of the concrete blocks shall match that required for the finished surface. Wire ties shall be embedded in concrete block bar supports.

4. The wire tie shall be 16-gauge or heavier, black annealed.

2.2 MECHANICAL COUPLERS

A. Mechanical couplers shall be provided where shown and where approved by the Engineer. The couplers shall develop a tensile strength that exceeds one hundred fifty percent (150%) of the yield strength of the reinforcement bars being spliced at each splice.

PART 3 EXECUTION

3.1 GENERAL

A. All reinforcement steel, welded wire fabric, couplers and other appurtenances shall be fabricated and placed in accordance with the requirements of the Contract Documents, including referenced specifications, codes and standards.

3.2 FABRICATION

A. Reinforcement steel shall be accurately fabricated to the dimensions and shape shown in the Contract Documents. Fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings. Bends shall conform to bend dimensions defined as standard in accordance with details in the ACI Detailing Manual and/or CRSI Manual of Standard Practice, unless otherwise shown. Bars shall be bent cold and shall not be bent or straightened in a manner that will injure the material. All hooks shall conform to bend dimensions defined as ACI Standard Hooks.

B. The Contractor shall fabricate reinforcement bars within the tolerances shown in the ACI Detailing Manual and/or CRSI Manual of Standard Practice.

C. Reinforcing bars delivered to the field shall be tagged with durable material and marked in a legible manner with waterproof markings. Tags shall show the grade, number of pieces, size and mark or length of bars.

3.3 PLACING

A. Reinforcing steel shall be accurately positioned as shown on the Contract Documents and placed per the minimum clearance requirements given on the Drawings and shall be adequately supported and wired together to prevent displacement. All reinforcement steel shall be supported or spaced off the forms by concrete or metal supports which are rigid enough to prevent any displacement or the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without settlement. Concrete blocks shall not be used as spacers between mats. All concrete blocks used to space reinforcement steel off vertical formed surfaces shall be tied to the steel with wire ties which are embedded in the blocks. For reinforcement including welded wire fabric over formwork, the Contractor shall furnish concrete or metal supports with plastic covered legs for bar supports.

B. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.

C. Bars additional to those shown which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at its own expense.

D. Placing Tolerances: Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318, except where in conflict with the requirements of Building Code.

E. Bars may need to be moved to avoid interference with other reinforcement steel, conduits or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be as acceptable to the Engineer. Additional bars may be necessary to prevent cracking or provide additional reinforcement in this case and shall be provided by the Contractor at its own expense.

F. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than three (3) feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.

3.4 SPACING OF BARS

A. The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall be not less than the nominal diameter of the bars nor less than 1-1/3 times the maximum size of the coarse aggregate, nor less than 1-inch.

3.5 SPLICING

A. General: Reinforcement bar splices shall only be used at locations shown, unless otherwise acceptable to the Engineer.

B. Splices of Reinforcement: The length of lap for reinforcement bars, unless otherwise shown shall be in accordance with ACI 318, Section 12.15.1 for a class C splice.

C. Laps of welded wire fabric shall be in accordance with ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each two (2) running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

D. Bending or Straightening: Reinforcement shall not be straightened or rebent in a manner which will injure the material. Bars with kinks or bends not shown shall not be used. All bars shall be bent cold, unless otherwise permitted by the Engineer. No bars partially embedded in concrete shall be field-bent, except as specifically permitted by the Engineer.

3.6 CLEANING AND PROTECTION

A. Reinforcing steel delivered to the jobsite shall be suitably stored off the ground and protected from oils, mud, concrete splatter and all conditions conducive to corrosion until embedded in concrete.

B. The surfaces of all reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcement shall be reinspected and, if necessary, recleaned.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. The Contractor shall furnish all materials for concrete in accordance with the provisions of this Section and shall form, mix, place, cure, repair, finish, and do all other work as required to produce finished concrete, in accordance with the requirements of the Contract Documents. All requirements included on the Drawings shall apply and shall take precedent over any indications in the present Section of the technical specifications in the case of contradictions.

B. The following types of concrete shall be covered in this Section:

1. Sitework Concrete: Concrete to be used for curbs, gutters, catch basins, sidewalks, pavements, thrust blocks, fence and guard post embedment, and other concrete ties unless otherwise shown.

2. Structural Concrete: Concrete to be used where noted in the Contract Documents.

3. Lean Concrete: Concrete to be used for pipe trench cut-off walls and cradles, where the preceding items are detailed on the Drawings as un-reinforced.

4. Duct Bank Concrete: Red colored concrete to be used for electrical duct banks.

C. The term "hydraulic structure" used in these specifications shall refer to environmental engineering concrete structures for the containment, treatment, or transmission of water, wastewater, or other fluids.

D. Related Sections:

1. Construction Drawings - General Notes and Specifications.

2. Section 03 10 00 - Concrete Forms and Accessories.

3. Section 03 20 00 - Concrete Reinforcement.

4. Section 03 29 00 - Joints in Concrete.

5. Section 03 60 00 - Grout.

6. Section 31 23 23 - Backfill.

7. Section 32 31 13 - Chain Link Fences and Gates.

8. Section 33 11 13 - Public Water Distribution Systems.

1.2 REFERENCES

A. American Concrete Institute:

1. ACI 117 - Standard Tolerances for Concrete Construction and Materials.

2. ACI 214 - Recommended Practice for Evaluation of Strength Test Results of Concrete.

3. ACI 301 - Specifications for Structural Concrete.

4. ACI 306 - Cold Weather Concreting.
5. ACI 308.1 - Standard Specification for Curing Concrete.
6. ACI 309 - Consolidation of Concrete.
7. ACI 318 - Building Code Requirements for Structural Concrete.

B. ASTM International:

1. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33 - Standard Specification for Concrete Aggregates.
3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C40 - Test Method for Organic Impurities in Fine Aggregates for Concrete.
5. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
6. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
7. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
8. ASTM C150 - Standard Specification for Portland Cement.
9. ASTM C156 - Test Methods for Water Retention by Concrete Curing Materials.
10. ASTM C157 - Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete.
11. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
12. ASTM C192 - Method of Making and Curing Concrete Test Specimens in the Laboratory.
13. ASTM C227 - Test for Potential Alkali Reactivity of Cement- Aggregate Combinations.
14. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
15. ASTM C309 - Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.
16. ASTM C441 - Test for Effectiveness of Mineral Admixtures in Preventing Excessive Expansion of Concrete Due to Alkali-Aggregate Reaction.
17. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
18. ASTM C1077 - Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction & Criteria for Laboratory Evaluation.
19. ASTM D2419 - Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
20. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.

1.3 SUBMITTALS

A. General**:** Submittals shall be submitted to the Engineer for review in accordance with Section 01 00 00, Contractor Submittals. Submittals shall include, but not be limited to the following:

1. Mix Designs**:** Prior to beginning the Work and within 14 days of the Notice To Proceed, the Contractor shall submit to the Engineer, for review, the proposed ready-mix supplier and their Laboratory-Certified concrete mix design for each class and type of concrete specified for the Work. Submitted mix designs shall have been performance-tested and certified by an independent laboratory approved by the Owner. Physical properties, including slump, air content, density and compressive strength shall be included with the submitted tests. All costs related to providing mix design shall be borne by the Contractor. Mix designs shall show the following in accordance with ACI 301:

   a. Proportions for all materials proposed.

   b. Mill tests for cement.

   c. Admixture certification, chloride ion content must be included.

   d. Aggregate gradation and certification.

2. Delivery Tickets: Where ready-mix concrete is used, the Contractor shall furnish delivery tickets at the time of delivery of each load of concrete. Each ticket shall show the state certified equipment used for measuring and the total quantities, by weight of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate added at the batching plant, and the amount allowed to be added at the site for the specific design mix. In addition, each ticket shall state the approved mix design number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to the times when the batch was dispatched, when it left the plant, when it arrived at the site, when unloading began, and when unloading was finished.

3. Materials and methods for curing:

   a. List of curing methods to be used on each type and class of concrete.

   b. Curing compound.

   c. Curing blankets and mats.

   d. Evaporation retardant.

1.4 QUALITY ASSURANCE

A. When required by any applicable permits, such as Construction Industries Division (CID) permits, Contractor shall have reinforcement inspected by the agency with jurisdiction prior to placement of concrete.

B. General:

1. Tests on concrete will be field performed in accordance with all requirements of applicable ASTM standards for such tests, including but not limited to obtaining samples, temperature, slump, air entrainment, making and curing specimens, breaking concrete cylinders, and other as may be applicable.

2. The cost of all laboratory tests on cement, aggregates, and concrete, for the development of the mix design, will be borne by the Contractor. The laboratory must meet or exceed the requirements of ASTM C1077.

3. Concrete for testing shall be supplied by the Contractor as part of the project cost, and the Contractor shall provide assistance in obtaining samples, and disposal and cleanup of excess material.

4. Test cylinders will be prepared one (1) test each day of placement for each mixture for the first 50 or less cubic yards and one (1) test for each additional 100 cubic yards of concrete.

C. Compression Tests:

1. Compression test specimens will be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as indicated above to ensure continued compliance with these specifications. Each set of test specimens will be a minimum of 5 cylinders.

2. Compression test specimens for concrete shall be made in accordance with ASTM C31. Specimens shall be 6-inch diameter by 12-inch high cylinders.

3. Compression tests shall be performed in accordance with ASTM C39. One test cylinder will be tested at 7 days and 2 at 28 days. The remaining cylinders will be held to verify test results, if needed.

4. Compression testing will be paid for by the Owner.

D. Evaluation and Acceptance of Concrete:

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 318, and as specified herein.

2. All concrete that fails to meet the ACI requirements and these specifications, is subject to removal and replacement at the cost of the Contractor.

3. Concrete delivered to the site that does not meet the requirements as herein specified may be rejected.

1.5 CONSTRUCTION TOLERANCES

A. The Contractor shall set and maintain concrete forms and perform finishing operations so as to ensure that the completed work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the specifications, permissible deviations will be in accordance with ACI 117.

B. The following construction tolerances are hereby established and apply to finished walls and slabs unless otherwise shown:

Item	Tolerance
Variation of the constructed linear outline from the established position in plan.	In 10 feet: 1/4-inch In 20 feet or more: 1/2-inch
Variation from the level or from the grades shown.	In 10 feet: 1/4-inch In 20 feet or more: 1/2-inch
Variation from the plumb.	In 10 feet: 1/4-inch In 20 feet or more: 1/2-inch
Variation in the thickness of slabs and walls.	Minus 1/4-inch; Plus 1/2-inch
Variation in the locations and sizes of slabs and wall openings.	Plus or minus 1/4-inch

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

A. All cast-in-place concrete at the site(s) shall be:

1. All cement, unless sulfate tests dictate otherwise, shall be standard brand Portland Cement conforming to ASTM C150 for Type II, low alkali.
2. Portland Cement shall contain not more than 0.60 percent total alkalies. The term "alkalies" is defined as the sum sodium oxide (Na_2O), potassium oxide (K2O), calculated as sodium oxide (.658 K2O).
3. Only one (1) brand of cement shall be used for exposed concrete in any individual structure. The cement shall be suitably protected from exposure to moisture until used. Certified mill test reports for each shipment of cement to be used shall be submitted to the Engineer. Mill test reports shall include the alkali content.

B. Water shall be potable, clean and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. The water shall be considered potable, for the purpose of this Section only, if it meets the requirements of the local governmental agencies. Agricultural water with high total dissolved solids (over 1000 mg/l TDS) shall not be used.

C. All concrete aggregates shall be obtained from pits acceptable to the Engineer, shall be non-reactive, sound, uniformly graded and free of deleterious material in excess of allowable limits specified. Combined aggregates shall be well graded from coarse to fine sizes, and be uniformly graded between screen sizes to produce a concrete that has optimum workability and consolidation characteristics. Lightweight sand for fine aggregate will not be permitted. Aggregates shall conform to ASTM C33.

1. Coarse Aggregate: Coarse aggregate shall consist of gravel, crushed gravel or crushed stone made up of clean, hard, durable particles free from calcareous coatings, organic matter or other foreign substances. Thin or elongated pieces having a length greater than four (4) times the average thickness shall not exceed fifteen percent (15%) by weight. Deleterious substances shall not be present in

excess of the following percentages by weight, and in no case shall the total of all deleterious substances exceed one and one-half percent (1.5%):

Soft Fragments	1.5%
Shale	1.5%
Coal and Lignite	0.25%
Clay Lumps	0.25%
Materials Finer than No. 200 Sieve	0.50%*

*Except that when material finer than No. 200 sieve consists of crusher dust, the maximum amount maybe 1%.

Except as otherwise specified or approved in writing by the Engineer, coarse aggregate shall be graded as specified in ASTM C33, size No. 57.

2. Fine Aggregate: Fine aggregate for concrete or mortar shall consist of clean, natural sand or a combination of natural and manufactured sands that are hard and durable. Deleterious substances shall not be present in excess of the following percentages by weight of contaminating substances. In no case shall the total exceed three percent (3%):

Removed by Decantation (Dirt, Silt, Etc.)	3%
Shale	1%
Clay Lumps	1%

Fine aggregate shall not contain strong alkali nor organic matter which gives a color darker than a standard color when tested in accordance with ASTM C40. Fine aggregate shall have a fineness modulus not less than 2.50 nor greater than 3.00. Except as otherwise specified, fine aggregate shall be graded from coarse to fine in accordance with the requirements of ASTM C33.

D. If non-reactive aggregates are unavailable, and either the coarse or fine aggregates are found to be alkali-silica reactive, the Contractor shall submit a proposed design mix that effectively mitigates the alkali-silica reactivity, per ASTM C441. The admixture will be considered effective if the mean mortar bar expansion at 14 days is less than or equal to 0.10%.

E. Admixtures of any type, except as otherwise specified, shall not be used unless written authorization has been obtained from the Engineer. The use of calcium chloride will not be permitted.

1. All concrete shall contain five percent (5%), plus or minus one percent (1%) entrained air of evenly dispersed air bubbles at the time of placement. The air-entraining agent shall contain no chloride and conform to ASTM C260, or U.S. Army Corps of Engineers Specifications CRD-C13. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement. The Engineer, or Owner and his duly authorized representatives reserve the right, at any time, to sample and test the air-entraining agent or the air content of concrete received on the job by the Contractor. Air entrainment in the concrete shall be tested by ASTM C138, ASTM C231 or ASTM C173. If any sample

tested does not have the specified air content, a second test shall be performed. If the second test does not meet the specified air content, the concrete represented by the test shall be removed from the job.

2. A "super plasticizer" water reducing agent may be used at the Contractors option, subject to approval by the Engineer, for concrete in hydraulic structures. The amount of cement in the mix shall not be reduced. The slump may be increased to a maximum of 8-inches. Quantities of admixtures and procedures shall be in accordance with the manufacturers published recommendations. The super plasticizer shall conform to ASTM C494, Type F or G. The admixture shall be a second-generation type, free of chlorides and alkalies, composed of a synthesized sulfonated complex polymer that shall be added to the concrete mixer at the batch plant.

3. Fly ash/pozzolan shall conform to ASTM C618, including the requirements of Table 1A, therein, and the following supplementary requirements:

a. Class F Fly Ash

Loss on ignition, maximum	1%
SO3 content, maximum	3%
Moisture content, maximum	1%
$R = (CaO - 5\%)/(Fe_2O_3)$, maximum	1.5

2.2 CONCRETE CURING MATERIALS

A. Evaporation Retardant: Shall be monomolecular film-forming liquid for application to fresh concrete to prevent rapid drying of the surface.

B. Materials for curing concrete shall conform to the following requirements:

1. Concrete curing compound shall be Protex LR-151 as manufactured by Protex Industries, Denver, CO; Hunt Process Clear ARB as manufactured by Hunt Process Co., Santa Fe Springs, CA; Select Cure CRB as manufactured by Select Products Co., Upland, CA; or equal. The curing compound shall contain a fugitive dye so that areas of application will be readily distinguishable. All admixtures, including superplasticizers, shall be included in submittals in the mix proportions.

2. Polyethylene sheet for use as concrete curing blanket shall be white and shall have a normal thickness of 10 mils.

3. Burlap, cotton mats or other covering material for use as concrete curing blanket must be overlapped adequately to ensure 100% coverage at all times, and must not be allowed to become dry at any point during the curing period

4. The loss of moisture, when determined in accordance with the requirements of ASTM C156, shall not exceed 0.055 grams per square centimeter of surface.

C. Evaporation Retarder: Waterborne, monomolecular fil forming, manufactured for application to fresh concrete.

2.3 CONCRETE DESIGN REQUIREMENTS

A. General: The concrete mixes shall be designed to produce a concrete of such consistency and composition so as to obtain maximum density and minimum shrinkage. Mix designs with more than forty-one percent (41%) of sand of the total weight of fine and coarse aggregate shall not be used.

B. All concrete shall contain five percent (5%), plus or minus one percent (1%) entrained air of evenly dispersed air bubbles at the time of placement. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement. The Engineer or Owner and his duly authorized representatives reserve the right, at any time, to sample and test the air-entraining agent or the air content of concrete received on the job by the Contractor. Air entrainment in the concrete shall be tested by ASTM C138, ASTM C231 or ASTM C173. If any sample tested does not have the specified air content, a second test shall be performed. If the second test does not meet the specified air content, the concrete represented by the test shall be removed from the job.

C. Water-Cementitious Materials Ratio and Compressive Strength: The minimum compressive strength and cement content of concrete shall not be less than that specified in the following Table:

Type of Work	Min. 28-Day Compressive Strength (psi)	Max. Size Aggregate (in.)	Min. Cement W/C per CY (94# sacks)	Maximum w/cm (by wt.)
Slabs on grade, footings, floor slabs, and all other concrete items not specified elsewhere.	4,000	1	6.0	0.50
Site work concrete such as fence posts, thrust blocks, valve collars, etc.	3,000	1	5.0	0.50

D. Adjustments to Mix Design: The mixes used shall be changed whenever such change is necessary or desirable to secure the required strength, density, workability and surface finish and the Contractor shall be entitled to no additional compensation because of such changes.

E. At the Contractors option, fly ash/pollozan may be used as a partial cement replacement in concrete as follows:

1. Fly ash shall replace not more than twenty five percent (25%) by weight of the Portland Cement in the design mix. The design mix shall contain a minimum of six (6) sacks of cement per cubic yard before the replacement is made.

2. Fly ash for all structures shall be Class F fly ash.

3. If the coarse or fine aggregates are proven to be potentially alkali-silica reactive per ASTM C227, the mineral admixture Class F fly ash shall be proportioned by weight of cement to provide a fly ash to portland cement ratio not less than 1:4, not less than 20 percent of the total cementitious material. The Contractor shall

provide the Engineer with chemical and physical analysis of the fly ash, and detailed design mix to meet the requirements of ASTM C441.

F. A "superplasticizer" (high-range water-reducing) admixture may be used at the Contractor's option, subject to approval by the Engineer, for concrete in hydraulic structures. The amount of cement in the mix shall not be reduced. The slump may be increased to a maximum of 9-inches. Quantities of admixtures and procedures shall be in accordance with the manufacturers published recommendations

2.4 CONSISTENCY

A. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143. The slumps shall be as follows:

Part of Work	Slump (inches)
Footings and Slabs	3-inches + 1/2-inches, - 1 inch.
Other Work	3-inches ± 1-inch.
With High Range Water Reducer Added	8-inches maximum.

2.5 TRIAL BATCH AND LABORATORY TESTS

A. Before placing any concrete, the Contractor shall submit the certified trial batch results of each class of concrete having a 28-day strength of 3,500 psi or higher, based on the preliminary concrete mixes submitted by the Contractor. All concrete shall conform to the requirements of this Section, whether the aggregate proportions are from the Contractors preliminary mix design, or whether the proportions have been adjusted during the trial batch process. The trial batch shall be prepared using the aggregates, cement and admixture proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain three (3) drying shrinkage, and six (6) compression test specimens from each batch. The costs for the trial batch tests shall be borne by the Contractor.

B. The determination of compressive strength will be made by testing 6-inch diameter by 12-inch high cylinders; made, cured and tested in accordance with ASTM C192 and ASTM C39. Three (3) compression test cylinders will be tested at 7-days and three (3) at 28-days. The average compressive strength for the three (3) cylinders tested at 28-days for any given trial batch shall not be less than one hundred twenty-five percent (125%) of the specified compressive strength.

C. A standard sieve analysis of the combined aggregate for each trial batch shall be performed according to the requirements for ASTM C136. Values shall be given for percent passing each sieve.

2.6 SHRINKAGE LIMITATION

A. Drying shrinkage specimens shall be 4-inch by 4-inch by 11-inch prisms with an effective gage length of 10-inches, fabricated, cured, dried and measured in accordance with ASTM C157 modified as follows: Specimens shall be removed from molds at an age of 23+ hours after trial batching, shall be placed immediately in water at 70 degrees F. ±3 degrees F. for at least thirty (30) minutes, and shall be measured within thirty (30) minutes thereafter to determine original length and then submerged in saturated lime

water at 73 degrees F. ±3 degrees F. Measurement to determine expansion expressed as a percentage of original length shall be made at age 7-days. This length at age 7-days shall be the base length for drying shrinkage calculations ("0" days drying age). Specimens then shall be stored immediately in a humidity control room maintained at 73 degrees F. ±3 degrees F. and fifty percent (50%) ±4 percent relative humidity for the remainder of the test. Measurements to determine shrinkage expressed as percentage of base length shall be made and reported separately for 7, 14, 21 and 28-days of drying after 7-days of moist curing.

B. The drying shrinkage deformation of each specimen shall be computed as the difference between the base length (at "0" days drying age) and the length after drying at each test age. The average drying shrinkage deformation of the specimens shall be computed to the nearest 0.0001-inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004-inch, the results obtained from that specimen shall be disregarded. Results of the shrinkage test shall be reported to the nearest 0.001 percent of shrinkage. Compression test specimens shall be taken in each case from the same concrete used for preparing during shrinkage specimens. These tests shall be considered a part of the normal compression tests for the project. Allowable shrinkage limitations shall be specified herein.

C. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21-day drying age or at 28-day drying age, shall be 0.036 percent or 0.042 percent, respectively. The Contractor shall only use a mix design for construction that has first met the trial batch shrinkage requirements.

D. The maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than twenty-five percent (25%).

E. If the required shrinkage limitation is not met during construction, the Contractor shall take all necessary action, at not additional cost to the Owner, for securing the specified shrinkage requirements. These actions may include changing the source of aggregates, cement and/or admixtures; reducing water content ratio; washing or aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or the effects of shrinkage.

2.7 CEMENT GROUT

A. Cement grout materials shall be as specified in Section 03 60 00 - Grout.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Coordination and project conditions.

B. Verify requirements for concrete cover over reinforcement.

C. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.2 MIXING CONCRETE

A. Mixing equipment shall be subject to the Engineers approval. Mixers shall be of the stationary plant or truck mixer type. Adequate equipment and facilities shall be provided

for accurate measurement and control of all materials and for readily changing the proportions of the material. The mixing equipment shall be maintained in good working order and shall be capable of combining the aggregates, cement and water within the specified time into a thoroughly mixed and uniform mass and of discharging the mixture without segregation. Cement and aggregate shall be proportioned by weight.

B. The batch plant shall be capable of controlling and delivering of all material to within one percent (1%) by weight of the individual material. If bulk cement is used, it shall be weighed on a separate visible scale that will accurately register the scale load at any stage of the weighing operation from zero to full capacity.

1. Cement shall not come in contact with aggregate or with water until the materials are in the mixer ready for complete mixing with all mixing water. The procedure of mixing cement with sand or with sand and coarse aggregate for delivery to the jobsite for final mixing and an addition of mixing water will not be permitted. Retempering of concrete (addition of water to previously prepared concrete mix) will not be permitted. The entire batch shall be discharged before recharging. The volume of the mixed material per batch shall not exceed the manufacturers rated capacity of the mixer.

2. Each mixer shall be equipped with a device for accurately measuring and indicating the quantity of water entering the concrete, and the operating mechanism shall be such that leakage will not occur when the valves are closed. Each mixer shall be equipped with a device for automatically measuring, indicating and controlling the time required for mixing. This device shall be interlocked to prevent the discharge of concrete from the mixer before the expiration of the mixing period.

3. Transit-mixed concrete shall be mixed and delivered in accordance with ASTM C94. After the drum is once started, it shall be revolved continuously until it has completely discharged its batch. Water shall not be admitted to the mix until the drum has started revolving. The right is reserved to increase the required minimum number of revolutions allowed, if necessary, to obtain satisfactory mixing, and the Contractor will not be entitled to additional compensation because of such an increase or decrease.

C. Mixed concrete shall be delivered to the site of the work and discharge shall be completed within one (1) hour after the addition 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 F. or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed forty-five (45) minutes. The use of non-agitating equipment for transporting concrete will not be permitted.

D. Truck mixers shall be equipped with counters so that the number of revolutions of the drum may be readily verified. The counter must be capable of being reset and shall be actuated at the time of starting mixers at mixing speeds. Concrete shall be mixed in a truck mixer for not less than seventy (70) revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.

3.3 PREPARATION OF SURFACES FOR CONCRETING

A. Earth surfaces shall be thoroughly and uniformly wetted by sprinkling prior to the placing of any concrete. These surfaces shall be kept moist by frequent sprinkling up to the time concrete is placed thereon. The surface shall be free from standing water, mud and debris at the time of placing concrete.

B. The surfaces of all horizontal construction joints shall be cleaned of all laitance, loose or defective concrete and foreign material. Such cleaning shall be accomplished by sandblasting followed by thorough washing. All pools of water shall be removed from the surface of construction joints before the new concrete is placed.

C. No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel and preparation off surfaces involved in the placing have been completed and accepted by the Engineer at least four (4) hours before placement of concrete. All reinforcement, anchor bolts, sleeves, inserts and similar items shall be set and secured in the forms where shown or by shop drawings and shall be acceptable to the Engineer before any concrete is placed. Accuracy of placement is the responsibility of the Contractor. All surfaces of embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.

D. All form surfaces in contact with the concrete shall be thoroughly cleaned of all previous concrete, dirt and other surface contaminants prior to use. Damaged form surfaces shall not be used.

1. Wood form surfaces in contact with the concrete shall be coated with an approved release agent prior to form installation. The release agent shall be non-staining and non-toxic after thirty (30) days. Mill scale and other ferrous deposits shall be sandblasted or otherwise removed from the contact surface of steel forms.

2. All steel forms shall have the contact surfaces coated with an approved release agent. The release agent shall be effective in preventing discoloration of the concrete from rust and shall be non-toxic after thirty (30) days.

E. Where concrete is to be cast against old existing concrete, the old concrete shall be thoroughly roughened to exposed, hard aggregate by sandblasting or chipping. Any additional surface preparation shall be as called for in the drawings.

F. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or diverted out of the forms and clear of the work. No concrete shall be deposited under water or allowed to rise on any concrete until the concrete has attained its initial set. Pumping or other necessary dewatering operations for removing ground water, if required, shall be the responsibility of the Contractor and will be subject to review by the Engineer.

G. Pipe, conduit, dowels, sleeves and other ferrous items required to be embedded in concrete construction shall be adequately positioned and supported prior to placement of concrete. There shall be a minimum of 2-inches clearance between embedded items and any of the concrete reinforcement. Securing embedments in position by wiring or welding them to the reinforcement will not be permitted.

3.4 PLACING CONCRETE

A. No concrete shall be placed without prior inspection of the forms, reinforcing and embedded items and approval from an authorized representative of the Engineer. The Contractor shall notify he Engineer at least twenty-four (24) hours in advance of any scheduled concrete placement and shall call for final inspections no later than four (4) hours in advance of the scheduled placement. The Contractor shall notify the Engineer at least two (2) hours in advance of setting the opposite side of wall forms so that the construction joint preparation, water stop installation and reinforcing steel inspections can be conducted. It is the Contractors responsibility to see that the forms are properly cleaned and oiled before being set, the construction joints properly prepared, reinforcing steel is securely and properly supported in the correct position and that all embedment items including electrical conduit is correctly installed before calling for inspections. The Engineer may at his option require the use of placement cords if deemed necessary.

B. Placement of concrete shall conform to the requirements and recommendations of ACI 301, 304 and 318, except as modified herein.

C. Concrete, which upon or before placing is found not to conform to the requirements specified herein, shall be rejected and immediately removed from the Work. Concrete which is not placed in accordance with these specifications, or which is of inferior quality, shall be removed and replaced at the expense of the Contractor.

D. No concrete shall be placed during rain or snowstorms, unless completely covered to prevent storm water from coming in contact with it. Sufficient protective covering material shall be kept on hand at all times should rain or snowstorms arise during concrete placement operations.

E. Concrete shall be deposited at or near its final position to avoid segregation caused by rehandling or flowing. Concrete shall not be deposited in large quantities in one place and worked along the forms with vibrator or other means. Concrete shall be uniformly distributed during the placing process and in no case after depositing shall any portion be displaced in the forms more than 2-feet in horizontal direction. Concrete shall be deposited in forms in horizontal layers not to exceed 24-inches in depth and shall be brought up evenly in all parts of the form. The rate of placement of concrete in forms shall not exceed 5-feet of vertical rise per hour. As the concrete is placed it shall be consolidated thoroughly and uniformly by mechanical vibration to secure a dense mass, close bond with reinforcement and other embedded items and smooth surface. The mechanical vibrator shall penetrate not only the freshly placed concrete, but also the previously placed lift to ensure the lifts become monolith. New concrete shall be placed against previously placed concrete, not away from it. When concrete is placed on a slope, placement shall begin at the lower end of the slope and progress to the upper end for the full width of the placement. Consolidation by mechanical vibration shall follow directly behind placement and the rate of placement shall never get ahead of the consolidation crew. Concrete placement shall continue without avoidable interruption, in a continuous operation until the end of the placement is reached.

F. The drop of concrete into slab or wall forms shall be vertical. Concrete shall not be dropped through reinforced steel, but deposited in forms using a hopper with a drop chute to avoid segregation and to keep mortar from coating the reinforcement steel and forms above the in-place concrete. In no case shall the free fall of concrete exceed 4-feet below the end of the hopper or chute.

G. If it takes more than 20-minutes to get back to place concrete over concrete previously placed, the depth of the layers being placed at one time shall be reduced, and/or placing equipment increased, until it is possible to return with the placing operation to previously placed concrete within 20-minutes. If concrete is to be placed over previously poured concrete and more than 20-minutes have elapsed, then a layer of grout not less than 1/2-inch thick shall be spread over the surface before placing the additional concrete.

H. The placement of concrete for slabs, beams or walkways cast monolithically with walls or columns shall not commence until the concrete in the walls or columns has been allowed to set and shrink. The time allowed for shrinkage shall be not less than one (1) hour.

I. Concrete shall be placed with the aid of approved mechanical vibrators. Vibration shall be supplemented by manual forking or spading adjacent to the forms on exposed faced in order to secure smooth dense surfaces. The concrete shall be thoroughly consolidated around reinforcement, pipes or other shapes built into the work. The vibration shall be sufficiently intense to cause the concrete to flow and settle readily into place and to visibly affect the concrete over a radius of at least 18-inches.

1. Sufficient vibrators shall be on hand at all times to vibrate the concrete as placed. In addition to the vibrators in actual use while concrete is being placed, the Contractor shall have on hand one (1) spare vibrator in serviceable condition. No concrete shall be placed until it has been ascertained that all vibrating equipment, including spares, is in serviceable condition.

J. Special care shall be taken to place the concrete solidly against the forms so as to leave no voids. Every precaution shall be taken to make all concrete solid, compact and smooth, and if for any reason the surfaces or interiors have voids or are in any way defective, such concrete shall be repaired as directed by the Engineer. No defective work shall be patched or repaired without the prior inspection and approval of the Engineer.

K. The temperature of concrete when it is being placed shall be not more than 90 degrees F. nor less than 40 degrees F. in moderate weather, and not less than 50 degrees F. in weather during which the mean daily temperature drops below 40 degrees F. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F., the Contractor shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90 degrees F. The Contractor shall be entitled to no additional compensation on account of the foregoing requirements.

L. Concrete shall not be placed on a frozen subgrade or subgrade that contains frozen materials. All ice and snow shall be removed from inside forms and from reinforcing steel and embedded items. The temperature of all surfaces that the concrete will contact shall be raised above the freezing point for at least 12-hours prior to placing new concrete.

1. The minimum temperature of fresh concrete as mixed shall be 60 degrees F. for ambient temperature above 30 degrees F.; 65 degrees F. for ambient temperature 0 degrees F. to 30 degrees F.; and 70 degrees F. for ambient temperature below 0

degrees F. The minimum temperature of fresh concrete after placing shall be 55 degrees F. for the first 72-hours.

2. The use of calcium chloride shall not be permitted.

3. In general, the Contractor shall adhere to the recommendations as outlined in ACI Standard 306.1 for cold weather concreting, except as required herein.

3.5 PUMPING OF CONCRETE

A. Pumping of concrete will be permitted only with the Engineer's approval. The pumping equipment must have two (2) cylinders and be designed to operate with one (1) cylinder only in case the other one is not functioning. In lieu of this requirement, the Contractor shall have a standby pump or crane and concrete bucket on site during pumping to provide assurance the concrete will be placed without cold joints in the event of pumping equipment breakdown. The minimum diameter of the hose (conduits) shall be 4-inches. Pumping equipment and hoses (conduits) that are not functioning properly, shall be replaced. Aluminum conduits for conveying the concrete will not be permitted.

B. Concrete samples for slump and test cylinders will be taken at the discharge end of the pumping conduit.

3.6 ORDER OF PLACING CONCRETE

A. The order of placing concrete in all parts of the work shall be acceptable to the Engineer. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least 7-days before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the two (2) adjacent wall panels have cured at least 14-days.

B. The surface of the concrete shall be level whenever a run of concrete is stopped. To ensure a level, straight joint on the exposed surface of walls, a wood strip at least 3/4-inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about 1/2-inch above the underside of the strip. About one (1) hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel.

3.7 TAMPING AND VIBRATING

A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets and bringing only a slight excess of water to be exposed surface of concrete during placement. Vibrators shall be high speed power vibrators (8,000 to 10,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required.

B. Care shall be used in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where flat-strip type waterstops are horizontal, the concrete shall be worked under the waterstops by hand, making sure that all air and rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional vibration, over

and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.

C. Concrete in walls shall be internally vibrated and at the same time rammed, stirred or worked with suitable appliances, tamping bars, shovels or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the results herein specified with fifteen (15) minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner than causes segregation of its constituents.

3.8 FINISHING CONCRETE SURFACES

A. General: Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles and dimensions shown are defined as tolerances and are specified in Paragraph 1.5, herein. These tolerances are to be distinguished from irregularities in finish as described herein. Aluminum finishing tools shall not be used.

B. Unformed Surfaces: After placing and consolidating concrete, all unformed top surfaces of slabs, walls, curbs, gutter and steps, shall be brought to a uniform finished surface. The classes of finish specified for unformed concrete surfaces are defined as follows:

1. Finish U1 (screeded concrete): Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8-inch. No further special finish is required.

2. Finish U2 (floated surface): After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades. Excessive floating or surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted. Floating shall be the minimum necessary to produce a surface that is free from screed marks and is uniform texture. Surface irregularities shall not exceed 1/4-inch. Joints and edges shall be tooled where shown or as determined by the Engineer.

3. Finish U3 (steel trowel finish): After the floated surface (as specified for Finish U2) has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples and trowel marks. The finish shall be smooth and free of all irregularities.

4. Finish U4 (light broom finish): Steel trowel finish (as specified for Finish U3) without local depressions or high points. In addition, the surface shall be given a light hairbroom finish with brooming perpendicular to drainage unless otherwise shown. The resulting surface shall be rough enough to provide a non-skid finish.

C. The schedule for finished unformed surfaces shall be as follows:

Unformed Concrete Surface Schedule

Area	Finish
Grade slabs and foundations to be covered with concrete or fill material.	U1
Floor slabs to be covered with grouted tile or topping grout and slabs to be covered with built-up roofing.	U2
All building and machine room floors, basin floors not receiving a grout topping, channel floors, top of interior walls, top of interior curbs, steps and walkways.	U3
Exterior walkways, curb, gutter, sidewalk and steps, top of valve or meter vaults, electrical pull boxes and catch basins.	U4

D. Floor Sealer Hardener (Surface Applied):

1. Floor hardener shall be applied where shown or noted on the drawings.

2. Floors to receive hardener shall be cured, cleaned and dry with all work above them completed. Apply zinc and/or magnesium fluosilicate evenly, using three (3) coats, allowing 24-hours between coats.

3. The first coat shall be 1/3 strength, second coat 1/2 strength and third coat shall be 2/3 strength. Each coat shall be applied so as to remain set on the concrete surface for fifteen (15) minutes. If sodium silicate is used, it shall be applied evenly, using three (3) coats, allowing twenty-four (24) hours between coats, and the material shall be applied full strength at the rate of one (1) gallon per 300 square feet. Approved proprietary hardeners shall be applied in conformance with the manufacturers' instruction. After the final coat is completed and dry, surplus hardener shall be removed from the surface by scrubbing and mopping with water.

E. Formed Surfaces: Immediately following the removal of forms, the concrete shall be inspected for defects such as rock pockets, grout loss, damage from stripping forms, surface defects such as fins, offsets, bulges, excessive bug-holes and stains. All defective concrete work shall be removed and replaced or repaired to the satisfaction of the Engineer. Any work which has not been constructed in accordance with the plans and specifications will be considered defective.

Correction of defective work shall be as directed by the Engineer and specified herein. No defective work shall be patched, repaired or covered without prior inspection and approval of the Engineer.

Holes left by tie-rod cones or taper ties shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with non-metallic grout.

The classes of formed concrete surfaces are defined as follows:

1. Finish F1: No special treatment is required after form removal except for curing, repair of defective concrete treatment of surface defects, removal of fins and

projections, filling of tie holes and filling of depressions and bug-holes 3/8-inch or larger in width or depth with mortar.

2. Finish F2: All defective concrete shall be repaired, all fins, offsets, bulges and projections ground smooth, filling of tie holes and filling of depressions and bug-holes 1/4-inch or larger in width or depth with mortar.

3. Finish F3: All defective concrete shall be repaired, all fins, offsets, bulges and projections ground smooth and tie holes filled with grout. The entire surface shall then receive a light stoning or grinding using a No. 50 or No. 60 grit carborundum stone or grinding wheel to remove any laitance and curing film and to open up bug-holes hidden beneath the thin surface grout film. The surface shall then be given a stoned-sand type architectural finish as follows:

   a. The concrete surface shall be pre-wet for several hours or overnight before treatment.

   b. While the surface is still damp, spread a sand mix, consisting of one (1) part of the appropriate Type of Cement and one to one and a half (1 to 1-1/2) parts of fine sand passing the No. 70 screen mixed with enough water and an emulsified bonding agent to have the consistency of thick cream. The sand mix should be spread thinly over the damp surface with a rubber float and rubbed in over the entire area leaving only a minimum amount of material on the surface necessary to produce a sand texture, approximately 1/32-inch in thickness.

   c. The surface shall be kept continually damp for seventy-two (72) hours following this finish treatment.

F. The schedule for formed surface finish shall be as follows:

Formed Concrete Surface Schedule

Area	Finish
Formed concrete surfaces to be covered by backfill or coated with below grade waterproofing systems.	F1
Formed concrete surfaces in water channels, below water surface of basins, inside meter and valve vaults, inside cells of hydraulic splitter boxes and weirs.	F2
Formed concrete surfaces inside buildings and machine rooms and all exposed exterior surfaces of foundations, basins, vaults, hydraulic structures and curbs.	F3

3.9 CURING AND DAMPPROOFING

A. General: All concrete shall be cured for not less than ten (10) days in warm to hot weather and fourteen (14) days in cold weather after placing, unless otherwise indicated by the Engineer, in accordance with the methods specified herein for the different parts of the Work, and described in detail as follows:

1. Water Curing: Keep the concrete structures thoroughly and continuously wet and covered for at least 7 days. Place and anchor covers, mats, and sheeting to

ensure continuous contact with the concrete surfaces. Use one of the water curing methods as detailed in ACI 308.1.

2. Curing Compound: The surface shall be sprayed with a liquid membrane-forming curing compound applied in accordance with the manufacturers printed instructions.

   a. Care shall be exercised to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.

   b. Curing compound specified shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces, and within one (1) hour after removal of forms from contact with formed surfaces. Repairs to formed surfaces shall be made within the said one (1) hour period. If repairs cannot be made with the one (1) hour period they shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be sandblasted to remove the curing compound, following which repairs shall be made as specified herein.

3. Cold weather is defined as when the temperature reaches or goes below 35 degrees F. for one (1) hour during any 24-hour period during the curing period.

B. Method 2 shall be used for wall sections with forms removed, encasement concrete and all concrete surfaces where Method 1 is not feasible.

3.10 PROTECTION

A. The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress or any other cause until final acceptance by the Owner. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damage to finish surfaces.

B. Finished floor slabs in buildings and machine rooms shall be suitably protected from wear or damage from construction operations. The Contractor shall not use newly finished floors or buildings for machine assembly, fabrication, pipefitting, curing or welding operations without covering the working area with plastic sheets and/or plywood. Any concrete found to be damaged or which may have been originally defective or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at the Contractor's expense.

C. Immediately following the first frost in the fall, the Contractor shall be prepared to protect all concrete against freezing.

3.11 CURING IN COLD WEATHER

A. After the first frost, and until the mean daily temperature in the vicinity of the worksite falls below 40 degrees F. for more than one (1) day, the concrete shall be protected against freezing temperatures for not less than forty-eight (48) hours after it is placed.

After the mean daily temperature in the vicinity of the worksite falls below 40 degrees F. for more than one (1) day, the concrete shall be maintained at a temperature not lower than 50 degrees F. for at least seventy-two (72) hours after it is placed.

B. Discontinuance of protection against freezing temperatures shall be such that the drop in temperature of any portion of the concrete will be gradual and will not exceed 40 degrees F. over a (3) three day duration.

C. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying. Use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected from drying and excessive carbon dioxide atmosphere by application of curing Method 2 or Method 3, as specified under Article 3.9, Paragraph A herein.

3.12 REPAIR OF DEFECTIVE CONCRETE

A. No concrete repairs shall be made until after inspection and approval of the method of repair by the Engineer. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing extensive voids, holes, honeycombing or similar depression defects shall be completely removed and replaced. Concrete containing minor voids, holes, honeycombing or similar depression defects shall be repaired as specified herein. All concrete repairs and replacements shall be promptly executed by the Contractor at its own expense.

B. The repair of holes left by rock pockets, penetrations, tie rods or other reasons will require the use of non-shrink, non-metallic grout material.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removing surface debris.
2. Removing designated paving, curbs, and other obstructions.
3. Removing designated trees, shrubs, and other plant life.
4. Removing abandoned utilities.
5. Excavating topsoil.

B. Related Sections:

1. Section 02 21 32 - Surveying
2. Section 31 22 13 - Rough Grading.
3. Section 31 23 18 - Rock Removal.

1.2 QUALITY ASSURANCE

A. Perform Work in accordance with the most recent edition of the New Mexico Standard Specifications for Public Works Construction, with latest revisions.

B. Conform to applicable Navajo Tribal code and State of New Mexico code for environmental requirements, disposal of debris, burning debris on site, use of herbicides.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Quality Requirements: Examination of existing conditions before starting work.

B. Verify existing plant life designated to remain is tagged or identified.

C. Identify waste area and/or salvage area for placing removed materials.

3.2 PREPARATION

A. Call Navajo Tribal Utility Authority "Call Before You Dig Program" at least fourteen (14) working days before performing Work.

1. Request that underground utilities be located and marked within and surrounding construction areas.

B. Call New Mexico "One Call" at 811 and/or local utility companies at least three (3) working days before performing Work.

1. Request that underground utilities be located and marked within and surrounding construction areas.

C. Contractor shall not work in any area where the designated work area has not been staked by Owner's Surveyor. Contractor shall be wholly liable for any damage caused by working in areas that have not been staked, or by encroaching outside the staked work area.

D. Notify Engineer at least five (5) working days prior to commencing work within 100 feet of any designated restricted area or culturally sensitive area, as shown on Plans. Do not commence work unless barricades are in place and/or archaeological monitor is present, as required. Refer to Section 01 00 00 – Basic Requirements and the Drawings for site-specific requirements.

3.3 PROTECTION

A. Locate, identify, and protect utilities indicated to remain, from damage.

B. Protect trees, plant growth, and features designated to remain, as final landscaping.

C. Protect benchmarks, survey control points, and existing structures from damage or displacement.

3.4 CLEARING

A. Clear areas required for access to site and execution of Work.

B. Remove trees and shrubs within indicated areas. Remove stumps and surface rock.

C. Clear undergrowth and deadwood, without disturbing subsoil.

D. Apply herbicide to remaining stumps to inhibit growth.

3.5 REMOVAL

A. Remove debris, rock, and extracted plant life from site, as directed in field by Engineer.

B. Tree removal:

1. Trees larger than 3" in diameter shall be cut, de-limbed, and left in stacks on edge of ROW for public firewood gatherers. Place firewood such that the public may gather it without creating safety hazards or additional disturbance to the public, work site or the environment.
2. Trees smaller than 3" in diameter, slash, and brush shall either be chipped and spread on the ROW or hauled to appropriate disposal site. Chipped material shall be distributed so as not to interfere with successful re-vegetation efforts.

3. Tree stumps and other material that cannot be chipped or used by the public shall be hauled to an appropriate disposal facility.
4. Contractor shall abide by all conditions contained in ROW stipulations.

C. Partially remove paving, curbs, and other obstructions as indicated on Drawings. Neatly saw cut edges at right angle to surface.

D. Remove abandoned utilities as directed by Owner and/or Engineer. Indicate removal termination point for underground utilities on Record Documents.

E. Continuously clean up and remove waste materials from site. Do not allow materials to accumulate on site.

F. The Engineer will indicate to the Contractor which obstructions are to be removed, disposed of, or salvaged, and will require special documentation.

G. All existing fences crossed by the Work, or are within the construction area, are to be removed and rebuilt to original condition or better. Fence materials resulting from such removal are to be stored or disposed of as directed by the Engineer. Fence materials suitable for reuse or salvage that are damaged, lost or destroyed due to the Contractor's negligence or carelessness are to be replaced at the Contractor's expense.

H. Do not burn or bury materials on site. Leave site in clean condition.

3.6 TOPSOIL EXCAVATION

A. Excavate top 6 inches of topsoil from areas to be further excavated, relandscaped, or regraded, without mixing with foreign materials or vegetable matter for use in finish grading.

B. Do not excavate wet topsoil.

C. Stockpile in area designated on site to depth not exceeding 8 feet and protect from erosion. Stockpile material on impervious material and cover over with same material, until disposal.

D. Remove excess topsoil not intended for reuse, from site.

E. All equipment shall be properly maintained and with proper safety devices.

F. Contractor must maintain control of dust and minimize blowing debris.

END OF SECTION

SECTION 31 23 17

TRENCHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating trenches for utilities.
2. Sheeting and shoring.
3. Disposal of excavated material.

B. Related Sections:

1. Section 02 21 32 - Surveying
2. Section 03 30 00 - Cast-in-Place Concrete.
3. Section 31 22 13 - Rough Grading: Topsoil and subsoil removal from site surface
4. Section 31 23 23 - Backfill: General backfilling.
5. Section 33 11 13 - Public Water Transmission Systems.

1.2 REFERENCES

A. Sub-surface Data:

1. Report prepared by Inberg-Miller Engineers, entitled: “Subsurface Exploration and Geotechnical Engineering Report NNMP Waterline HDD, Farmington, NM”, dated March 29, 2023. Refer to Exhibit A of the Contract Documents.
2. Report prepared by Geotest, Inc., entitled: “Geotechnical Engineering Services Report No. 1-11003 Navajo Nation Municipal Pipeline, Bluff Road Horizontal Directional Drilling, Upper Fruitland, New Mexico”, dated March 23, 2022. Refer to Exhibit A of the Contract Documents.
3. Report prepared by Western Technologies Inc., entitled: “Geotechnical Evaluation Report, Navajo Nation Municipal Pipeline, Bluff Road, Upper Fruitland, NM, WT Reference No. 3121JS009” dated May 24,2021 and Addendum No. 1 dated August 17, 2021. Refer to Exhibit A of the Contract Documents.
4. Note that in the event of any discrepancy or difference in requirements between the geotechnical reports referenced above and the Technical Specifications, the more stringent requirement shall apply.
5. Refer to Section 01 00 00 regarding Contractor’s ability to rely on subsurface data provided by Owner.

B. New Mexico Standard Specifications for Public Works Construction (NMSSPWC):

1. NMSSPWC Sections 701, 801 & 802 “Trenching, Excavation and Backfill”.

C. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and an 18-in. Drop.

D. American Society for Testing and Materials International (ASTM):

1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D422 - Particle -Size Analysis of Soils.
3. ASTM D653 - Terminology Relating to Soil, Rock, and Contained Fluids.
4. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
5. ASTM D1140 - Amount of Material in Soils Finer than the No. 200 Sieve.
6. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
7. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3).
8. ASTM D1633 - Test Method for Compressive Strength of Molded Soil - Cement Cylinders.
9. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
10. ASTM D2216 - Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
11. ASTM D2487 - Classifications of Soils for Engineering Purposes (Unified Soil Classification System).
12. ASTM D2488 - Description and Identification of Soils (Visual-Manual Procedure).
13. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
14. ASTM D2901 - Test Method for Cement Content of Freshly Mixed Soil Cement.
15. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
16. ASTM D4254 - Minimum Index Density and Unit Weight of Sols and Calculation of Relative Density.
17. ASTM D4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
18. ASTM D4564 - Density of Soil in Place by the Sleeve Method.
19. ASTM D4643 - Determination of Water (Moisture) Content of Soil by the Microwave Oven Heating.

20. ASTM D4718 - Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.
21. ASTM D4832 - Compressive Strength of Controlled Low Strength Material.
22. ASTM D4914 - Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit.
23. ASTM D4959 - Determination of Water (Moisture) Content of Soil by Direct Heating.
24. ASTM D5030 - Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit.
25. ASTM D5080 - Rapid Determination of Percent Compaction.
26. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Materials Source: Submit name of imported fill materials suppliers.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with applicable New Mexico, Navajo Nation and U.S. Bureau of Reclamation standards.

B. Perform Work in accordance with applicable OSHA trench safety standards.

1.5 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.6 COORDINATION

A. Section 01 00 00 - Administrative Requirements: Coordination and project conditions.

B. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Pipe Bedding and Embedment: As specified in Section 31 23 23 - Backfill.

B. Pipe Backfill: As specified in Section 31 23 23 - Backfill.

C. Structural Fill: As specified in Section 31 23 23 - Backfill.

D. Concrete: Structural concrete, as specified in Section 03 30 00, with minimum compressive strength of 4,000 psi at 28 days. Concrete for thrust blocking with minimum compressive strength of 3,000 psi at 28 days.

PART 3 EXECUTION

3.1 PREPARATION

A. Call New Mexico "One Call" at 811 and local utilities not less than three working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Contractor shall not work in any area where the designated work area has not been staked by Owner's Surveyor. Contractor shall be wholly liable for any damage caused by working in areas that have not been staked, or by encroaching outside the staked work area.

C. Notify Engineer at least five (5) working days prior to commencing work within 100 feet of any designated restricted area or culturally sensitive area, as shown on Plans. Do not commence work unless barricades are in place and/or archaeological monitor is present, as required. Refer to Section 01 00 00 – Basic Requirements and the Drawings for site-specific requirements.

D. Identify required lines, levels, contours, and datum locations.

E. Protect plant life, lawns and other features remaining as portion of final landscaping.

F. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

G. Maintain and protect above and below grade utilities indicated to remain.

H. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.2 LINES, GRADES AND DIMENSIONS

A. Excavate trench to lines and grades indicated on Drawings.

1. Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required based on field conditions.

2. Deviations from horizontal and vertical pipe line and grade by Contractor: Refer to Section 33 11 13 – Public Water Transmission Systems.

3. When bottom of trench is rocky, over-excavate and fill as specified in Section 31 23 23 – Backfill.

B. Excavate trench to minimum width as indicated on Drawings.

1. Increase trench width as required to meet required clearances between pipe and trench wall, to avoid voids in the haunch areas of the pipe and to meet embedment compaction requirements or minimum soil cement slurry layer thickness. Increased trench width, if needed to meet these requirements, shall be provided at no additional cost to the Owner.

3.3 TRENCHING

A. Excavate subsoil required for utilities.

B. Remove to 6 inches of topsoil and stockpile separately. The stockpiled soil shall be free of organic material. This topsoil shall be spread on top of the reclaimed area after backfilling, prior to re-seeding.

C. Remove lumped subsoil, boulders, and rock to bottom of trench.

D. Rock removal requiring specialized equipment or procedures is incidental to contract.

E. Allowable open trench: Trenches may be opened in advance of pipe placement and backfill operations under the following conditions:

1. Do not open more than ½ mile of trench at one time. Do not leave any section of trench open for more than 24 hours.

2. Do not leave any trench open at the end of the workday within 100 feet of any road, driveway parking lot or other trafficked area, whether said road or driveway is shown on the Drawings or not.

3. Do not block vehicular traffic or impede access to homes or businesses.

4. Temporary fences shall be required for all trenches left open when the Contractor is not working on-site. All required temporary fencing shall be provided at no additional cost to the Owner.

5. Provide security at open trenches to protect the public, livestock, wildlife and the environment.

   a. Comply with all stipulations set forth by McKinley County, BIA Department of Transportation, the Navajo Nation, and other land-controlling agencies and owners of existing utility lines. These stipulations are provided Appendices C, D, and E.

   b. Provide animal escape ramps and cross-overs in accordance with the ROW stipulations provided in Appendix C.

6. Contractor is solely responsible for safety of all open trenches and bears sole liability for any incidents or accidents arising from open trenches.

7. The Owner may further restrict the amount of open trench as needed due to safety, land use or environmental considerations.

F. Remove water or materials that interfere with Work. Remove groundwater by pumping to keep excavations dry.

G. Provide uniform and continuous bearing and support for bedding material and pipe.

H. Do not interfere with 45 degree bearing splay of foundations. Any excavation in this area shall be backfilled and compacted using the same materials and methods as structural fill for new buildings. Refer to Section 31 23 23.

I. Slope or shore trench as needed to meet safety requirements. When sidewalls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this section.

J. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by Engineer until suitable material is encountered. Backfill and compact to

reach specified or directed line and grade. Refer to specifications for overexcavation backfill, as set forth in Section 31 23 23.

K. Cut out soft areas of subgrade not capable of compaction in place. Backfill and compact to specified or directed line and grade. Refer to specifications for overexcavation backfill, as set forth in Section 31 23 23.

L. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.

M. Correct over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Engineer.

N. Remove excess subsoil not intended for reuse from site.

O. Do not excavate in the rain or snow without approval from the Engineer.

P. Do not excavate in frozen materials without approval from the Engineer.

Q. Blasting is not allowed.

3.4 ADDITIONAL EXCAVATION

A. Perform additional excavation in trench bottom for pipe foundations as show on drawings and other additional excavations beyond specified lines as directed by the Engineer.

3.5 OVEREXCAVATION

A. When foundation material is over-excavated beyond specified or directed lines, fill the over-excavation with embedment or bedding material and compact in accordance with Section 31 23 23 - Backfill.

B. If foundation material is over-excavated by being disturbed or loosened during excavation, compact material in place or remove and replace with embedment or bedding material as determined by the Engineer and compact in accordance with Section 31 23 23 - Backfill.

3.6 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.

C. Design sheeting and shoring to be removed at completion of excavation work. If the Engineer orders the sheeting to be left in place for the protection of the work, a payment will be allowed only for the actual cost of the timber left in place.

D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.7 BACKFILLING OF TRENCHES

A. See Section 31 23 23 – Backfill for general backfill requirements, as well as trench backfill, bedding and embedment requirements around pipelines.

3.8 DISPOSAL OF EXCAVATED MATERIALS

A. Excess excavated material or excavated material not suitable for backfill may be disposed of on-site, provided that:

1. The finished grade substantially conforms with the drawings, or any deviation therefrom is approved by the Engineer

a. Blend with natural terrain

b. Minimum slope: 2%

c. Maximum slope: 4:1, unless otherwise noted on Drawings

2. All excess excavated material spread on the right-of-way is compacted to the same specifications as final backfill, as set forth in Section 31 23 23 - Backfill and the Drawings, and

3. All on-site disposal of material is approved by the Engineer.

B. Do not dispose of waste material by dumping from tops of slopes.

C. Do not dispose of excess material within 15 feet of any wash, drainage or waterway.

D. Re-seed waste material areas in accordance with Section 32 92 19 - Seeding.

3.9 TOLERANCES

A. Section 01 00 00 - Quality Requirements: Tolerances.

B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

3.10 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Testing, adjusting, and balancing.

B. Determine compaction characteristics of materials in accordance with ASTM D698.

C. Classify soils in accordance with ASTM D2487.

D. Field moisture content measured as specified in Section 31 23 23 - Backfill.

E. Unit weight of in-place compacted material shall be measured as specified in Section 31 23 23 - Backfill.

F. Perform in place compaction tests as specified in Section 31 23 23 - Backfill.

G. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest at no additional cost to the Owner.

3.11 PROTECTION OF FINISHED WORK

A. Section 01 00 00 - Execution Requirements: Protecting installed construction.

B. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION

SECTION 31 23 23

BACKFILL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backfilling building perimeter to subgrade elevations.
2. Backfilling site structures to subgrade elevations.
3. Fill under slabs-on-grade.
4. Fill under paving.
5. Fill for over-excavation.
6. Pipe bedding material.

B. Related Sections:

1. Section 02 21 32 - Surveying
2. Section 03 30 00 - Cast-in-Place Concrete: Concrete materials.
3. Section 31 22 13 - Rough Grading: Site filling.
4. Section 31 23 17 - Trenching: Backfilling of utility trenches.
5. Section 31 23 25 – Controlled Low Strength Material.
6. Section 33 11 13 - Public Water Transmission Systems.

1.2 REFERENCES

A. Sub-surface Data:

1. Report prepared by Inberg-Miller Engineers, entitled: “Subsurface Exploration and Geotechnical Engineering Report NNMP Waterline HDD, Farmington, NM”, dated March 29, 2023. Refer to Exhibit A of the Contract Documents.
2. Report prepared by Geotest, Inc., entitled: “Geotechnical Engineering Services Report No. 1-11003 Navajo Nation Municipal Pipeline, Bluff Road Horizontal Directional Drilling, Upper Fruitland, New Mexico”, dated March 23, 2022. Refer to Exhibit A of the Contract Documents.
3. Report prepared by Western Technologies Inc., entitled: “Geotechnical Evaluation Report, Navajo Nation Municipal Pipeline, Bluff Road, Upper Fruitland, NM, WT Reference No. 3121JS009” dated May 24,2021 and Addendum No. 1 dated August 17, 2021. Refer to Exhibit A of the Contract Documents.
4. Note that in the event of any discrepancy or difference in requirements between the geotechnical reports referenced above and the Technical Specifications, the more stringent requirement shall apply.

5. Refer to Section 01 00 00 regarding Contractor's ability to rely on subsurface data provided by Owner.

B. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

C. ASTM International:

1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse ‘‘Aggregates.
2. ASTM D422 - Particle -Size Analysis of Soils.
3. ASTM D653 - Terminology Relating to Soil, Rock, and Contained Fluids.
4. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
5. ASTM D1140 - Amount of Material in Soils Finer than the No. 200 Sieve.
6. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
7. ASTM D1633 - Test Method for Compressive Strength of Molded Soil - Cement Cylinders.
8. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
9. ASTM D2216 - Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
10. ASTM D2487 - Classifications of Soils for Engineering Purposes (Unified Soil Classification System).
11. ASTM D2488 - Description and Identification of Soils (Visual-Manual Procedure).
12. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
13. ASTM D2901 - Test Method for Cement Content of Freshly Mixed Soil Cement.
14. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
15. ASTM D4254 - Minimum Index Density and Unit Weight of Sols and Calculation of Relative Density.
16. ASTM D4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
17. ASTM D4564 - Density of Soil in Place by the Sleeve Method.
18. ASTM D4643 - Determination of Water (Moisture) Content of Soil by the Microwave Oven Heating.
19. ASTM D4718 - Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.
20. ASTM D4832 - Compressive Strength of Controlled Low Strength Material.
21. ASTM D4914 - Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit.

22. ASTM D4959 - Determination of Water (Moisture) Content of Soil by Direct Heating.
23. ASTM D5030 - Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit.
24. ASTM D5080 - Rapid Determination of Percent Compaction.
25. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

D. United States Bureau of Reclamation (USBR):

1. USBR EM - Earth Manual, Part 2, Third Edition (1990).
2. Procedure No. and Title:
   a. USBR EM 3900 - Standard Definitions of Terms and Symbols Relating to Soil Mechanics .
   b. USBR EM 5000 - Determining Unified Soil Classification (Laboratory Method).
   c. USBR EM 5005 - Determining Unified Soil Classification (Visual Method).
   d. USBR EM 5300 - Determining Moisture Content of Soil and Rock by the Oven Method.
   e. USBR EM 5315 - Determining Moisture Content by the Microwave Method.
   f. USBR EM 5325 - Performing Gradation Analysis of Gravel Size Fraction of Soils.
   g. USBR EM 5330 - Performing Gradation Analysis of Fines and Sand Size Fraction of Soils, Including Hydrometer Analysis.
   h. USBR EM 5335 - Performing Gradation Analysis of Soils Without Hydrometer.
   i. USBR EM 5350 - Determining the Liquid Limit of Soils by the One Point Method.
   j. USBR EM 5355 - Determining the Liquid Limit of Soils by the Three Point Method.
   k. USBR EM 5360 - Determining the Plastic Limit and Plasticity Index of Soils.
   l. USBR EM 5500 - Performing Laboratory Compaction of Soils - 5.5 lb Rammer and 18-in Drop.
   m. USBR EM 5525 - Determining the Minimum Index Unit Weight of Cohesionless Soils.
   n. USBR EM 5530 - Determining the Maximum Index Unit Weight of Cohesionless Soils.
   o. USBR EM 5605 - Determining the Permeability and Settlement of Soils Containing Gravel.

p. USBR EM 7205 - Determining Unit Weight of Soils In-Place by the Sand-Cone Method.

q. USBR EM 7215 - Determining Unit Weight of Soils In-Place by the Sleeve Method.

r. USBR EM 7220 - Determining Unit Weight of Soils In-Place by the Sand Replacement Method in a Test Pit.

s. USBR EM 7221 - Determining Unit Weight of Soils In-Place by the Water Replacement Method in a Test Pit.

t. USBR EM 7230 - Determining Unit Weight and Moisture Content of Soils In-Place - Nuclear Moisture - Density Gauge.

u. USBR EM 7240 - Performing Rapid Method of Construction Control.

v. USBR EM 7250 - Determination of Percent Relative Density.

w. USBR EM 7255 - Determining the Percent Compaction of Earthwork for Construction Control.

1.3 DEFINITIONS

A. Percentage Compaction – Ratio, expressed as percentage, of actual density of material compared with maximum dry density based on Standard Proctor (ASTM D698).

B. Optimum Moisture Content – Based on Standard Proctor (ASTM D698).

C. Unified Soil Classification System – Based on ASTM D2487.

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures.

B. Submit samples and certified test documentation of all materials to be used.

C. Materials Source: Submit name of imported fill materials suppliers.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

E. Submit field soil test on material in place as backfill.

PART 2 PRODUCTS

2.1 NATIVE FILL MATERIAL

A. Native material may be used for bedding, embedment and/or backfill, provided that said material meets all specifications set forth in this section. The Contractor may screen or otherwise process the material on-site to meet the specifications.

B. No dedicated borrow area for fill material has been pre-determined for this project. Native material may be borrowed from within the designated right-of-way and hauled within the project area if needed, provided that

a. All borrow areas receive prior approval from the Engineer. Finished grades shall conform to the finished grades shown in the plans, or any deviations therefrom must receive prior approval by the Engineer.

b. Borrow areas do not encroach beyond the designated project right-of-way. Borrow areas shall not encroach on any protected culturally sensitive area.

c. All borrow areas are sloped and dressed to minimize erosion.

d. Adequate stormwater pollution prevention measures are installed and maintained during construction. Such controls must be approved by the Engineer.

e. All borrow areas are re-seeded upon completion of the project, in accordance with Technical Specification 32 92 19, and post-construction stormwater controls are installed with approval from the Engineer.

C. All costs incurred in removing, hauling, or processing native material and reclaiming borrow sites shall be considered incidental and shall be borne by the Contractor at no additional expense to the Owner.

D. The Owner makes no guarantee that native materials meeting the fill and backfill material specifications contained herein are available within the project area.

2.2 IMPORTED FILL MATERIAL

A. If imported materials are required to meet the quantity requirements of the project, it will be provided at no additional expense to the Owner.

2.3 TYPES OF ACCEPTABLE FILL MATERIAL

A. Structural Fill: Structural fill for use as sub-foundation material under tanks, buildings and other structures shall be provided in accordance with the Geotechnical Report provided in Exhibit A of the Contract Documents.

B. Fill for Appurtenances: Fill under and around in-line valves and structures at the same elevation as the pipe shall comply with specifications for the corresponding type of fill under or around the pipe. Fill under and around appurtenances such as valves, vaults and other structures above the top of the pipe shall comply with specifications for initial backfill material.

C. Pipe Bedding and Embedment Material: The following types of material are acceptable for use as pipe bedding and embedment material:

1. Crushed Rock: Not more that 25% passing 3/8-inch sieve and not more than 12% fines. Maximum particle size shall not exceed ½ inch for pipe bedding and ¾ inch for embedment.

2. Clean Coarse-Grained Soils: Sands and gravels with 12% or less fines. Unified Soil Classification System designation GW, GP, SW, SP or any soil beginning with one of these symbols. Maximum particle size shall not exceed ½ inch for pipe bedding and ¾ inch for embedment.

3. Coarse-Grained Soils with Fines: Sands and gravels with more than 12% fines. Unified Soil Classification System designation GC, GM, SC, SM or any soil beginning with one of these symbols. Maximum particle size shall not exceed ½ inch for pipe bedding and ¾ inch for embedment.

4. Sandy or Gravelly Fine-Grained Soils: Fine-grained soils (LL<50) with medium to no plasticity and with 30% or more coarse-grained particles. Unified Soil Classification System designation CL, ML or CL-ML. Maximum particle size shall not exceed ½ inch for pipe bedding and ¾ inch for embedment.

5. Other: Other types of material may be considered only with prior written approval by the Engineer. The Contractor is advised that soil amendment and/or higher levels of compaction may be required if using other soil types. Any costs associated with use of other soil types shall be borne by the Contractor at no additional expense to the Owner.

D. Pipe Backfill Material:

1. Initial backfill: All material placed in the trench between the top of the embedment and 18 inches above the top of the pipe shall be free from clumps, organic material, frozen material, debris or rocks larger than ¾ inch.

2. Final backfill: All material placed in the trench more than 18 inches above the top of the pipe shall be free from clumps, organic material, frozen material, debris or rocks larger than 3 inches.

E. Drainage Culvert Backfill Material:

1. All material placed in the trench for galvanized drainage culvert pipe bedding and backfill shall be acceptable fill material as listed previously, with the following additional requirements:

a. Resistivity (as per AASHTO T 288) greater than 2000 ohm-cm.

b. pH (as per AASHTO T289) greater than 6.0.

c. Volcanic ash type material for backfill shall not be used.

F. Base Course: Refer to Technical Specification 32 11 23 – Aggregate Base Course and Gravel.

G. Soil Cement Slurry: Refer to Technical Specification 31 23 25 – Soil Cement Slurry.

H. All fill material shall be free of clumps, organic material, frozen material, ice, snow, debris or organic contaminants.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Coordination and project conditions.

B. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.

C. Verify structural ability of unsupported walls to support loads imposed by fill.

3.2 PREPARATION

A. Compact subgrade to density requirements for subsequent backfill materials.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill and compact to density equal to or greater than requirements for subsequent fill material.

C. Scarify subgrade surface to depth of 8 inches.

D. Proof roll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

3.3 USE OF ACCEPTABLE MATERIALS

Fill and Backfill materials specified in Part 2 of this Section shall be used in accordance with the following provisions:

A. Over-excavation: Backfill to specified or directed lines using Embedment or Bedding material as specified above.

B. Bedding: Use Bedding material as specified above.

C. Embedment: Use embedment material as specified above.

D. Initial back fill: For backfilling between top of embedment (0.7 of pipe O.D.) and 18" above top of pipe, use initial backfill material as specified above.

E. Final backfill: For backfilling more than 18" above top of pipe, backfill as follows:

1. Outside of surfaced roads, driveways or parking areas: Use final backfill material as specified above.

2. Under surfaced or paved roads, driveways or parking areas: Use final backfill material as specified above, topped with base course as specified above. Apply base course to same thickness as existing driving surface, or 6 inches, whichever is greater. If paved, apply pavement patch to thickness equal to or greater than existing pavement.

F. Embankments: Use final backfill material as specified above, unless otherwise indicated on the Drawings.

G. Under buildings, tanks, slabs-on-grade and other structures: Use structural fill as specified above unless otherwise indicated on Drawings.

H. Soil Cement Slurry: At Contractor's option and expense, soil cement slurry may be used in lieu of bedding, embedment, initial backfill and/or final backfill materials. Soil cement slurry, if used, shall be provided at no additional expense to the Owner, and conforming to Section 31 23 25 Controlled Low Strength Material.

3.4 BACKFILLING FOR STRUCTURES, SITE WORK AND APPURTENANCES

A. Refer to the Geotechnical Reports in Exhibit A regarding any issues not specifically addressed in these Technical Specifications. In the event of any discrepancies or differences in requirements between the Geotechnical Report and the Technical Specifications, the more stringent requirement shall apply.

B. Backfill areas to lines and grades as indicated on the Drawings or as directed by the Engineer.

1. For demolition work, backfill to existing grade or finished grade as indicated on Drawings, or as directed by the Engineer.

C. Systematically backfill to allow maximum time for natural settlement.

D. Do not backfill over porous, wet or spongy subgrade surfaces. Do not place backfill if either the material or the surface on which it is to be placed is frozen.

E. Each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer.

F. Place material in continuous, uniform layers such that all spaces around rocks and clods are filled. Thickness of such layers shall be as follows:

1. Subsoil Fill: Maximum 8 inches compacted depth.

2. Structural Fill: Maximum 6 inches compacted depth.

3. Granular Fill: Maximum 6 inches compacted depth.

G. Employ placement method that does not disturb or damage other work.

H. Slope grade away from building minimum 4%, unless otherwise noted on the Drawings.

I. Make gradual grade changes. Blend slope into level areas.

J. Shape and drain embankments and excavations, maintain ditches and drains to provide drainage at all times. Protect graded areas against action of elements prior to acceptance of work, and reestablish grade where settlement or erosion occurs.

K. Bench hillside slopes or fills to key the embankment. Remove and re-compact a minimum of 12 inches normal to the slope of the hillside or fill as the embankment or fill is brought up in layers.

L. Spread stockpiled topsoil on areas to be reclaimed prior to re-seeding.

M. Remove surplus backfill materials from site in accordance with Technical Specification 31 22 13 – Rough Grading.

N. Leave fill material stockpile areas free of excess fill materials.

3.5 BACKFILLING OF TRENCHES

A. Place material in pipe trenches to lines and grades indicated on Drawings or as directed by Engineer.

B. Do not place material when either the material or the surface upon which it is to be placed upon are frozen.

C. When using select material for pipe bedding, place bedding material below bottom of pipe before pipe is laid. Grade bedding material parallel to bottom of pipe.

D. When using select material for pipe embedment:

1. Exercise care not to damage pipe or appurtenances when placing embedment material.

2. Ensure material is placed to equal height on both sides of pipe to avoid unequal loading and possible lateral displacement of the pipe. Elevation difference of embedment between each side of pipe shall not exceed 6 inches.

3. Place material in uniform layers.

4. Work material into pipe haunches to prevent voids and achieve specified compaction under the haunches.

E. When using soil cement slurry: See Technical Specification 31 23 25 – Controlled Low Strength Material.

F. If pipe laying operations are interrupted for more than 24 hours, cover pipe laid in the trench with backfill.

G. When the bottom of the trench is rocky, the trench shall be overexcavated and backfilled by 4 inches prior to placing the bedding layer, as directed by the Engineer. Backfill of this overexcavation shall comply with the requirements for overexcavation backfill provided in these Technical Specifications.

H. When using crushed rock or gravel for embedment on stretches longer than 300 feet, install trench plugs composed on silty, non-plastic material at 300 ft intervals to prevent piping of trench water through the embedment.

3.6 COMPACTION

A. Do not place and compact soil under the following conditions:

1. Ambient air temperature below freezing.
2. Rain that creates puddles in clayey or silty materials.
3. Ice or snow pockets visible in material being placed.

B. Surface Preparation:

1. Prepare surface so that first compacted lift will be placed on firm, stable base. Compact surface to specified percent compaction, if necessary.
2. For water-retaining compacted fill, scarify and moisten surface to provide satisfactory bonding surface before placing first layer of material to be compacted.
3. Do not place material to be compacted on frozen surface.

C. Compact material in trenches in layers having approximately the same top elevation on both sides of the pipeline to avoid unequal loading and displacement of the pipe.

D. Placement:

1. Place soil to be compacted in horizontal layers.
2. Blend materials as needed to ensure compacted fill is homogenous and free from lenses, pockets, streaks, voids, laminations and other imperfections.

E. Compaction Procedures:

1. Silty or Clayey Material:
   a. Compact with mechanical impact tampers, tamping rollers, vibrating pad foot rollers, rubber tire rollers or other suitable compaction equipment.
   b. Uniformly distribute equipment passes.
   c. Compact in horizontal layers to compacted thickness of 6 inches or less.
2. Cohesionless Free-Draining Material: Compact in horizontal layers to maximum compacted thickness of:
   a. Tampers and rollers: 6 inches

b. Crawler-type tractors, vibrating drum rollers, surface vibrators or similar equipment: 12 inches

c. Saturation and internal vibration: Penetrating depth of vibrator.

3. When compacting pipe embedment material, exercise care not to damage the pipe or appurtenances with compaction equipment. Do not apply compaction equipment directly above the pipe.

4. Demonstration: Lift thicknesses may vary depending on equipment and methods. Field adjustments to the specified lift thicknesses may be allowed or required. Contractor shall demonstrate that proposed equipment and methods will meet required compaction for the proposed lift thickness.

5. Flooding and jetting is not allowed unless specifically approved by the Engineer.

F. Moisture Content:

1. Optimum moisture content for each soil type, whether native soil or imported material, shall be determined by the Standard Proctor method, ASTM D 698.

2. Moisture content during compaction shall be no more than 2 percentage points wet or dry of optimum moisture content.

3. Moisten or aerate material, as necessary, to provide specified moisture content. Add water to soil in increments that will permit moisture content to be uniform and homogenous through each layer after mixing.

4. Add no more than 2 percent water to fill by sprinkling just prior to compaction when fill is clayey and contains dry clods of clay.

a. If clayey soil is more than 2 percent below optimum moisture, pre-conditioning and curing may be required to obtain uniform and homogenous distribution of moisture in clods.

b. Use of disks, harrows or rakes may be required to blend moisture prior to placement and compaction.

5. For cohesionless soils, add water as necessary during compaction, as these soils are free-draining.

G. Minimum Percent Compaction:

1. Contractor is advised that compaction requirements shall be strictly enforced. In the event that the contractor is unable to meet compaction requirements for pipe embedment using select material, the Contractor shall have the option to use soil cement at no additional cost to the Owner.

2. Over-excavation – Backfill of overexcavation to specified or directed lines shall be compacted to same percent compaction as embedment material or undisturbed foundation material, whichever is greater. If the in-place compaction of the undisturbed foundation material is greater than 95%, the overexcavation backfill may be compacted to 95%.

3. Embedment – Compact pipe embedment material to percent compaction as indicated on Drawings for given soil classification, pipe wall thickness diameter ratio (DR) and depth of cover. For pipes 10” diameter or smaller no compaction

is required. For trenches within driving surfaces of roads, driveways or parking areas (both paved and unpaved), compact to 95%.

4. Initial and Final Backfill –

   a. Compact backfill to 95% for trenches within:
      1) The driving surfaces or prisms of roads, driveways or parking areas (both paved and unpaved), within wash or gas line crossings, crossings under bar ditches, and crossings at "head cutting" areas.
      2) Around valve boxes, air valve vaults, flush valves and vault foundations.
      3) Against thrust blocks and horizontal and vertical ells.

   b. For trenches outside of roads, driveways, parking areas, gas line crossing, or wash crossings, compaction of the backfill is not required, provided soil is mounded above the trench.

5. Embankments – Compact to same requirements as Final Backfill.

6. Under buildings, tanks, slabs and other structures – Compact in accordance with Geotechnical reports provided in Exhibit A.

7. Pump site – Compact all driving surfaces and fill slopes to 95%.

8. Note that all Percent Compaction values in these Technical Specifications and Drawings are based on Standard Proctor, ASTM D698.

H. Soil Cement Slurry may be used in trenches, at Contractor's option and expense, to replace bedding, embedment or backfill materials where it is not practical to reach minimum compaction requirements using select material.

1. If soil cement slurry is to be used in lieu of embedment material, soil cement slurry shall also replace the bedding material. Do not use soil cement slurry for embedment on top of select material bedding.

3.7 TOLERANCES

A. Section 01 00 00 - Quality Requirements: Tolerances.

B. Top Surface of Backfilling within Building Areas: Plus or minus 1 inch from required elevations.

C. Top Surface of Backfilling under Paved Areas: Plus or minus 1 inch from required elevations.

D. Percent Compaction: Shall meet minimum required compaction as set forth in these Technical Specifications

E. Moisture Content: As set forth in these Technical Specifications.

3.8 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Testing, Adjusting, and Balancing.

B. Classification of materials to determine adequacy for use as fill or backfill shall be performed in accordance with ASTM D2487 and designated based on the Unified Soil Classification System described therein.

C. Measurement of optimum moisture content and maximum dry density for each type of material to be compacted shall be determined using the Standard Proctor method, ASTM D698.

1. All references to "optimum moisture content" or "percent compaction" in these Technical Specifications and on the Drawings are based on Standard Proctor, ASTM D698.

2. While it may not be necessary to perform a separate Proctor test for every single compaction test location, it is necessary to perform this test for every type of material to be field tested. All material tested for compaction must correspond to a representative Proctor test.

3. Exhibit A to the Contract Documents contains the geotechnical reports which includes in-situ soil moisture measurements and Standard Proctor test results (including optimal moisture content) from test holes at various locations along the pipeline. Contractor is advised that test holes reveal information about only a very small area, and sub-surface conditions between the test holes may vary. Contractor is wholly responsible for any assumptions made about sub-surface conditions between the test holes. Moreover, in-situ moisture content varies with time, and the Owner makes no representation that the in-situ moisture at the time the measurements were taken will be the same at the time of construction.

   a. Contractor shall perform Proctor tests on actual fill material (whether native or imported) and shall base determination of optimum moisture content and maximum density for compaction on the Contractor's own tests.

4. Proctor tests upon which the Contractor bases determination of optimum moisture content and maximum density for calculation of percent compaction are subject to approval by the Engineer. The Engineer may require additional tests to ensure that Proctor tests are representative of the actual fill material being compacted.

D. Field moisture content shall be measured by one or more of the following methods, as determined by the Engineer:

1. ASTM D2216 (USBR EM 5300)

2. ASTM D6938 (USBR EM 7230), provided that corrections can be made of gage error for the specific soils tested. The moisture content of the total material may require adjustment for the control fraction in accordance with ASTM D4718 (USBR EM 7230, Method C).

3. ASTM D4959 or ASTM D4643 (USBR EM 5315), provided that the results have been correlated to ASTM D 2216 (USBR EM 5300) for the specific soil tested.

4. For silty or clayey soils containing more than 5% gravel: Results of water content corrected for oversized particle in accordance with ASTM D4718.

E. Unit weight of in-place compacted material shall be measured as follows:

1. Haunch area of pipe – By Drive Cylinder (ASTM D2937) or by Sand Cone (ASTM D1556 or USBR EM 7205), or as directed by the Engineer

2. Springline of pipe – By Sand Cone (ASTM D1556 or USBR EM 7205), or as directed by the Engineer

3. For cohesionless soils – By Sleeve Method (ASTM D4564 or USBR EM 7215), or as directed by the Engineer

4. Initial trench backfill – By Sand Cone (ASTM D1556 or USBR EM 7205) or by Nuclear Methods (ASTM D6938), as directed by the Engineer. Note that selection of density test will depend in part on distance from the pipe and potential for pipe interference with nuclear density measurements.

5. Final trench backfill – By Sand Cone (ASTM D1556 or USBR EM 7205) or by Nuclear Methods (ASTM D6938), as directed by the Engineer. Note that selection of density test will depend in part on distance from the pipe and potential for pipe interference with nuclear density measurements.

6. Fill outside of trenches, including embankments, structural fill and driving surfaces – By Nuclear Methods (ASTM D6938).

7. For silty or clayey soils containing more than 5% gravel: Results of unit weight corrected for oversized particle in accordance with ASTM D4718.

F. Percent compaction shall be determined by one of the following methods:

1. Comparison of in-place density of compacted material with maximum dry density of similar soil, as determined by Standard Proctor, ASTM D698.

2. Rapid Method: ASTM D5080 (USBR EM 7240)

G. Compaction testing frequency:

1. Minimum testing intervals shall be as follows:

a. One test per compaction crew per day

b. One test pit per 1000 LF of pipeline

c. One test per 500 CY of structural fill or one test per lift, whichever results in greater testing frequency

2. Greater testing frequency is typically required at the beginning of new work, new personnel, new compaction methods or new equipment.

3. Additional tests may be required for areas suspected of having incomplete compaction or improper moisture content, or surfaces that may have become torn up subsequent to compaction efforts, at the direction of the Engineer.

4. Additional tests may be required for any reason at the discretion of the Engineer.

H. Contractor Support

1. At the direction of the Engineer, the Contractor shall provide inspection pits to check for voids under the haunches of the pipe and test pits to perform density and compaction testing at the springline and haunch areas of the pipe or against structure foundations.

a. All test and inspection pits shall comply with all relevant OSHA safety requirements.

b. Contractor shall provide warning lights, flags and other safety devices as needed by testing personnel.

c. Upon completion of testing, Contractor shall backfill pits to original fill and backfill requirements.

2. When density is being measured by Sand Cone, Contractor shall cease construction activity in the immediate vicinity of testing.

3. The cost of all work associated with excavating, protecting and backfilling inspection and test pits, including implementation of safety requirements and time delays, shall be incidental to the unit price of the applicable pay item being tested, and shall be provided at no additional cost to the Owner.

4. Laboratory fees only shall be reimbursed to the Contractor from the Materials Testing Allowance bid item in accordance with Section 01 00 00 - Basic Requirements: Testing and Inspection Allowances. Other costs associated with testing, such as excavations, providing access, safety, time delays, transportation and other costs shall be considered incidental to the work.

3.9 CORRECTION OF SUB-STANDARD WORK

A. All fill and backfill represented by tests that fail to meet compaction, moisture content, soil classification or other specifications shall be uncovered as needed, replaced as needed, re-compacted and re-tested until all specifications are met, at no additional expense to the Owner.

1. Elevations, lines and grades of replaced material, as well as of pipe and other structures resting against such material, shall be re-surveyed at the direction of the Engineer, at Contractor's sole expense. Contractor shall correct elevations, lines and grades as needed, at Contractor's sole expense.

B. The cost of failed tests shall not be reimbursed by the Owner from the testing allowance.

3.10 PROTECTION OF FINISHED WORK

A. Section 01 00 00 - Execution Requirements: Protecting Installed Construction.

B. Reshape and re-compact fills subjected to vehicular traffic.

END OF SECTION

SECTION 31 23 25

CONTROLLED LOW STRENGTH MATERIAL (CLSM)

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Controlled Low Strength Material (CLSM) for:
   a. Utility bedding.
   b. Utility backfill.

B. Related Sections:

1. Section 31 23 17 - Trenching: Soil and aggregate backfill for utility trenches.
2. Section 31 23 23 - Backfill: Soil and aggregate backfill for structures.

1.2 BASIS OF MEASUREMENT AND PAYMENT

A. Controlled Low Strength Material (CLSM):

1. Measurement: Volume measured in place to lines, grades, and dimensions shown on drawings or established by the Engineer.
2. Payment: Shall be considered incidental to the price of the items embedded in the CLSM. No separate payment shall be made.

1.3 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 318 - Building Code Requirements for Structural Concrete

B. ASTM International:

1. ASTM C33 - Standard Specification for Concrete Aggregates.
2. ASTM C40 - Organic Impurities in Fine Aggregates for Concrete.
3. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
4. ASTM C114 - Chemical Analysis of Hydraulic Cement.
5. ASTM C143/C143M - Slump of Hydraulic Cement Concrete.
6. ASTM C150 - Standard Specification for Portland Cement.
7. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
8. ASTM C403/C403M - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance.
9. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
10. ASTM C595 - Blended Hydraulic Cements.

11. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
12. ASTM C1017/C1017M - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
13. ASTM C1040 - Standard Test Methods for Density of Unhardened and Hardened Concrete In Place By Nuclear Methods.
14. ASTM C1602/C1602M - Mixing Water Used in the Production of Hydraulic Cement Concrete.
15. ASTM D558 - Standard Test Methods for Moisture-Density Relations of Soil-Cement Mixtures.
16. ASTM D1558 - Moisture Content Penetration Resistance of Fine Grained Soils
17. ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils
18. ASTM D4832 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
19. ASTM D6024 - Ball Drop on Control Low Strength material (CLSM) to determine Suitability for Load Application
20. ASTM D6103 - Flow Consistency of Controlled Low Strength Material.

1.4 DEFINITIONS

A. The term “CLSM” is commonly used as an abbreviation for “Controlled Low Strength Material” in the contract documents.

1.5 SUBMITTALS

A. Section 01 33 01 - Submittal Procedures: Requirements for submittals.

B. Approval Data for CLSM Produced Without Native Soil:

1. Mix Design: For each CLSM Mix:

a. Mixture Proportions.

b. Material Sources:
   1) Name and manufacturer of each cementitious material.
   2) Name of aggregate sources.
   3) Product name and manufacturer of admixtures to be used in mix.
   4) Government reserves right to require submission of samples of CLSM materials for testing before or during use in concrete.

c. If proposed material has more than 30 percent passing the 200 sieve, provide mix designs for:
   1) 10 to 30 passing 200 sieve
   2) 30 to 50 passing 200 sieve

d. Physical properties:
   1) Trial mixtures:
      a) Results from trial batches made within past 6 months.
      b) Trial mix test results, three 6 inch diameter, 12 inch high cylinders. each at 7 days and 28 days

c) Average compressive strength of trial batch cylinders at specified design age.

e. Resubmit mix design for change in material source or type.

f. Cementitious materials manufacturer's certifications and test reports within last 6 months.

g. Aggregate test reports for gradation and plasticity, less than 6 months old.

h. Method to determine moisture and consistency of materials to maintain specified strengths. Provide testing frequency.

2. If Quality control test results show CLSM does not meet requirements, submit revised mix design.

C. Approval Data for CLSM Produced With Native Soil:

1. Submit Mix design for each material type:

a. If proposed material has more than 30 percent passing the 200 sieve, provide mix designs for:
1) 10 to 30 percent passing 200 sieve.
2) 30 to 50 percent passing 200 sieve.

b. Physical properties:
1) Trial mixtures:
a) Results from trial batches made within past 6 months.
b) Trial mix test results, three 6 inch diameter, 12 inch high cylinders each at 7 days and 28 days.
c) Average compressive strength of trial batch cylinders at specified design age.

c. Resubmit mix design for change in material source or type.

d. Cementitious materials manufacturer's certifications and test reports within the last 6 months.

e. Material test reports for gradation and plasticity, less than 6 months old.

2. Soil processing and mixing equipment.

3. Foreman references.

4. Method to maintain specified strengths using native soils.

5. If quality control test results show CLSM does not meet specified requirements, submit revised mix design.

D. Quality Control Test Results:

1. Notify Resident Project Representative within 2 hours if testing does not meet specified requirements.

2. If Quality Control Test Results show CLSM does not meet specified requirements, submit a revised mix design.

E. Approval Data for method to prevent pipe flotation while placing CLSM.

1.6 DELIVERY, STORAGE AND HANDLING

A. For CLSM delivered from ready mix plants, furnish batch ticket with each batch of CLSM in accordance with ASTM C94. Deliver ticket to Resident Project Representative at jobsite prior to discharging material from the transport vehicle.

1.7 QUALIFICATIONS

A. References for foreman in charge of CLSM placement, if CLSM is produced with native soils: 3 projects within last 3 years.

PART 2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

A. Cement and pozzolan shipments shall be accompanied by shipping documents containing:

1. Manufactures Certification that material meets requirements.
2. Type or class of material shipped.
3. Manufacturing locations and dates.
4. Lot (bin) number.
5. Date of shipment.
6. Quantity of material shipped.
7. Provide to Resident Project Representative.

B. Cementitious Materials Option:

1. Specified Portland cement plus 20 to 80 percent by weight of total cementitious (cement plus pozzolan) specified pozzolan, in accordance with ACI 318.

C. Portland Cement:

1. ASTM C150, Type II.
2. Meet equivalent alkalies requirements of ASTM C150 - Table 2.
3. Meet false-set requirements of ASTM C150 - Table 4.

D. Pozzolan:

1. ASTM C618, Class F, except:
   a. Sulfur trioxide for Class F, maximum: 4.0 percent.
   b. Loss on ignition, maximum: 2.5 percent.
   c. Test for effectiveness in controlling alkali-silica reaction under optional physical requirements in Table 2 of ASTM C618. Use low-alkali cement for test.
   d. Does not decrease sulfate resistance of concrete by use of pozzolan.

1) Demonstration pozzolan will have an "R" factor less than 2.5.

2) R = (C-5)/F

3) C: Calcium oxide content of pozzolan in percent determined in accordance with ASTM C114.

4) F: Ferric oxide content of pozzolan in percent determined in accordance with ASTM C114.

2.2 WATER

A. Water: ASTM C1602, including optional requirements of Table 2.

2.3 AGGREGATE

A. Aggregate: ASTM C33

1. Maximum particle size: 1-1/2 inches or 1/8 of open distance between pipe and trench wall, whichever is less.

2.4 SOIL

A. Soil producing a color darker than the standard color when tested in accordance with ASTMC40: Not allowed.

B. Plasticity: Non-plastic or low plasticity (P.I. less than 5) in accordance with ASTM D4318.

C. Gradation:

1. Passing U.S. Standard N0. 200 sieve by weight, maximum: 50 percent.

2. Passing U.S. Standard No. 100 sieve by weight, maximum: 70 percent.

3. Maximum particle size: 1/8 of open distance between pipe and trench wall or 3/8 inch, whichever is less.

D. Select or process soil so that particles remain in suspension, i.e. no segregation occurs, when CLSM is placed.

E. Clay balls:

1. Maximum percent, by weight of soil: 10 percent.

2. Maximum size: 3/8 inch.

2.5 MIX

A. Mixture of Aggregate or Soil, Cementitious Materials, Water, and Admixtures:

1. Cementitious material content: Percent by dry weight of aggregate or soil to obtain specified compressive strength.

2. Make trial mixes prior to placing CLSM to determine mixture adequacy.

a. Determine compressive strength in accordance with ASTM D4832.

b. Determine slump in accordance with ASTM C143.

B. Water content: Not to exceed that required to provide a mix that will flow and can be pumped.

C. 7-day compressive strength, ASTM D4832: Not less than 50 psi and not more than 150 psi.

D. Consistency:

1. Except, when stiffer mix required to prevent CLSM from flowing down trenches on a steep slope:

a. Slump, ASTM C143: 8 to 10 inches.

2.6 CLSM TEMPERATURE

A. CLSM temperature at time of placement: 50 degrees to 85 degrees F (10 to 30 degrees C).

PART 3 EXECUTION

3.1 BATCHING EQUIPMENT

A. Design and operation of mixers: CLSM, as discharged, is uniform in composition and consistency throughout each batch.

1. Adjust amount of water and aggregates batched for CLSM to compensate for variations in moisture content or grading of aggregates as they enter mixer.

2. Inform Engineer prior to and after adjustments in batching equipment and control instrumentation.

3. Equip truck mixer with dial or digital water meter accurate to within 1 percent of total mix water located between water supply and mixer.

4. Provide revolution counter which indicates total number of revolutions of drum per batch.

a. Visible from outside truck.

b. Reset to zero for each batch.

5. Attach metal plate attached in a prominent place on the mixer listing:

a. Manufacturer's recommended drum capacity.

b. Mixing and agitating speeds in accordance with ASTM C94.

6. Initial Mixing: Not less than 70 revolutions and not more than 100 revolutions after ingredients are in the drum.

7. Mix 30 revolutions after addition of tempering water.

8. Mix 10 to 12 revolutions after a prolonged period of agitation.

9. Discharge CLSM before 300 drum revolutions

B. Manufacture and deliver in accordance with ASTM C94.

1. In addition to the requirements of ASTM C94, use a water meter approved by the Engineer to measure and record mix water for each batch.

C. Provide following information to Engineer:

1. Copy of current calibration of scales and water meters.
2. Mix water information.

3.2 TRIAL BATCH

A. Perform trial run with proposed equipment and material prior to placing CLSM.

1. Obtain Representative Sample of Material:

a. If native soil materials are used, mix material from top of trench to proposed invert.
1) Discard plastic material.

b. Test material for gradation, plasticity.

2. Test CLSM for slump and compressive strength.

a. Prepare and test three 6 by 12 inch cylinders for both 7 and 28 day according to ASTM D4832.

3.3 PREPARATION

A. Place pipe on soil pads or other approved compressible material such as extruded polystyrene foam insulation. Soil pads shall maintain horizontal and vertical alignment during backfilling operations.

1. Do not create point loads on the pipe.

a. Soil pads shall have a lower compressible strength than the surrounding CLSM.

3.4 PLACING

A. Notify Engineer at least 24 hours before batching CLSM. Include quantity of CLSM required for each daily placement.

B. Do not place CLSM during rain or on frozen ground.

C. Do not mix or place CLSM when ambient temperature is below 40 degrees F. When ambient temperature is 35 degrees F or above, CLSM may be placed when ambient temperature is rising with approval from Engineer.

D. Place CLSM to lines, grade, and dimensions shown on drawings.

1. Initially, place CLSM from one side of pipe. Where necessary, rod or vibrate CLSM so that CLSM flows under pipe and appears on other side.
2. Add CLSM to both sides of pipe and rod or vibrate until CLSM completely fills space between pipe and trench.
3. Ensure that CLSM flows freely from one side of the pipe to the other.
4. Do not disturb trench or allow foreign material to become entrained in the CLSM.

E. Do not allow the pipe to float or move.

1. The Engineer may limit the length of pipe that can be laid or embedded with CLSM in advance of backfilling operations to prevent flotation, or may require the contractor to place the CLSM in layers to prevent flotation or movement.
2. Restrain pipe to prevent flotation or movement during and after placement of CLSM.
3. Pipe that has floated or moved after surveying shall be re-surveyed at the direction of the Engineer to ensure compliance with specified lines and grades. contractor shall correct lines and grades, and pipe shall be re-surveyed after such correction, as needed. All re-surveying shall be done at contractors' sole expense.
4. Do not disturb pipe trench or allow foreign material to become mixed with CLSM.
5. Do not point load pipe.

F. Do not place backfill material over CLSM until CLSM has reached initial set.

1. As determined by ASTM D6024 (ball drop test) or ASTM D1558 in the presence of the Engineer.
2. Do not place greater than 10 feet of backfill over the pipe until the CLSM has a compressive strength of 50 pounds per square inch or greater.

3.5 CONTRACTOR FIELD QUALITY TESTING

A. Testing:

1. Independent testing laboratory shall perform sampling, testing, and reporting
2. If CLSM Contains Native Soils:
   a. Obtain and test soil samples for gradation and plasticity once every 14 days at a minimum or if a change in soil is visually noted.
      1) Test material 14 days ahead of placement from top of trench to proposed invert.
   b. During CLSM batching, provide an inspector from testing laboratory to monitor soil characteristics and operations.
      1) Modify material and or batching operations as recommended by testing laboratory.
      2) Notify Engineer within 24 hours of modifications.
3. Obtain samples and test to determine compressive strength in accordance with ASTM D4832 and slump in accordance with ASTM C143.
   a. Testing frequency:
      1) At least once for each shift when placing CLSM.
      2) Once every 100 cubic yards or,
      3) If consistency of materials change.
   b. Acceptance Criteria:
      1) 7 day compressive strength, ASTM D4832:
         a) Not less than 50psi and not more than 150 psi.
         b) 70 percent of test cylinders shall exceed 75 psi.
   c. Make adjustments to mixture to comply with strength requirements.

d. Stop work if specified requirements are not met.

3.6 FIELD QUALITY ASSURANCE

A. The contractor shall supply material samples to Engineer upon request for independent testing of compressive strength in accordance with ASTM D4832 and slump in accordance with ASTM C143.

3.7 PROTECTION

A. When subsequent lifts of CLSM are to be placed, maintain surface of CLSM in a moist condition by use of tarps or water mist until subsequent lift of CLSM is placed.

B. If backfill will not be placed over CLSM within 8 hours after initial set, place 6-inch minimum cover of moist backfill over CLSM. Maintain moisture in 6-inch soil cover until additional backfill is placed.

C. If ambient temperature is 50 degrees F or less, place 12-inch minimum additional cover of loose backfill over 6-inch moist backfill cover before end of workday. Do not allow CLSM to freeze.

END OF SECTION

SECTION 31 35 27

CABLE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cable concrete mats.

B. Related Sections:

1. Section 31 22 13 - Rough Grading.
2. Section 03 30 00 Cast-In-Place Concrete.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Cable concrete mats:

1. Basis of Measurement: By square yard of cable concrete mat for horizontal surface only. Wastage will not be paid for. Area of turn-downs are not included in quantities on Drawings and Bid Form and shall be considered incidental to the Contractor's price.
2. Basis of Payment: Includes cable concrete mat, geotextile, preparation of surface, compaction, placing of cable concrete mats, cable clamps, clips, anchors, lifting bar rental, mobilization and delivery.

B. Bid items for cable concrete mats or other specific erosion control features that appear on the Bid Form apply only to features designed and directed by the Engineer. They do not include preparation of the Storm Water Pollution Prevention Plan (SWPPP) or implementation of any Best Management Practices (BMPs) stipulated therein. Separate bid items are provided for preparation and implementation of the SWPPP. Contractor is wholly responsible to prepare and implement the SWPPP to the satisfaction of relevant governmental authorities for the prices given under the SWPPP bid items.

1.3 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Cable concrete materials.

1.4 QUALITY ASSURANCE

A. General:

1. Tests on concrete will be performed in accordance with all requirements of applicable ASTM standards for such tests, including but not limited to obtaining samples, temperature, slump, air entrainment, making and curing specimens, breaking concrete cylinders, and other as may be applicable.

2. The cost of all laboratory tests on cement, aggregates, and concrete, for the development of the mix design, will be borne by the Contractor. The laboratory must meet or exceed the requirements of ASTM C1077.

3. Test cylinders will be prepared one (1) test each day of placement for each mixture for the first 50 or less cubic yards and one (1) test for each additional 100 cubic yards of concrete.

B. Compression Tests:

1. Compression test specimens will be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as indicated above to ensure continued compliance with these specifications. Each set of test specimens will be a minimum of 5 cylinders.

2. Compression test specimens for concrete shall be made in accordance with ASTM C31. Specimens shall be 6-inch diameter by 12-inch high cylinders.

3. Compression tests shall be performed in accordance with ASTM C39. One test cylinder will be tested at 7 days, and 2 at 28 days. The remaining cylinders will be held to verify test results, if needed.

4. Compression testing will be paid for by the Owner.

C. Evaluation and Acceptance of Concrete:

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 318, and as specified herein.

2. All concrete that fails to meet the ACI requirements and these specifications, is subject to removal and replacement at the cost of the Contractor.

3. Concrete delivered to the site that does not meet the requirements as herein specified may be rejected.

D. Visual Inspection:

1. A visual inspection of the mats shall be completed.

2. All mats shall be sound and free of defects that would interfere with the proper placing of the mats or impair the strength or performance of the construction.

3. Pin holes on the surface of the mats resulting from entrapped air in the wet cast procedure, surface cracks and any other incidental imperfections from the usual methods of manufacturing including surface chipping from handling the mats on the job site and in shipment and delivery, shall not be deemed grounds for rejection.

4. Cable concrete that does not meet the requirements as herein specified may be rejected.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete:

1. Minimum 28-day compressive strength: 4,000 psi.
2. Minimum density: 140 lbs/cf
3. Air entrainment- all concrete shall contain 5.5% +/- 1.5% entrained air of evenly dispersed air bubbles at the time of placement.
4. Concrete Materials: Refer to Technical Specification 03 30 00 – Cast-In-Place Concrete.
5. Blocks shall be 15.5” square at the base and 11.5” square at the top face (truncated pyramid shape), and have a height of 5.5”.
6. The blocks shall be spaced 0.5” at the base.
7. Weight: 52 lbs per square foot

B. Geotextile Fabric:

1. 8 oz. per square yard.
2. Needle punched non-woven geotextile fabric.
3. Shall be attached to the bottom of the articulated concrete mat during production.
4. An overlap of 2’ to 3’ shall be incorporated on three sides of the mat. The overlap shall provide an area for the adjoining mats to be placed upon and prevent undermining of the erosion control system.

C. Cables:

1. Cables shall be made of stainless steel aircraft cables of type 304, shall be 1 x 19 construction, with 3/16” diameter, and 4,700 lbs breaking strength.
2. Cables shall be integral (poured into) to the concrete block, and shall traverse through each block in both longitudinal and lateral directions of the mat system.

D. Clamps:

1. Stainless steel clamps shall be used to secure loops of adjoining cable concrete mats.
    a. The standard placement of clamps shall be placed on 4’ centers interlocking adjoining mats together.
    b. The clamps are required only in applications exceeding 10’ per section. In slope applications greater than 2 to 1 where the mats are placed end to end, clips shall be placed on 4’ centers interlocking adjoining mats together.
2. Position cable clamps as close to the base of the concrete block by sliding cable clamp down to the adjacent loops before tightening securely.
3. Stainless steel Type 304 shall be used.

PART 3 EXECUTION

3.1 INSTALLATION

A. Placement shall be in accordance with Manufacturer's recommendations.

B. Do not place cable concrete mats over spongy subgrade surfaces.

C. Surface erosion control locations, dimensions, and quantities shown on Drawings are approximations only, and are subject to change based on finished grade. Final quantities, dimensions, and locations of cable concrete mats to be determined in field by Engineer after installation of pipeline and related facilities.

D. Prepared areas shall be graded to a smooth plane finish. Any roots, debris and stones must be removed and regarded. The mats shall be laid in such a manner to produce a smooth plane surface.

E. The gaps between each cable concrete mat shall not be greater than 1".

F. For at-grade installations, where approved by Engineer, the upstream and downstream edges of the mat system shall be keyed into the ground at a 45°angle for a length of 2 block rows on both the upstream and downstream edges, or as shown on Drawings.

G. For buried installations at wash crossings, the upstream edge shall be turned down vertically for 2 block rows, and the downstream edge shall be turned down vertically for 1 block row, or as shown on Drawings.

3.2 FIELD QUALITY CONTROL

A. Cracks exceeding 0.25 inches (0.635 cm) in width and/or 1.0 inch (2.54 cm) in depth, shall be deemed grounds for rejection.

B. Chipping resulting in a weight loss exceeding 10% of the average weight of the blocks shall be deemed grounds for rejection.

END OF SECTION

SECTION 31 37 00

RIPRAP AND ROCK LINING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Riprap placed loose.
2. Wire Caged Riprap.

B. Related Sections:

1. Section 31 22 13 - Rough Grading.
2. Section 31 23 23 - Backfill.
3. Section 31 23 17 - Trenching.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Check dams and riprap placed loose:

1. Basis of Measurement: By cubic yard of riprap volume, riprap only.
2. Basis of Payment: Includes preparation of surface, compaction, placing of riprap material.

B. Wire caged rip rap:

1. Riprap:
   a. Basis of Measurement: By cubic yard of riprap volume, riprap only.
   b. Basis of Payment: Includes preparation of surface, compaction, placing of riprap material.
2. Wire mesh, geotextile, tie wire, angle iron, and other appurtenances:
   a. Basis of Measurement: By square yard of riprap area encaged in completed installation. Wastage will not be paid for.
      1) Measurement is based on actual coverage area. Where the Drawings require wire mesh both above and below the riprap blanket, both layers are included the pay item, but the coverage area is not doubled for purposes of measurement.
   b. Basis of Payment: Includes cutting and placement of wire mesh material both above and below the riprap, geotextile fabric, tie wires, and angle irons.

C. Bid items for riprap, rock check dams or other specific erosion control features that appear on the Bid Form apply only to features designed and directed by the Engineer. They do not include preparation of the Storm Water Pollution Prevention Plan (SWPPP) or implementation of any Best Management Practices (BMPs) stipulated therein. Separate bid items are provided for preparation and implementation of the SWPPP. Contractor is wholly responsible to prepare and implement the SWPPP to the satisfaction of relevant governmental authorities for the prices given under the SWPPP bid items.

1.3 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Gradation of rock.

1.4 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

B. Perform Work in accordance with State of New Mexico Department of Transportation standard, if related to roadway construction or drainage.

C. Samples of riprap material shall be provided to the Engineer for inspection and approval for every 500 cubic yards of riprap delivered to the site.

D. Submit representative samples of riprap for testing using the Los Angeles Abrasion Test using ASTM-C131 and for Soundness Testing using ASTM C-88.

1. Loss of aggregate from abrasion test shall not exceed 40 percent. Sample results shall be provided to the Engineer for every 500 cubic yards of riprap delivered to the site.

2. Loss of aggregate for soundness test shall not exceed 15 percent. Sample results shall be provided to the Engineer for every 500 yards of riprap delivered to the site.

3. Riprap testing shall be covered under the testing allowance.

PART 2 PRODUCTS

2.1 MATERIALS

A. Furnish materials in accordance with State of New Mexico Department of Transportation standards, Section 602.

B. Riprap:

1. Shall comply with New Mexico Department of Transportation standards, Section 602.2

2. Angular shaped rock:

a. Minimum size (as measured in the smallest dimension):

1) Class A Wire enclosed riprap:

a) At least 50% of the rock shall be a minimum of 4 inches measured in the smallest dimension. Remaining smaller rock shall not be smaller in any dimension than the smallest mesh openings.

2) Uncaged riprap and rock check dams:

a) 8” minimum rock dimension, measured in the smallest dimension.

b. Solid and nonfriable.

C. Wire mesh:

1. Non-raveling, uniform, hexagonal double-twisted galvanized wire mesh, with a diameter of at least 0.087", with 2½" x 3¼" mesh openings.

2. Shall comply with New Mexico Department of Transportation standards, Section 602.2.2.2

D. Selvedges:

1. Selvedge wire with a diameter of at least 0.150-inch.

2. Shall comply with New Mexico Department of Transportation standards, Section 602.2.2.2.3

E. Stakes:

1. 4"x4"x3/8" angle iron, per New Mexico Department of Transportation standard, Section 602.

2. Lengths per Drawings.

F. Tie Wire:

1. Soft tempered Class 3 zinc coated 0.120-inch diameter tie wire.

G. Geotextile Fabric:

1. Provide non-woven geotextile (filter fabric) Class 1, as per New Mexico Department of Transportation standards, Section 604.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Do not place riprap over frozen or spongy subgrade surfaces.

3.2 PLACEMENT

A. Riprap locations, dimensions, and quantities shown on Drawings are approximations only, and are subject to change based on finished grade. Final quantities, dimensions, and locations of riprap to be determined in field by Engineer after installation of pipeline and related facilities.

B. Filter fabric:

1. Place Class 1 non-woven geotextile (filter fabric) between the riprap and the supporting soil.

C. Installed Thickness: As shown on Drawings, or as directed in field by Engineer.

D. Wire enclosure: Where wire enclosure is to be used, enclose rock in wire mesh and anchor in place as indicated on Drawings.

E. Class A Riprap Placement

1. Shall comply with New Mexico Department of Transportation standards, Section 602

2. Enclose Class A riprap with wire mesh drawn tightly on all sides. The Contractor may connect wire mesh using approved fasteners or lacing wire. Weave adjacent edges at least once with double loops of lacing wire that is as strong and flexible as the mesh.

3. Provide continuous lacing as far as possible that passes through each mesh opening. Where splicing is necessary, overlap the lacing at least 12 inches.

4. Space galvanized wire ties connecting top and bottom mesh layers approximately 24 inches on centers. Anchor the ties to the bottom wire-fabric layer. Extend the ties through the rock layer and secure to the top wire-fabric layer. Anchor wire-enclosed riprap to slopes with steel stakes driven into the Embankment. Space stakes in accordance with the Contract.

END OF SECTION

SECTION 32 11 23

AGGREGATE BASE COURSE AND GRAVEL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aggregate base course.
2. Clean gravel.

B. Related Sections:

1. Section 31 22 13 - Rough Grading: Preparation of site for base course.
2. Section 31 23 17 - Trenching: Compacted fill under base course.
3. Section 31 23 23 - Backfill: Compacted fill under base course.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Aggregate Base Course:

1. Basis of Measurement: By the square yard to depth indicated on Drawings.
2. Basis of Payment: Includes supplying fill material, stockpiling, scarifying substrate surface, placing aggregate to the depths and at the locations indicated on the Drawings, and compacting.

B. Clean Gravel

1. Basis of Measurement: By the square yard to depth indicated on Drawings.
2. Basis of Payment: Includes supplying fill material, stockpiling, placing gravel to the depths and at the locations indicated on the Drawings, and compacting.

1.3 REFERENCES

A. New Mexico Department of Transportation (NMDOT) Standard Specifications for Highway and Bridge Construction.

B. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and an 18-in. Drop.

C. ASTM International:

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
2. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Materials Source: Submit name of imported materials suppliers.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

B. Perform Work in accordance with NMDOT standards.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aggregate Base Course:

1. Base course gradation shall have a percent passing sieve sizes as shown in TABLE 304, SECTION 304-BASE COURSE, New Mexico Department of Transportation Standard Specifications for Highway and Bridge Construction, latest edition.

B. Clean Gravel (Class I crushed stone):

1. Manufactured angular, crushed stone, crushed rock, or crushed slag with the following gradation requirements.

Sieve Size	Percentage Passing
3/4-inch	100
No. 4	30 – 50
No. 200	0 - 5

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.2 PREPARATION

A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.

B. Do not place fill on soft, muddy, or frozen surfaces.

C. Subgrade surface shall be kept at all times in such manner that it will drain readily and effectively.

D. Mix aggregate material to provide a homogenous mixture of uniformly dispersed materials as placed in position for compacting.

3.3 AGGREGATE PLACEMENT

A. Spread aggregate over prepared substrate in layers that will permit the required density be obtained. Density requirements will be determined by AASHTO T-180.

B. Compact each layer of material full width with: (1) two passes of a 50 ton compression type roller, or (2) two passes of a vibratory roller having a minimum dynamic force of 40,000 pounds impact per vibration and a minimum frequency of 1,000 vibrations per minute, or (3) eight passes of a 10 ton compression-type roller, or (4) eight passes of a vibratory roller having a minimum dynamic force of 30,000 pounds impact per vibration and a minimum frequency of 1,000 vibrations per minute.

C. No displacement (pumping) of subgrade soils shall be visually observed when loaded by heavy equipment traffic.

D. Level and contour surfaces to elevations and gradients indicated.

E. Incorporate only suitable roadway excavation material into embankments. Compact material placed in all embankment layers and the material scarified in cut sections to a uniform density of not less than 95% Standard Proctor density.

F. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.

G. Maintain optimum moisture content of fill materials to attain required compaction density.

H. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.4 TOLERANCES

A. Section 01 00 00 - Quality Requirements: Tolerances.

B. Maximum Variation from Flat Surface: 3/8 inch measured with 10-foot straight edge in any direction.

C. Maximum Variation from Thickness: 1/2 inch.

3.5 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Testing, adjusting, and balancing.

B. Field testing of density and moisture content of in-place material will be performed in accordance with Nuclear Method, ASTM D6938.

C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

D. Frequency of Tests: One test every 2,500 square feet or portion thereof, at locations directed by Engineer.

END OF SECTION

SECTION 32 92 19

SEEDING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preparation of subsoil.
2. Placing topsoil.
3. Seeding, Hydroseeding, Seed Drilling.
4. Seed Protection, Mulching
5. Maintenance.

B. Related Sections:

1. Section 31 22 13 - Rough Grading: Rough grading of site.
2. Section 31 23 17 - Trenching: Rough grading over cut.
3. Section 31 23 23 - Backfill

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Grassed Areas:

1. Basis of Measurement: By linear foot of centerline within the disturbed area of pipeline right of way and temporary use area. Lump sum for each site.
2. Basis of Payment: Includes preparation of subsoil, topsoil, placing topsoil, seeding, watering and maintenance to specified time limit.

1.3 REFERENCES

A. Federal Specifications:

1. OF-241 - Fertilizers, Mixed, Commercial.

B. ASTM International:

1. ASTM C602 - Standard Specification for Agricultural Liming Materials.

1.4 DEFINITIONS

A. Weeds: Vegetative species other than specified species to be established in given area.

B. NNDA: Navajo Nation Department of Agriculture

1.5 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data for seed mix, fertilizer, and other accessories.

1.6 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.

B. Perform Work in accordance with Navajo Nation Department of Agriculture standards.

C. Seed mixtures must be certified. There shall be no primary or secondary noxious weeds in the seed mixtures.

D. Temporary Best Management Practices (BMPs) must be installed along areas where sediment is being transported out of the construction area. Fiber rolls (mulch socks) rip rap blankets, rip rap check dams, soil cement, soil berms, surface roughening, or other appropriate BMPs shall be used in these areas. Such BMPs shall be included in the Storm Water Pollution Prevention Plan (SWPPP) provided and implemented by the Contractor.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Product storage and handling requirements shall be as specified in applicable sections of these Specifications and in accordance with recommendations of the supplier.

B. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.

C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.8 COORDINATION

A. Section 01 00 00 - Administrative Requirements: Requirements for coordination.

B. Do not commence seeding until all work that could require ground disturbance has been completed, tested, and approved.

C. Contractor is advised that there are three (3) Navajo Nation Department of Agriculture (NNDA) seed mixtures included in the appendices, Selection of specific mixture will depend on existing vegetation and soil type at each location. Contractor shall coordinate with Engineer prior to purchasing seed to determine exactly where to use each seed mixture.

D. Contractor shall coordinate seeding dates to coincide with the dates stipulated in the NNDA re-vegetation requirements and stipulations.

1. Contractor shall indicate exact proposed re-seeding dates in project schedule, and shall notify the Engineer as early as possible of any deviations from this proposed seeding schedule.

1.9 MAINTENANCE SERVICE

A. Section 01 00 00 - Execution Requirements: Requirements for maintenance service.

B. The cover will be maintained by occasional mowing, spot spraying, reseeding weak areas, or by controlled burns. Maintain seeded areas for three months from Date of Substantial Completion. Maintenance shall include weekly watering.

C. After the first full season of growth (not the first year) the cover should be mowed or grazed to control annual weeds to encourage good growth. Timing of mowing should avoid nesting times of birds (indicated in Environmental Requirements, Appendix C).

PART 2 PRODUCTS

2.1 SEED MIXTURE

A. Furnish materials in accordance with Navajo Nation Department of Agriculture standards. Refer to seed mixtures provided in Appendix C.

B. Engineer, in consultation with NNDA, shall determine which seed mixture applies at each location within the project. Contractor is responsible to coordinate with Engineer to determine proper seed mix prior to purchasing seed.

C. In developing seed mixtures, the percentage of each included species should first be determined. This percentage, which should total 100, is then multiplied by the recommended seeding rate for the concerned species. This will give the required pounds PLS for that species in the mix.

2.2 SOIL MATERIALS

A. Topsoil: Excavated from site and free of weeds.

2.3 ACCESSORIES

A. Water: Clean, fresh and free of substances or matter capable of inhibiting vigorous growth of grass.

B. Erosion Fabric: Jute matting, open weave.

C. Herbicide: If required, Owner and Engineer's approval must be obtained prior to use.

D. Stakes: Softwood lumber, chisel pointed.

E. String: Inorganic fiber.

F. Mulch:

1. Mulch of any kind shall not be used on Tribal lands.

PART 3 EXECUTION

3.1 GENERAL

A. Prepare and restore site per applicable NNDA Revegetation Plan, included in Appendix C to the Contract Documents.

B. Seed and reclaim all disturbed areas, including temporary construction easements and any areas disturbed by construction traffic.

C. Temporary fence gates along the pipeline alignment must be kept closed to manage the livestock in the pipeline area.

3.2 EXAMINATION

A. Verify prepared soil base is ready to receive the Work of this section.

3.3 PREPARATION OF SUBSOIL

A. Prepare sub-soil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas. The heel of a boot should not sink in more than ½ to 1 inch.

B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated sub-soil.

C. Topsoil removed from the right-of-way must not be mixed with sagebrush debris which may impede seed germination during the revegetation process.

D. In areas needing reseeding, the top layer of soil shall be softened by ripping and disking prior to seeding to create the soil structure necessary to allow for seed germination.

E. Scarify subsoil to depth of 6 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted sub-soil.

3.4 PLACING TOPSOIL

A. Spread topsoil to minimum depth of 6 inches over area to be seeded. Rake until smooth.

B. Place topsoil during dry weather and on dry unfrozen subgrade.

C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.

D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.

3.5 SEEDING

A. Use seed mixture indicated by Engineer, based on land ownership and native vegetation.

B. Apply seed at rates specified by NNDA for their respective seed mixtures. Use seed drill followed by drag packer over area to incorporate seed approximately ½ inch deep.

C. Planting Season: See Article 1.8. of this Section.

D. Do not sow immediately following rain, when ground is too dry, or when winds are over 12 mph.

E. Seed placement rows on steep slopes should not be placed parallel to the down slope, but at angles to the down slope to prevent the formation of gullies and rills.

F. A seed drill followed by a drag packer shall be required unless specific exceptions are authorized in writing by the Engineer.

G. Some hand seeding may be needed along steep slopes where equipment is difficult to use.

H. Apply water with a fine spray immediately after each area has been seeded. Saturate to 4 inches of soil.

3.6 HYDROSEEDING

A. Hydroseeding shall only be allowed where it is physically unfeasible to seed drill.

B. Hydroseeding shall not be performed without prior written authorization by the Engineer.

C. Apply fertilizer and seeded slurry with hydraulic seeder at an approved rate evenly in one pass.

D. After application, apply water with fine spray immediately after each area has been hydroseeded. Saturate to 4 inches of soil and maintain moisture levels two to four inches.

E. If hydroseeding is used, the specified rates of seed application shall be doubled.

3.7 SEED PROTECTION

A. Cover seeded slopes where grade is 3:1 or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.

1. All slopes around the perimeters of sites shall be covered with erosion fabric, regardless of grade.

B. Lay fabric smoothly on surface, bury top end of each section in 6 inch deep excavated topsoil trench. Overlap edges and ends of adjacent rolls minimum 12 inches. Backfill trench and rake smooth, level with adjacent soil.

C. Secure outside edges and overlaps at 36 inch intervals with stakes.

D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.

E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

F. Protection of seeded areas from traffic: Contractor shall take measures as required by the Owner, Engineer, and/or land controlling agencies to prevent traffic on re-seeded areas. Such measures may include warning signs, fence post barricades, earthen berms, and/or other measures at intersections of seeded ROW and existing roadways and driveways, and at other locations as directed by Engineer. Earthen berms shall extend the full width of the disturbed area, with dimensions as directed in field by Engineer.

G. All seed protection measures, including traffic prevention, shall be subject to approval of land-controlling agencies.

3.8 MULCHING

A. Do not apply mulch on Tribal lands.

3.9 MAINTENANCE

A. Immediately reseed areas showing bare spots.

B. Repair washouts or gullies.

C. Protect seeded areas with warning signs during maintenance period.

3.10 SCHEDULE

A. All utility routes, disturbed areas, vault areas, and non-traveled areas in road rights-of-way to be reseeded when Work is completed in affected areas.

END OF SECTION

SECTION 33 05 23
HORIZONTAL DIRECTIONAL DRILLING (HDD)

PART 1 GENERAL

1.1 WORK INCLUDED

A. Weekly meetings in accordance with Part 3.18.

B. Procure and transport all suitable equipment, labor, and materials for the Work to and from the job site.

C. Prepare the site as specified herein.

D. Fusing the Carrier Pipe per manufacturer or pipe supplier's specification by a certified fusing technician.

E. Install the Conductor Casings per Specification 33 05 23.1.

F. Install the ballasted Carrier Pipe using HDD including drilling the Pilot Bore and Reaming a suitable diameter Borehole for the installation of the Carrier Pipe into the Borehole. Swabbing the borehole prior to installation of the carrier pipe. The selected materials must meet all project requirements and be approved by the Engineer.

G. Cleanup and perform final restoration of all work areas.

1.2 RELATED WORK

A. Related documents and Specification Sections include but are not limited to:
1. 33 05 23.1 Conductor Casing Installation and Backfill
2. Geotechnical Data Memorandum (GDM), Lithos Engineering, June 2023
3. IR and Pull Force Calculations, Lithos Engineering, August 2023
4. Geotechnical Engineering Services Report, GeoTest (March 2022)
5. Subsurface Exploration and Geotechnical Engineering Report, Inberg-Miller Engineers (March 2023)

1.3 DEFINITIONS

A. BOREHOLE: The elongated cavity created through the HDD process. The Borehole is not a void, but rather a hole filled and stabilized with Drilling Fluids mixed with native soil/formation.

B. CARRIER PIPE: The proposed pipeline to be installed via HDD and used for conveyance of waterline.

C. CONDUCTOR CASING: See Specification 33 05 23.1.

D. CONTRACTOR: Specialty Contractor in charge of installing HDD portions of the alignment.

E. DIMENSION RATIO (DR): The ratio of Carrier Pipe diameter to wall thickness; DR = D/t where "D" is the outside diameter and "t" is the pipe wall thickness.

F. DRILL HEAD: Tooling used to facilitate steering and to excavate soil or rock at the face of the Borehole.

G. DRILLING FLUIDS: Fluids consisting of water, bentonite, polymers, and any approved additives pumped downhole to cool downhole equipment, stabilize the Borehole, and facilitate removal of cuttings.

H. ENGINEER: Individual responsible for HDD design. In this case Lithos Engineering.

I. FILTER CAKE: The wall cake that forms on the Borehole wall from the platelets in bentonite-based Drilling Fluid. The Filter Cake provides a barrier between the Borehole and the formation, helping to reduce loss of Drilling Fluid to the formation and groundwater to the Borehole.

J. GYROSCOPE: A tool mounted within the downhole assembly that measures calculation parameters in real time. The Gyroscope combines this data with measured distance to calculate the coordinates, elevation, and vertical and horizontal offsets from the alignment. The position of the Drill Head is calculated continuously along the alignment without use of an energized coil on the ground surface.

K. GYROSCOPIC TRACKING: Tracking the position of the Drill Head using a Gyroscope.

L. HORIZONTAL DIRECTIONAL DRILLING (HDD): A surface-launched trenchless technology for the installation of pipes, conduits, and cables. HDD creates a Pilot Bore along the design pathway and enlarges the Pilot Bore in one or more Reaming passes to a diameter suitable for installation of the Carrier Pipe, which is pulled into the prepared Borehole as the final step of the process. The HDD process often includes a Swab Pass.

M. INADVERTENT RETURN (IR): When the Drilling Fluid pressure exceeds the strength and confining pressure of the ground and reaches the surface or waterway. Also known as hydrofracture or "frac-out."

N. INTERSECT: An intersect involves drilling the Pilot Bore from both ends of the alignment and intersecting the pilot bore at a subterranean location. A Pilot Bore intersect is often used when Conductor Casings are on both ends of the alignment and/or to limit Drilling Fluid pressures when performing long HDD installations.

O. MAXIMUM ALLOWABLE DOWNHOLE PRESSURE: The Drilling Fluid pressure at which higher pressures will theoretically cause an IR to occur. Estimates of this pressure for a given location along the bore profile use subsurface engineering properties, Drilling Fluid properties, drilling means and methods, and HDD alignment geometry.

P. MUD CIRCULATION PIT: An excavated area used to manage, monitor, control, and recirculate Drilling Fluid.

Q. MUD RECYCLING SYSTEM: A specialized system designed to separate suspended solids or excavated soil or rock materials from Drilling Fluids during the HDD installation.

R. PILOT BORE: The initial, steered, and controlled drilled path used to establish the plan and profile alignment of the HDD, guide the enlargement to the required size, and define the eventual final alignment of the Carrier Pipe.

S. PITCH: The deviation angle from a horizontal plane is measured as Pitch. When the drill is directed downward, the Pitch is negative. When it is directed toward the surface, the Pitch is positive. Also known as inclination.

T. PRODUCT PIPE: The Carrier Pipe.

U. PULLBACK: The Carrier Pipe installation process where the Carrier Pipe is connected behind a barrel or compacting style Reamer, using a Swivel and pull head, and the Carrier Pipe is pulled into place.

V. REAMER: A tool designed to enlarge the Borehole.

W. REAMING: The enlargement of the Pilot Bore in one or more passes to accommodate the desired Carrier Pipe diameter.

X. SWAB PASS: A proof pass with a barrel or compacting style Reamer of equal to or greater diameter than the Carrier Pipe used to check the Borehole is properly conditioned and has been prepared to an appropriate final diameter. The Swab Pass does not cut the Borehole to a larger diameter from the Borehole diameter established during the final Reaming pass.

Y. SWIVEL: A device that allows the pull head and Carrier Pipe to be isolated from drill pipe rotation yet transfer tensile forces from the drill pipe to the pull head.

Z. TRACKING SYSTEM: Tracking the position of the Drill Head using Gyroscopic Tracking.

1.4 REFERENCES

A. ASTM International
1. D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
2. D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
3. F1962 – Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit under Obstacles, Including River Crossings.
4. F2620 – Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings.
5. F2634 – Standard Test Method for Laboratory Testing of Polyethylene (PE) Butt Fusion Joints using Tensile-Impact Method

6. F3124-15e1 – Standard Practice for Data Recording the Procedure Used to Produce Heat Butt Fusion Joints in Plastic Piping Systems or Fittings

B. American Water Works Association (AWWA)
   1. AWWA M55 – HDPE Pipe: Design and Installation

C. Plastics Pipe Institute (PPI)
   1. Technical Report TR-33 - Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe.
   2. Handbook of Polyethylene Pipe, Second Edition.

D. NSF International Standard / American National Standard (ANSI)
   1. NSF/ANSI 61 – Drinking Water System Components – Health Effects

E. National Utility Contractors Association
   1. NUCA - HDD Installation Guidelines.

F. North American Society for Trenchless Technology (NASTT)
   1. Horizontal Directional Drilling (HDD) Good Practices Guidelines – 2017 (4th Edition)

1.5 GENERAL REQUIREMENTS

A. Be responsible for the HDD design verification, construction, and performance of the HDD work as specified herein.

B. Minimum design and construction requirements are presented herein and in the Drawings. It is the Contractor's responsibility to review and confirm design to fulfill the specified design requirements necessary for completion of the work.

C. Perform the HDD installation in accordance with all Governing Agency(s) applicable permit requirements and industry standards. In the case of differing Governing Agency(s) specifications or requirements, the appropriate requirements shall apply as determined by the Owner.

D. Provide adequate communication between entry and exit locations if work is being performed at both ends of the alignment.

E. Utilize a data logger on the Carrier Pipe fusing equipment to determine and record the fusing parameters, i.e. temperature, fusing pressure, time to fuse each joint, etc., for each joint assembled.

F. Be responsible for containing, collecting, cleaning up, and disposal for all Drilling Fluid used for the Project.

G. Design Criteria:
   1. The Carrier Pipe is appropriately fused and positioned for Pullback without bending the Carrier Pipe tighter than minimum bending radii as specified herein and as recommended by the Carrier Pipe manufacturer. Use rollers to reduce

frictional forces during Pullback. At no time shall the pipe be allowed to be pulled along the ground surface.

2. Do not bend the Carrier Pipe at a radius tighter than the manufacturer's recommendations.

1.6 QUALIFICATIONS

A. Contractor: The Contractor has been prequalified to perform the HDD work associated with the Project.

B. All personnel employed by the Contractor in the work shall be experienced and competent in their respective tasks and shall work only under the direct control of a suitably experienced Superintendent.

C. HDPE pipe joining shall be performed by personnel trained in the use of butt-fusion equipment. Personnel directly involved with installing the Carrier Pipe shall have received training in the proper methods for joining the pipe. Training shall be conducted by a qualified representative of the fusion equipment manufacturer.

1.7 SUBMITTALS

A. Preconstruction: Submit to the Engineer the following a minimum of two weeks before the scheduled start of the applicable activity. Each number submittal below is to be submitted as a single package, i.e. submit all components of the HDD Work Plan as a single submittal package.

1. Review IR calculations, pull force calculations, and Contract Drawings and inform the Engineer if you take exception to any of the input parameters or means and methods assumptions presented within the calculations.
2. Qualification information as required under Section 1.06.
3. HDD Work Plan:
    a. Working drawings for project layout including:
        1) For the Carrier Pipe, this includes work, storage, staging, and Carrier Pipe assembly areas, including location of equipment used to loft the Carrier Pipe during Pullback and the planned lift height at each support location.
        2) Midfuse sequencing, if used.
        3) Excavation, equipment, ancillary equipment, and materials staging and layout for the HDD operation.
        4) Pollution prevention measures.
    b. HDD schedule. Include a critical path schedule for HDD-related activities. At minimum the schedule shall have the following tasks: site setup, Conductor Casing Installation, installation of centralizer casing within the Conductor Casing, Pilot Bore installation, Reaming passes (one task per Reaming pass), Carrier Pipe fusing, Swab Pass, Carrier Pipe Pullback, Carrier Pipe testing, and backfill grouting. The schedule shall be updated weekly after submission through construction completion.
        1) See Specification 33 05 32.1 for Conductor Casing and backfill grouting requirements.

c. HDD Equipment. Supply details of the HDD system to be used including: HDD rig, drill pipe, Mud Recycling System, mud pump, pit pump, Tracking System and components, downhole assembly configuration, downhole tooling, and drill pipe loading equipment. Equipment shall meet the requirements in Part 2 and be presented in:
   1) Manufacturer's technical specifications of HDD rig.
   2) Manufacturer's technical specifications of Mud Recycling System.
   3) Manufacturer's technical specifications of the mud pump.
   4) Manufacturer's technical specifications and data on the proposed guidance/tracking system, and the accuracy of the guidance system at the design drill depths. Include equipment calibrations and certifications for downhole surveys. Describe procedures for operating the Tracking System and for verifying the accuracy of the tracking data. An example as-built of the pilot bore plan and profile using the proposed Tracking System is to be submitted
   5) A data sheet showing the type and sizing of all Pilot Bore bits and Reamers, including the Reamer to be used during the Swab Pass.
   6) Tensile rating of the Swivel.

d. Plan to keep the drill pipe centered within the Conductor Casing during the entirety of the HDD process along with a drawing of the casing centralizers and description of their installation and removal process.

e. Drilling Fluids:
   1) Include the proposed Drilling Fluid mix design based on anticipated subsurface conditions, including percentages of bentonite and additives. Include manufacturers information and purpose of any additives used in the mix design. The Drilling Fluid shall be designed to maintain an adequate Filter Cake and stabilize the Borehole during all phases of HDD installation.
   2) Submit management procedures employed throughout the installation, including:
      a) Procedures for monitoring the Drilling Fluid unit weight, sand content, and viscosity.
      b) Provide the maximum Drilling Fluid flow rates that will be used during Pilot Bore drilling and each Reaming pass.
      c) Drilling Fluid disposal plan listing the equipment to be used and the location that is willing and able to accept Drilling Fluid waste from the project.
   3) Equipment and materials that will be included in the Drilling Fluid spill kit.

f. Fuel and Hydraulic Fluid Containment and Contingency Spill Plan. Include means and methods for managing, containing, and cleanup of fuel and oil spills should they occur at the site. Dispose of all fuel, oil, or other leakage from equipment including diapers, absorbent material, and other related cleanup and spill control materials. A Fuel and Oil Spill Kit shall be on site and available for use during all drilling operations.

g. Contingency plans for the following scenarios are required and shall include the observations that may indicate the presence of the scenario occurring and possible actions that may be taken in the event the scenario occurs:
   1) Loss of Drilling Fluid circulation
   2) Inadvertant return (IR)
   3) Obstruction encountered during Pilot Bore drilling or Reaming
   4) Broken drill pipe or broken Carrier Pipe during pipe positioning or Pullback
   5) Pullhead or Reamer caught on the edge of a Conductor Casing
   6) Utility strike or damage to an existing utility
   7) Line or grade outside specified tolerances
   8) Unforeseen subsurface conditions

4. Manufacturer’s technical data showing complete information on material composition, physical properties, and dimensions of the Carrier Pipe and fittings. Manufacturer’s recommendations for transport, handling, and storage of pipe and fittings shall be included.
5. Manufacturer's Certificate: Certify the Carrier Pipe meets or exceeds specified requirements.
6. Health and safety submittals including:
   a. Accident prevention program.
   b. Site-specific health and safety plan.
   c. Emergency response plan.

B. Construction Submittals shall be digital and submitted to the Engineer within 24 hours of the day the event occurs and shall include at minimum:
1. A preliminary Pilot Bore as-built shall be submitted prior to proceeding with Reaming. At minimum, a survey data point shall be obtained for the as-built borepath at a maximum spacing equivalent to one drill pipe.
2. Drill and Drilling Fluid logs.
3. Carrier Pipe Fusing logs.
4. Pressure test and deflection test results.
5. Construction records as noted in Part 3.17.

C. Postconstruction:
1. Project Record Documents: provide an as-built plan and profile for the borepath. At minimum, a survey data point shall be obtained for the as-built borepath at a maximum spacing equivalent to one drill pipe.
   a. Identify and describe unexpected variations to subsurface conditions or discovery of uncharted utilities.
   b. Show depth and location of any abandoned Boreholes and document the filling of them with grout.

1.8 QUALITY ASSURANCE

A. Perform work in accordance with the following:
1. Applicable New Mexico state standards
2. NUCA HDD Installation Guidelines.
3. ASTM F1962.

4. NASTT's HDD Good Practice Guidelines, 4th edition.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Conduct operations so as not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

B. Comply with all other Federal, State, and local environmental requirements including, but not limited to, storm water runoff, construction dewatering, disposal of Drilling Fluid, and hazardous waste management and disposal.

1.10 COORDINATION

A. Coordinate work with the Navajo Nation Governing Agency, local Municipal Public Works Department (if applicable), and utilities within construction area.

PART 2 EQUIPMENT, PRODUCTS, AND MATERIALS

2.1 EQUIPMENT

A. Provide the equipment necessary for the excavation of the Borehole and installation of the Carrier Pipe and to complete all work associated with this section.

B. TRACKING SYSTEM
1. Shall be a Gyroscopic or Magnetic Wireline Tracking system.
2. Shall provide immediate information on the tool face position, inclination, and azimuth. The Tracking System shall provide continuous electronic monitoring and recording capabilities.
3. Tracking System data shall be recorded digitally. Handwritten data will not be accepted.
4. Shall be capable of tracking the Pilot Bore progress within the specified tolerances.
   a. Specified tolerances are provided in Part 3.14.
5. Tracking information is fully capable of being obtained without use of an energized coil.
   a. Walkover locating techniques are acceptable only as supplementary to a Gyroscopic or Magnetic Wireline Tracking System.

C. DRILLING FLUID SPILL KIT
1. Shall be adequate to contain, collect, and dispose of Drilling Fluid that is either spilled on site or surfaced to the ground or waterbody through an IR. A Drilling Fluid Spill Kit shall be located at each end of the Borepath during all HDD operations.

D. HDD RIG
1. Shall have a minimum thrust and pull capacity of 440,000 lbs.
2. Shall have sufficient torque to excavate the Borehole within the ground conditions described in the geotechnical reports.

3. Shall be capable of producing a digital printout of Drilling Log drilling parameters, as specified herein.

E. MUD PUMP
1. Shall have the ability to pump Drilling Fluid at the required pressure and flow rate for all drilling and excavation rates realized during the project at the anticipated Drilling Fluid viscosity at the ground surface elevation of the project site.

F. MUD RECYLING SYSTEM
1. Shall have the capability of separating excavated materials anticipated and as presented in the geotechnical reports. Shall be capable of separating excavated materials and recycling clean Drilling Fluid at a rate sufficient for all drilling and excavation rates realized during the project.

G. Tooling shall be suitable for the site conditions as presented in the Contract Drawings and geotechnical reports.

2.2 PRODUCTS AND MATERIALS

A. Provide the products and materials necessary for the excavation of the borepath and installation of the Carrier Pipe and to complete all work associated with this section.

B. DRILLING FLUID
1. Designed to ensure continuous circulation and Borehole stability within the anticipated subsurface conditions as provided in the geotechnical reports.

C. CARRIER PIPE
1. Furnish materials in accordance with New Mexico state standards.
2. High Density Polyethylene Pipe
   a. 24-inch DIPS DR9 HDPE
   b. Shall use resin PE 4710.

D. CONDUCTOR CASING AND BACKFILL GROUT
1. See Specification 33 05 23.1

E. WATER SOURCE
1. Be responsible for obtaining water required for conducting the Work of this section. Taking water from the San Juan River is prohibited.

F. UNDERGROUND PIPE MARKERS
1. Tracer Wire: Magnetic detectable conductor insulated with high density polyethylene (HDPE) or UF- XHHW in accordance with physical and electrical properties per ASTM D1248.
   a. Tracer wire shall be rated for “Direct Burial”, 30 volts, and be appropriate for installation in HDD applications,
   b. Tracer wire shall be constructed of copper clad hard drawn extra high strength (EHS) tracer wire with a steel core or Engineer approved equal, and

c. Tracer wire must be appropriately sized and compatible with HDD means and methods.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify connection to existing piping system size, location, and invert elevations are in accordance with Drawings.

B. Do not begin work until required preconstruction submittals listed in Part 1.07A have been accepted by the Engineer and Owner and notice to proceed has been provided by the Owner.

3.2 PREPARATION

A. Call the Local Utility Line Information (811) service not less than three working days, and as required by conflicting utility owners, before performing Work.
1. Request underground utilities to be located and marked within and surrounding construction areas.
2. Maintain active utility clearances for the duration of the Work.

B. Locate, identify, and protect utilities indicated to remain from damage.
1. At minimum, any utility within 10 feet of the HDD borepath shall be exposed and supported and protected in place.

C. Identify required lines, levels, contours, and datum locations.

D. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Perform grading and site modifications necessary to control Drilling Fluids and prevent drainage of Drilling Fluids, other fluids, and contaminated material away from the site. A minimum 1-foot-tall berm shall be constructed, or straw wattles shall be used, around the drill rig to convey Drilling Fluid toward the Mud Circulation Pit nearest the drill rig.

3.3 DEWATERING

A. Intercept and divert surface drainage and precipitation away from Mud Circulation Pit excavations and temporary site work through use of dikes, curb walls, ditches, pipes, sumps, or other means.

B. Comply with New Mexico state standards and requirements for dewatering to any watercourse, prevention of stream degradation, and erosion and sediment control.

3.4 GENERAL

A. Provide the Engineer unrestricted access and provide necessary assistance to review data, measurements, observations, and other records including but not limited to visual access

to real-time operator controls, locator's screens, gauges, and indicators during drilling operations.

B. Control Drilling Fluid pressures, Drilling Fluid weights, drilling speed, and other operational factors to prevent Drilling Fluid loss to the surrounding formation.

C. Use a Gyroscopic Tracking or Magnetic Wireline system to track the pilot bore.

D. Use an electronic monitoring system to record Drill Log and Tracking System data. Maintain a log of the electronic data and make it available for review by the Engineer.

3.5 EXCAVATION

A. Excavate any approach trenches and Mud Circulation Pits in accordance with shop drawings and as site conditions require.

B. Provide Mud Circulation Pits at either end of the Borehole.

C. Maintain clean working conditions at all times at the job site. All excavated soil, and any other material not required for construction, shall be removed from the excavation area in a timely manner.

D. Safety fencing shall be installed around the perimeter of the Mud Circulation Pits during nonworking hours.

E. Restore areas after completion of HDD and Carrier Pipe installation.

3.6 CONDUCTOR CASING AND BACKFILL GROUTING

A. See Specification 33 05 23.1 for installation procedures.

B. Install and use drill pipe centralizers to center the drill pipe within the Conductor Casing during the entire HDD operation.

C. Install Conductor Casing prior to the Pilot Bore and Reaming.

3.7 PILOT BORE AND REAMING

A. Do not begin HDD Pilot Bore operations until as-builts of the Conductor Casings have been submitted and approved by Engineer and Owner.

B. Calibrate Tracking System equipment prior to beginning the Pilot Bore.

C. Perform Borehole excavation operations in a manner that will minimize loss of ground and minimize settlement of the ground surface, structures, and utilities above and adjacent to the alignment.

D. Furnish all manpower and equipment required to perform the Carrier Pipe installation. The operation shall include all excavation, Pilot Bore, Reaming, Borehole conditioning, Swab Pass, and Pullback operations.

E. Install and operate HDD equipment and support utilities as necessary for the proposed construction and the safety of workers in accordance with project requirements and all Federal, State, and local laws, regulations, and codes.

F. Mix Drilling Fluids to suit the proposed drilling application and the subsurface materials to be encountered. Drilling Fluids shall be used and mixed in full accordance with the Drilling Fluid manufacturer's instructions.

G. Drilling shall be conducted with controlled Drilling Fluid and advancement rates to minimize Borehole annular pressures and prevent excavation at a rate not able to be maintained by the mud pump or Mud Recycling System. The Contractor is encouraged to retract drill pipe during the Pilot Bore and Ream Passes as necessary to facilitate cleaning of any settled cuttings from the Borehole as a means of lessening annular pressures and improving mud circulation.

H. Drilling Fluid shall be used during Pilot Bore, Reaming, Swabbing, and Pullback. Drilling Fluid shall be present within the Borehole to the extent possible throughout the HDD operation. Sufficient Drilling Fluid shall be mixed to ensure this requirement is satisfied.

I. Drill Pilot Bore with vertical and horizontal alignment as indicated on Drawings, within the tolerances specified herein.

J. Guide and monitor the Pilot Bore using the accepted Tracking System.
1. Record and plot the horizontal and vertical alignment at least once per each drill pipe, including position of the Drill Head relative to the ground surface. Update daily during the Pilot Bore, at minimum.
2. Adjust Drill Head orientation to maintain design alignment.
3. Calibrate and verify electronic monitor accuracy in presence of Engineer. When required accuracy is not met, adjust equipment or provide new equipment capable of meeting required accuracy.

K. Continuously monitor Drilling Fluid pumping rate and pressure while drilling Pilot Bore, Reaming, Swabbing, and installing Carrier Pipe to ensure adequate removal of soil cuttings and stabilization of the Borehole.
1. At minimum, monitor sand content, unit weight or density, and viscosity of the Drilling Fluid no less than once every two hours during HDD operations.
2. Theoretical cutting return pressures and IR pressures are provided in the design calculations for reference, subject to verification per Part 1.07A.

L. After completing the Pilot Bore, the Borehole shall be enlarged using progressively larger Reamers. Be responsible for conditioning the Borehole as necessary prior to the installation of the Carrier Pipe.
1. If the Pilot Bore is sufficiently off line and grade such that the Carrier Pipe will not meet the tolerances specified herein, a new Pilot Bore meeting the line and grade tolerances specified herein shall be drilled.
2. The minimum diameter of the final conditioned Borehole shall be 36 inches.
3. A minimum of one Swab Pass is required to prove the Borehole has been properly conditioned for Pullback. The Swab Pass shall be completed after

Reaming and prior to Pullback. The Swab Pass shall be completed with the tooling described in the Contractor's approved submittals.

M. Assume liability for loss or damage to down-hole equipment.

3.8 DRILLING OBSTRUCTIONS

A. When obstructions are encountered during drilling, notify the Engineer immediately. Do not proceed around obstruction without Engineer's approval.

B. Maintain adjusted bore alignment within easement or right-of-way.

3.9 DELIVERY, STORAGE, AND HANDLING

A. Transport, handle, and store Carrier Pipe and fittings as recommended by the manufacturer.

B. Carrier Pipe and fittings that are damaged before or during installation shall be repaired or replaced, as recommended by the manufacturer or required by the Engineer. Be responsible for costs of such repair or replacement. Repair or replace damaged Carrier Pipe and fittings prior to proceeding with the project.

C. Deliver, store, and handle other materials as required to prevent damage. Repair or replace materials that are damaged or lost at no additional expense to the Engineer or Owner.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping system pieces from entry of foreign materials and water by temporary covers, completing sections of work, and isolating parts of completed system.

F. Accept products on site in manufacturer's original containers or configuration. Inspect for damage.

G. Support pipes with nylon slings during handling.

3.10 HDPE CARRIER PIPE FUSION PROCESS

A. Carrier Pipe shall be fused according to manufacturer's recommendations.

B. Carrier Pipe shall be assembled and staged in such a manner as to not obstruct or impact traffic or third parties within the easement limits presented on the Contract Drawings.

3.11 PULLBACK

A. Do not proceed with Pullback without an accepted submittal of the Pilot Bore as-built profile and alignment.

B. Pullback operations shall be carried out as soon as possible, and within 24 hours, following the final Swab Pass of the Borehole. Once Pullback has begun, the Contractor shall continue Pullback operations without interruption regardless of the day of week or hour of the day. A Pullback head shall be attached to the Carrier Pipe and connected to the drill pipe with a Swivel. The Pullback head shall be closed to prevent Drilling Fluid from entering the Carrier Pipe during Pullback and be fixed to the Carrier Pipe in accordance with pipe Manufacturer or supplier's recommendations.

C. Do not damage the Carrier Pipe during installation.

D. Do not exceed pipe manufacturer's recommended maximum Pullback forces.

E. Ballasting for the Carrier Pipe is required to decrease the Pullback load and stresses on the Carrier Pipe. A minimum of 2,000 feet of the pipeline alignment shall be ballasted during Carrier Pipe Pullback.

F. Limit the minimum Carrier Pipe bend radius to greater than the pipe manufacturer's recommended maximum bending radius during handling and installation.

G. Install continuous tracer wire without splices. Tape or insulate tracer wire to prevent corrosion and maintain integrity of pipe detection.
1. Terminate tracer wire at structures along pipeline system.
2. Provide extra length of tracer wire at each structure, so trace wire can be pulled three feet out top of structure for connection to detection equipment.
3. Test tracer wire for continuity before acceptance.

H. At completion of Pullback, the Carrier Pipe shall extend a minimum of 10 feet past connection locations, or as recommended by the Carrier Pipe manufacturer, whichever is greater. The Carrier Pipe shall not be allowed to be sucked back below the Borehole entry or exit elevations during the recovery period.

I. Allow minimum of 24 hours for Carrier Pipe relaxation after Pullback before making connections, or as recommended by the Carrier Pipe manufacturer, whichever is greater.

J. Be responsible for damage to the Carrier Pipe resulting from inadequate Reaming or Pullback operations.

3.12 DRILLING FLUID REMOVAL AND DISPOSAL

A. Contain excess Drilling Fluids at Borehole entry and exit sites.

B. Remove, transport, and legally dispose of drilling spoils.
1. Do not discharge drilling spoils in sanitary sewers, storm sewers, or other drainage systems.

C. Should Drilling Fluid spills or an IR occur, immediately contain the Drilling Fluid and barricade area from vehicular and pedestrian travel before resuming HDD operations.

D. Cleanup any surface Drilling Fluid at end of each workday, excepting fenced off Mud Circulation Pits and the Mud Recycling System.

3.13 BACKFILL

A. Install backfill as specified in Contract Documents.

B. Backfill approach trenches and Mud Circulation Pits to contours and elevations of surrounding existing grade.

3.14 INSTALLATION TOLERANCES

A. The as-built alignment shall be within 1-foot of the entry and exit locations as identified on the Construction Drawings. The as-built alignment shall have a maximum horizontal variation of 10 feet from the Construction Drawings or within provided easements, whichever is more restrictive. The as-built alignment shall have a maximum vertical elevation deviation of 10 feet from the Construction drawings.

B. Alignment shall be sufficiently true and accurate to design to allow HDD operations through Conductor Casings at both entry and exit points.

C. Under no circumstances shall the installed Carrier Pipe be outside of established easements as shown in the Contract Drawings.

D. Minimum horizontal and vertical clearance from other utilities: 48 inches.

E. When Carrier Pipe installation deviates beyond specified tolerances, remove installed Carrier Pipe, re-drill the Pilot Bore, Ream the Borehole to the specified requirements, and reinstall Carrier Pipe meeting the specified tolerances. Reinstallation of Carrier Pipe shall be at the Contractor’s sole expense.

3.15 SAFETY REQUIEMENTS

A. Methods of construction shall ensure the safety of the work, project participants, the public, third parties, and adjacent properties, whether public or private. All work shall conform to the requirements of all Federal, State, and local laws and regulations. The Contractor is solely responsible for maintaining safe working conditions at the site at all times.

B. Designate a Safety Officer. The Safety Officer shall administer an accident prevention program and shall prepare a code of safe practices and an emergency plan. Hold safety meetings daily prior to initiating work and provide safety instruction for new employees.

C. Fire Prevention and Control. All construction shall be performed in accordance with the applicable fire prevention and control requirements of all Federal, State, and local agencies.

3.16 CLEANUP AND RESTORATION

A. Upon completion of HDD and Carrier Pipe installation, remove drilling spoils, Drilling Fluids, debris, and unacceptable material from approach trenches and Mud Recycling Pits. Clean up slurry and Drilling Fluid from the ground to preconstruction conditions or better. Dispose of Drilling Fluids and cuttings at an approved site or facility. All fees and

costs related to the collection, transport, and disposal of fluids, cuttings, and debris and any related permit costs shall be the Contractor's responsibility. During transport, all fluids shall be contained in steel tanks or other suitable vessels.

B. Restore approach trenches and Mud Recycling Pits to original condition.

C. Remove temporary facilities used during drilling operations.

D. Fill any abandoned Boreholes with grout or flowable fill material.

E. Remove all equipment and debris from the site at the end of the job. Restoration shall follow construction as the work progresses and shall be completed as soon as possible. Any property or improvements damaged or destroyed shall be restored to a condition equal to or better than existing prior to construction at no additional cost to the Owner as approved by the Engineer and Governing Agency(s). Restoration shall be completed immediately if a third party or the Owner is inconvenienced by the damage, and in no case later than 30 days after the damage is discovered. The provision for restoration shall include all property which was affected by the construction operations.

3.17 CONSTRUCTION RECORDS

A. Maintain Daily Shift Reports for all components and phases of the Work. The reports shall be signed by the site superintendent or shift foreman, submitted to the Engineer within 24 hours of completed daily work, and shall contain the following:
1. Contractors onsite with their personnel and equipment, and the work performed. The reports shall be broken down into work time and down/standby time for each Contractor.
2. Work crews and equipment onsite, and the work performed. The reports shall be broken down into work time and down/standby time for each crew and piece of equipment.
3. Progress made for each construction stage.
4. Problems or unusual conditions encountered, and actions taken to address these situations.
5. Record of safety meetings conducted.
6. List of visitors to construction site.

B. Maintain Drill and Drilling Fluid Logs including but not limited to the following:
1. The station of the excavation and advance distance with respect to drill pipe count and date and time.
2. Drilling data for each drill pipe including but not limited to advance rate (min per drill pipe), torque (ft-lbs), thrust (lbs), Drilling Fluid injection flow rate (GPM), depth or inclination and measured distance, azimuth and measured distance or offset left/right, and Drilling Fluid pressure (psi). Drilling data shall be digital and recorded by the drill rig and ancillary equipment.
3. Drilling Fluid percent sand content, weight, and viscosity measured every two hours, at minimum.
4. The position of the drill path in relation to the design line and grade as measured during the Pilot Bore installation.
5. The date, starting time, and finish time.

6. Any unusual conditions, breakdowns, and delays.

C. Keep and maintain at the construction site a complete set of field drawings for the recording of as-built conditions. It shall be marked or noted thereon all field information, properly dated, recording up-to-date as-built conditions. As-built drawings shall be submitted and accepted by the Owner prior to recommending final payment.

D. Annular space grouting records, indicating the location along the borepath where grout has been applied and the volume of grout applied at each location.

E. Pressure test and deflection test logs with testing data and results.

3.18 PROGRESS MEETINGS

A. Contractor's onsite foreman to attend weekly hour-long construction meetings in person or digitally during a time frame of two weeks before the active HDD operations to two weeks after the active HDD operations.

END OF SECTION

SECTION 33 05 23.1
CONDUCTOR CASING INSTALLATION AND BACKFILL

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section presents requirements for Conductor Casing installation and Backfill Grouting requirements associated with the work, including furnishing all labor, equipment, and materials.

1.2 RELATED WORK

A. Related documents and Specification Sections include but are not limited to:
1. 33 05 23 Horizontal Directional Drilling (HDD)
2. Geotechnical Data Memorandum (GDM), Lithos Engineering
3. IR and Pull Force Calculations, Lithos Engineering
4. Geotechnical Engineering Services Report, GeoTest (March 2022)
5. Subsurface Exploration and Geotechnical Engineering Report, Inberg-Miller Engineers (March 2023)

1.3 DEFINITIONS

A. ANNULAR SPACE: The space between the inner diameter of the Conductor Casing and the outside diameter of the Carrier Pipe.

B. BACKFILL: Filling of the Annular Space between the Conductor Casing and Carrier Pipe.

C. BACKFILL GROUT: Flowable material to be used in the Backfill operations; Cellular Grout.

D. BULKHEAD: Material placed between the Carrier Pipe and the Conductor Casing used to contain the Backfill Grout during placement. Bulkheads are required at the ends of the Conductor Casing where the Carrier Pipe is connected to the remainder of the pipeline.

E. CARRIER PIPE: The proposed pipeline to be installed via HDD and used for conveyance of pressurized water; HDPE pipe.

F. CASING PIPE: See Conductor Casing.

G. CELLULAR GROUT: A low density, lightweight, cementitious material that contains stable air or gas cells as preformed foam uniformly distributed throughout the mixture.

H. CONDUCTOR CASING: Steel Casing Pipe installed at both ends of the HDD alignment through which the HDD operation is conducted. The Conductor Casing provides an artificial borehole boundary that prevents inadvertent return of Drilling Fluids and provides borehole stability for circulation of the Drilling Fluids and Pullback of the Carrier Pipe.

I. CUTTING SHOE: Reinforcement provided at the leading edge of the Casing Pipe string, which provides support, rock breaking capabilities, and is beveled to direct muck into the Casing Pipe during installation.

J. OBSTRUCTION: Objects or portions of objects located within the cross-sectional area of the excavation face. An Obstruction shall be defined as:
1. Makes further advancement of the Conductor Casing impossible using techniques typically used for the current installation and excavation method; and
2. Consists of steel, concrete, brick, timber, rubble, or other artificial material.

K. PIPE RAMMING: The trenchless installation of a Casing Pipe using a pneumatically powered percussive hammer with selective removal of soil from inside the Casing Pipe.

L. SOIL PLUG: Compacted ground materials inside the Casing Pipe that forms a stable excavation face. The length of the Soil Plug may vary as required by ground conditions and is intended to prevent an uncontrolled loss of material through the Casing Pipe leading to over excavation. Soil Plugs and artificial plugs serve a similar purpose.

1.4 REFERENCES

A. ASTM International:
1. A252 – Standard Specification for Welded and Seamless Steel Pipe Piles
2. C495 – Standard Test Method for compressive strength of lightweight insulating concrete.
3. C796 – Standard Test Method for foaming agents for use in producing Cellular Grout using preformed foam.
4. C869 – Standard Specification for foaming agents used in making preformed foam for Cellular Grout.
5. C939 – Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
6. D4832 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material Test Cylinders
7. D5971 – Standard Practice for Sampling Freshly Mixed Controlled Low-Strength Material
8. D6023 - Standard Test Method for Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material

B. ANSI:
1. ANSI/AWS D1.1 Structural Welding Code

1.5 GENERAL REQUIREMENTS

A. Be responsible for installation of Conductor Casings, performance of the excavation, and Backfill Grouting procedures.

B. Minimum design requirements are presented herein. Be responsible for developing and implementing the design to fulfill the specified design requirements provided by the Engineer which are necessary for completion of the work.

C. Perform Conductor Casing installation in accordance with all Governing Agencies, applicable permits and requirements, and all applicable laws and regulations.

D. Be responsible for design and execution of Backfill Grouting the annulus between the Carrier Pipe and the Conductor Casing.

1.6 QUALIFICATIONS

A. Contractor: The Contractor directly engaged in Conductor Casing installation will have completed at least three projects during the past five years using similar installation methods in similar ground conditions. The Contractor for Conductor Casing installation can be the same as the HDD Contractor if all requirements are met.

B. The onsite foreman for Conductor Casing installation shall have:
1. At least five years of construction experience with excavation and casing installation.
2. Successfully completed at least two similar jobs within the last five years using similar installation methods in similar ground conditions.

C. Designate a Backfill Grouting Expert. The Expert will have the following experience, at minimum:
1. Successfully completed at least two similar projects in which the annulus between the Carrier Pipe and Conductor Casing was Backfilled with Cellular Grout.
2. Be thoroughly knowledgeable about mixing, pumping, and placement of Backfill Grout.

D. All personnel employed by the Contractor in the work shall be experienced and competent in their respective tasks and shall work only under the direct control of a suitably experienced Superintendent.

1.7 SUBMITTALS

A. Preconstruction: Submit to the Engineer the following a minimum of two weeks before the scheduled start of the applicable activity. Conductor Casing installation and Backfill Grout submittals may be submitted separately.
1. Conductor Casing Installation:
    a. Submit Qualifications as stated in Section 1.06.
    b. Work Plan. Submit a detailed work plan of all proposed Conductor Casing construction operations. Include a description and drawings of proposed methods and procedures for:
        1) Shop drawings of the Conductor Casing and reinforcement to the penetrating end or Cutting Shoe.
        2) Working drawings including work area layouts, ancillary equipment, and limits of construction.
        3) Installation and excavation equipment to be used including manufacturer literature, drawings, as-builts, modified dimensions, and capacities.
        4) Line and grade control methods.

5) Line and grade surveying methods during installation.
6) Description of activities involved in a single cycle of Casing Pipe installation.
7) Description of how the Contractor will evaluate when to remove muck from the Conductor Casing and process for removing the muck.
8) Procedures for measuring excavated muck quantities versus the installed length or progress during installation operations.
9) Casing Pipe coupling methods to maintain Casing Pipe segment alignment during coupling and installation.
10) Hauling and disposal of excavated muck, including disposal site details.
11) Detailed contingency plans for the following:
    a) Obstructions (as defined herein) encountered during installation,
    b) Settlement and/or heave,
    c) Loss of line and grade during installation,
    d) Damage to the Cutting Shoe or leading edge of the Conductor Casing.
12) Plan for removing sacrificial portions of the Conductor Casings upon completion of HDD Pullback.

c. Schedule. A critical path schedule of Conductor Casing-related activities and activities for project components interfacing with the Conductor Casing. The schedule must be coordinated with the HDD Contractor. The schedule will include at a minimum:
   1) Work area set up.
   2) Anticipated daily production rate for Conductor Casing installation and excavation.

d. Removal of sacrificial portions of the Conductor Casing. Submit Manufacturer's written certifications that Casing Pipe materials meet or exceed the specified requirements as stated herein.

e. Prior to manned entry into the Conductor Casing, contractor's safety plan for personnel conducting tunneling operations including, but not necessarily limited to, provisions for ventilation, temperature control, lighting, electrical safeguards, safety of the public, monitoring, and warning systems.

f. Certifications of qualified welders where welding is required.

2. Backfill Grouting:
   a. Submit Qualifications as stated in Section 1.06.
   b. Schedule of Backfill Grouting activities.
   c. Description of equipment and methods proposed to mix Backfill Grout including:
      1) Mix design and results for the Backfill Grout including:
      2) Results of tests on trial batches conducted as part of grout mix design and pre-grouting testing including:
         a) Mix design including
            (1) Date of mix performed and reported
            (2) Mix number
            (3) Materials

(4) Sources
(5) Physical properties
(6) Compressive strength results
(7) Flowability

b) Mixing equipment
c) Quantity controls
d) Instrumentation
e) Description of trial batches, trial batch testing and proof of acceptable delivery and placement of Backfill Grout in the Conductor Casing. Results can include previous case histories where Backfill Grout was successfully placed in the Conductor Casing or trial testing performed prior to construction.

d. Description of injection methods for production Backfill Grout including:
1) Pumping equipment
2) Delivery equipment (tremie pipe, hoses, valves)
3) Pumping distances and delivery points
4) Flow rates
5) Pressures including maximum allowable injection and head pressure (if pump is used)
6) Bulkhead details
7) Proposed orientation of all grout and ventilation pipes.
8) Methods and description of instrumentation to monitor and control placement of the Backfill, and procedures to be used to verify Backfill volumes.

e. HDPE Carrier Pipe manufacturer certification letter stating that the proposed Backfill materials and methods are acceptable for the Carrier Pipe type.

B. Construction Submittals shall be digital and submitted to the Engineer every week and shall include at minimum:
1. Provide Daily Logs as specified in Section 3.08. Daily Logs are to be recorded by the Contractor's onsite personnel and signed by the Contractor's Superintendent for each shift.

C. Postconstruction:
1. Project Record Documents: provide an as-built plan and profile for the Conductor Casings. At minimum, a survey data point shall be obtained for the as-built casing at a maximum spacing equivalent to one stick of pipe.
2. Provide records as detailed in Section 3.08.

1.8 COORDINATION

A. Coordinate work with the Navajo Nation Governing Agency, local Municipal Public Works Department (if applicable), and utilities within construction area.

PART 2 EQUIPMENT, PRODUCTS, AND MATERIALS

2.1 EQUIPMENT

A. Provide the equipment necessary for installation of the Conductor Casing and Backfill Grouting and to complete all work associated with this section.

B. Conductor Casing installation equipment will have the following minimum attributes:
1. Be capable of controlling the ground during excavation and shutdown.
2. Be capable of being operated in a manner that will prevent loss of ground during excavation and have the ability to maintain line and grade within the tolerances specified.
3. The excavation and installation equipment will be capable of handling and removing all anticipated material documented in the GDM.
4. Have greater than 150 percent of the minimum ramming capacity required to install the Casing Pipe.

2.2 PRODUCTS AND MATERIALS

A. Provide the products and materials necessary for the installation of the Conductor Casing and Backfill Grouting and to complete all work associated with this section.

B. Conductor Casing (Casing Pipe)
1. Minimum diameter of 54 inches
2. Minimum wall thickness of 1.0 inches
3. At a minimum the Conductor Casing shall conform to ASTM A252 Grade 2 steel and be manufactured specifically for ramming.
4. Adhere to pipe manufacturer’s installation guidelines for:
   a. Handling;
   b. End preparations, mating procedures; and
   c. Installation.
5. The Casing Pipe will be round. Casing Pipe are required to have a roundness tolerance so that the difference between the major and minor outside diameters are not exceed to lesser of 1% of the specified nominal outside diameter or 0.25-inches.
6. Shall be constructed with a Cutting Shoe.

C. Casing Pipe Joints shall be welded with a full penetration butt weld in accordance with ANSI/AWS D1.1.
1. The joints are to be in accordance with the pipe manufacturer’s specifications and guidelines for rammed pipe.

D. Backfill Grout
1. Grout will be Cellular Grout and include a mix of cement and water.
   a. Portland Type I/II cement
   b. Foaming agent shall be in accordance with ASTM C869.
      1) Test in accordance with C796.
   c. Use only potable water. Alternative water sources may be utilized with the approval of the Engineer.

2. Typical penetration resistance of 100 psi or greater in 24 hours when tested in accordance with ASTM C403.
3. Typical minimum compressive strength of 300 psi in 28 days when tested in accordance with ASTM C495.
4. Grout shall have a unit weight greater than HDD drilling fluid.
5. Have a heat of hydration that will not weaken or otherwise harm Carrier Pipe materials.
6. Flowable through delivery lines.

E. Bulkhead Closure
1. Provide Bulkheads at the ends of the Casing Pipe to prevent spill out of the Backfill Grout.
2. Provide venting at the crown of the annulus between Carrier Pipe and Casing Pipe at the highest elevation to ensure the tunnel is fully evacuated of water/air and filled with grout.
3. Brick and mortar, concrete, or Engineer approved equivalent will be used for the Bulkhead.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Do not begin Conductor Casing installation until:
1. Required preconstruction submittals have been made and the Engineer has reviewed and accepted submittals in writing.
2. All required permits are in place and the Governing Agency has been satisfactorily notified of the schedule and work.
3. Existing utilities near the proposed alignment have been identified both horizontally and vertically.

B. Perform construction in a manner that will minimize loss of ground and minimize settlement or heave of the ground surface, structures, utilities, and other facilities above and adjacent to the Conductor Casing.

C. Maintain clean working conditions at all times inside and around the work area. All excavated muck, and any other material not required for installation of the Conductor Casing are to be removed from the excavation in a timely manner.

D. Design, install and operate support utilities as necessary for support of construction and the safety of workers in accordance with project requirements and all Federal, State, and local laws, regulations, and codes. Utilities include but are not limited to electrical, lighting, water, and ventilation.

3.2 CONDUCTOR CASING INSTALLATION

A. Install the Conductor Casing using Pipe Ramming techniques.

B. Position the hammer at the appropriate incline to develop a uniform distribution of ramming forces around the circumference of the pipe. Casing Pipe segment guide rails or

the HDD rig main beam are to be positioned to ensure correctness of line and grade as indicated in the Construction Drawings. Casing Pipe is to be securely fastened to the hammer such that the Casing Pipe is in full contact with the hammer continuously during hammering operations.

C. Control the advance, volume of material excavated, and size of the Soil Plug to prevent the loss of ground and heave.

D. Limit the ramming force to stay at or below the safe working limit of the Casing Pipe.

E. After HDD operations and Carrier Pipe pullback, remove sacrificial portions of the Conductor Casings so that tie-ins to the pipeline can be made.

3.3 OBSTRUCTION DURING INSTALLATION

A. Remove, clear, or otherwise make it possible for Conductor Casing to progress past, or through an Obstruction in accordance with the Contractor's submitted contingency plan.

B. Additional payment for Obstruction removal will be made if the object is found to meet the definition of an Obstruction and subject to the following requirements:

1. Notify the Owner in writing on the same calendar day as encountering the Obstruction.
2. Notify and obtain approval from affected Governing Agencies of the intent to excavate to remove the Obstruction if excavation is necessary within the right-of-way limits of affected Governing Agencies.
3. Submit a complete plan for removal of the Obstruction including estimated time and costs to the Owner prior to starting Work to remove the Obstruction.
4. Upon written authorization by the Owner, proceed with removal of the Obstruction by means of the approved removal procedure.
5. No excavation to remove the Obstruction will be allowed without the Owner being present.

3.4 LINE AND GRADE TOLERANCES

A. At a minimum, the Conductor Casing is to be within 2% of the total length of the design line and design grade, or sufficiently true and accurate to the design alignment and profile to allow for an accurate HDD alignment and placement of the Carrier Pipe. Installed Conductor Casings not meeting the tolerances indicated will be reconstructed or replaced at the Contractor’s cost.

B. The Contractor is responsible for setting control points and controlling the line and grade of the Conductor Casing as necessary to achieve the specified line and grade within the tolerances.

C. Do not begin HDD pilot bore operations until as-builts of the Conductor Casings have been submitted and approved by Engineer and Owner.

3.5 BACKFILLING METHODS

A. Do not commence with Backfill Grouting until the Carrier Pipe is appropriately in place.

B. Grout between the HDPE Carrier Pipe and the Conductor Casings as shown on the Contract Drawings.

C. The Carrier Pipe shall be filled with water at all times during Annular Space grouting. Under no circumstances shall grouting pressures cause deflection or damage to the Carrier Pipe.

D. Grout shall be placed using a tremie system to displace drilling fluid from within the Annular Space between the Conductor Casing and HDPE Carrier Pipe.

E. Backfill grout shall not be subject to free fall greater than 10 feet.

F. Monitor the volume of grout pumped and the amount of displaced drilling fluid.

G. The pressure of the Backfill Grout against the Carrier Pipe shall not exceed manufacturer limitations at any time and at any location.

H. If the complete filling of the annulus and voids is not verified during Backfilling, conduct a secondary grouting program to fill the remaining annulus and voids.

3.6 QUALITY CONTROL

A. Perform all Conductor Casing Installation and Backfill Grouting work in the presence of the Engineer unless the Engineer has granted prior approval in writing to perform such work in their absence.

B. Backfill Grout Mix Design:
1. Test methods are to be in accordance with ASTM C495. Cast specimens into cylinders at least 3 inches in diameter by 6 inches tall.
2. A minimum of four specimens will be made for compression testing. Test a minimum of two specimens at an age of 7 days and a minimum of two specimens at an age of 28 days.
3. Conduct set of index tests from the first batch of Backfill Grout mixed each day, after a change in mix design, and from each batch of Backfill Grout from which compression test specimens are made within two hours from each batch.
    a. Include as a minimum the following index tests at the time of placement:
        1) Wet unit weight (wet density)
        2) Ambient temperature
        3) Grout temperature
        4) Efflux time through Flow Cone

3.7 CLEANUP AND RESTORATION

A. Remove all equipment, unused materials, and debris from the site once the required work has been completed. Restoration will follow construction as the work progresses and be completed as soon as possible. Restore and repair any damage resulting from surface settlement or heave caused by the work immediately. Any property or improvements damaged or destroyed, will be restored to a condition equal to or better than existing prior to construction at no additional cost to the Owner. Restoration will be completed immediately if a third party or the Owner are inconvenienced by the damage and in no

case later than thirty days after the damage is discovered. This provision for restoration includes all property which was affected by the construction operations.

3.8 CONSTRUCTION RECORDS

A. Maintain Daily Logs for all components and phases of construction. Submit Daily Logs weekly to the Owner or Engineer. The Daily Logs are to be signed by the site Superintendent and contain the following:

1. Contractors or subcontractors onsite with their personnel and equipment, and the work performed. The reports are to be broken down into work time and down/standby time for each Contractor or subcontractor;
2. Progress made for each construction stage;
3. All Survey results;
4. Problems or unusual conditions encountered and actions taken to address these situations;
5. The effectiveness of the Contractor's dewatering system, if applicable;
6. A general summary of daily construction activities;
7. List of visitors to construction site; and,
8. Ramming records, including but not limited to:
    a. The station of the face of the excavation and advance distance;
    b. A summary of encountered ground type, conditions, behavior;
    c. The position of the Conductor Casing face in relation to the design line and grade;
    d. The date, starting time, and finish time for each shift;
    e. The type, size, condition, and length of any Soil Plug or artificial plug and the corresponding advance distance of the Conductor Casing face
    f. The length of any intermediate auger cleanouts correlated with the date and advance distance of the Conductor Casing face;
    g. Any inconsistencies such as unusual initial support lengths, unusual conditions, breakdowns, deformations, and delays; and
    h. Excavated muck quantity.
    i. Compressor(s) used and rated air flow;
    j. Compressor(s) operating pressure in Pounds per Square Inch (psi) of air delivered to the hammer;
    k. Stokes per minute of the hammer;
    l. Advance rate in minutes per foot of Casing Pipe advancement; and
    m. Line and grade.
9. Record of annular sealing materials and configuration of the Bulkheads;
10. Volume of Backfill Grout installed;
11. Materials testing results including index testing and specimens.

B. Construction Record Drawings. Keep and maintain at the construction site a complete set of final design drawings for recording as-built conditions. It will have been marked or noted thereon all field information, properly dated, recording as-built conditions. This set of field drawings will be kept up-to-date during construction. The record drawings will be updated at least once every week to current conditions. The record drawings will contain the following as a minimum:

1. Locations (line and grade) of the installed Conductor Casing as required herein.

C. As-built drawings are to be submitted and accepted by the Engineer prior to recommending final payment.

3.9 PROGRESS MEETINGS

A. Contractor's onsite foreman to attend weekly hour-long construction meetings in person during a time frame of two weeks before the active construction to two weeks after the active construction.

END OF SECTION

SECTION 33 11 13

PUBLIC WATER TRANSMISSION SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings for public line including potable water line.
2. Tapping Sleeves and Saddles.
3. Underground and Aboveground Pipe Markers.
4. Bedding and Cover Materials.
5. Source Quality Control and Assurance.

B. Related Sections:

1. Section 02 21 13 - Surveying.
2. Section 03 30 00 - Cast-in-Place Concrete
3. Section 31 23 17 - Trenching: Execution requirements for trenching.
4. Section 31 23 23 - Backfill: Requirements for backfill to be placed.
5. Section 32 92 19 - Seeding.
6. Section 33 12 16 - Water Utility Valves.
7. Section 33 13 00 - Disinfection of Water Utility Transmission Systems.

1.2 DEFINITIONS

A. Throughout the Drawings and Specifications, the terms “jointed PVC pipe” and “bell-and-spigot PVC pipe” shall be used interchangeably.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Pipe and Fittings:

1. Basis of Measurement: Incidental to HDD and valve installation bid items.
2. The cost of work associated with hydrostatic pressure testing for main pipeline and wash crossings shall be paid via a separate bid item.
3. The cost of work associated with disinfection and bacteriological testing for main pipeline and wash crossings shall be paid via a separate bid item.
    a. Laboratory costs associated with bacteriological testing shall be considered incidental and are not eligible for reimbursement under the testing allowance.

1.4 REFERENCES

A. Contractor shall refer to the latest revision of all standards listed herein.

B. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

C. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard

D. American Society for Testing and Materials International (ASTM):

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. ASTM A139 – Standard Specification for Electric Fusion (Arc) Welded Steel Pipe
5. ASTM A283 – Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
6. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
7. ASTM F593 – Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
8. ASTM F594 – Standard Specification for Stainless Steel Nuts.
9. ASTM A1011 – Standard Specification for Steel, sheet and strip, Hot Rolled, Carbon, Structural, High Strength Low Allow, High Strength Low Alloy with Improved Formability, and Ultra High Strength
10. ASTM A1018 – Standard Specification for Steel, Sheet and Strip, Heavy Thickness Coils, Hot Rolled, Carbon, Commercial, Drawing, Structural, High Strength Low Alloy, High Strength Low Allow with Improved Formability, and Ultra High Strength
11. ASTM B843 – Standard Specification for Magnesium Alloy Anodes for Cathodic Protection
12. ASTM D653 - Terminology Relating to Soil, Rock, and Contained Fluids.
13. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))
14. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
15. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

16. ASTM D2152 - Test Method for Degree of Fusion of Extruded Poly (Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion
17. ASTM D2467 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
18. ASTM D2487 - Classifications of Soils for Engineering Purposes (Unified Soil Classification System).
19. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings.
20. ASTM D2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping
21. ASTM D3035 – Standard Specification for Polyethylene Plastic Pipe (DR PR) Based on Controlled Outside Diameter
22. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
23. ASTM D3363 – Standard Test Method for Film Hardness by Pencil Test
24. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
25. ASTM D4752 – Standard Practice for Measuring MEK Resistance of Ethyl Silicate Zinc Rich Primers by Solvent Rub ASTM D638 – Standard Test Method for Tensile Properties of Plastics
26. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
27. ASTM E165 – Standard Practice for Liquid Penetrant Examination for General Industry
28. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
29. ASTM F1057 - Standard Practice for Estimating the Quality of Extruded Poly (Vinyl Chloride) (PVC) Pipe by the Heat Reversion Technique
30. ASTM F2164 – Standard Practice for Field Leak Testing of Polyethylene Pressure Piping Systems Using Hydrostatic Pressure
31. ASTM F2620 – Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
32. ASTM F2634 - Standard Test Method for Laboratory Testing of Polyethylene (PE) Butt Fusion Joints using Tensile-Impact Method

E. American Water Works Association (AWWA):

1. AWWA C110/ ANSI A21.10 - ANSI Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In. (76 mm through 1,219 mm), for Water.
2. AWWA C116 – Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service
3. AWWA C153 - ANSI Standard for Ductile-Iron Compact Fittings for Water Service.

4. AWWA C200 - Steel Water Pipe 6 In. (150 mm) and Larger.
5. AWWA C206 - Field Welding of Steel Water Pipe.
6. AWWA C207 - Steel Pipe Flanges for Waterworks Service - Sizes 4 In. through 144 In. (100 mm through 3,600 mm).
7. AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings.
8. AWWA C209 - Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
9. AWWA C210 – Standard for Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
10. AWWA C213 - Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
11. AWWA C219 – Standard for Bolted, Sleeve-Type Couplings for Plain-End Pipe.
12. AWWA C224 – Nylon Based Polyamide Coatings and Linings for Steel Water Pipe and Fittings.
13. AWWA C605 - Underground Installation of Polyvinyl Chloride PVC Pressure Pipe and Fittings for Water.
14. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. through 60 In. (100 mm through 1,500 mm), for Water Transmission and Distribution.
15. AWWA C901 - Polyethylene Pressure Pipe and Tubing, 1/2 In. through 3 In. (13 mm through 76 mm), for Water Service.
16. AWWA C906 - Polyethylene Pressure Pipe and Fittings, 4 In. through 63 In. (100 mm through 1,575 mm), for Water Distribution and Transmission).
17. AWWA M11 – Steel Pipe: A Guide for Design and Installation
18. AWWA M23 – PVC Pipe – Design and Installation
19. AWWA M55 – HDPE Pipe: Design and Installation

F. NACE International (NACE)

1. SP0169 – Control of External Corrosion on Underground or Submerged Metallic Piping Systems
2. TM0497 – Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems
3. SP0274 – High-Voltage Electrical Inspection of Pipeline Coatings Prior to Installation.

G. Manufacturer’s Standardization Society of the Valve and Fittings Industry:

1. MSS SP-60 - Connecting Flange Joint between Tapping Sleeves and Tapping Valves.

H. Society for Protective Coatings:

1. SSPC-SP5 White Metal Blast Cleaning

I. National Fire Protection Agency

1. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

J. NSF International Standard / American National Standard (ANSI)

1. NSF/ANSI 61 – Drinking Water System Components – Health Effects.

K. National Association of Pipe Fabricators

1. NAPF 500 – Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings.

L. American Welding Society

1. AWS D1.1 – Structural Welding Code

1.5 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on pipe materials, pipe fittings, and accessories.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

D. In addition to the submittal requirements listed above, Contractor shall also submit:

1. Shop drawings for any custom-fabricated steel fittings which clearly show compliance with AWWA M11, AWWA C207 and AWWA C208. Include design calculations, as applicable.

2. Submittal for all coatings which demonstrate compliance with relevant AWWA and NACE standards.

3. As-built drawings and any Subcontractor-provided survey data. Refer to Sections 01 78 30 Project Record Drawings and 01 71 20 - Surveying.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Execution Requirements: Requirements for submittals.

B. Project Record Documents: Refer to Sections 01 00 00 – Basic Requirements and 02 21 13 – Surveying.

1. All HDPE joint fusion documentation and fusion machine data logs shall be submitted to Engineer with project record documents, in addition to ongoing data log and analysis submittals during construction process.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with the most recent edition of New Mexico Standard Specifications for Public Works Construction, with latest revisions.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 00 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Block individual and stockpiled pipe lengths to prevent moving.

C. Do not place pipe or pipe materials on private property without prior authorization, or in areas obstructing pedestrian or vehicular traffic.

D. Store PVC materials out of sunlight. Contractor shall, at Contractor's expense, provide and maintain tarps, temporary shelters, or other such measures as necessary to protect PVC materials from sunlight. Such tarps or shelters must be adequately vented to prevent excess heat accumulation

1. Any PVC materials judged by the Engineer to be sun-damaged, including tan to brown discoloration, blistering, roughening or cracking of surface, or embrittlement, prior to installation shall be rejected.

E. Coated pipe shall be shipped on bunks and secured with nylon belt tie down straps or padded banding over braces, and shall be stored on padded skids or other suitable means to prevent damage to coating.

F. Coated pipe and other components shall be handled with wide belt slings, padded forks or other means to prevent damage to coating. Chains, cables or other equipment likely to damage coating or pipe shall not be used.

G. PVC pipe shall be bundled or stacked throughout the shipping, storage and handling process in accordance with AWWA M23 and pipe supplier's recommendations, whichever is most stringent. Excessive bundling or stacking that results in bends, kinks, gashes or uncorrectable ovality shall be rejected. Transport and handle pipe in accordance with AWWA M23 and pipe supplier's recommendations, whichever is most stringent. Off-loading devices such as chains, wire rope, chokers, or other pipe handling implements that may scratch, nick, cut, or gouge the pipe are strictly prohibited.

1. Any pipe showing a crack, or which has received a blow that may have caused an incident fracture, even though no fracture can be seen, shall be rejected.

2. Any pipe with a scratch or gouge greater than 10% of the wall thickness will be rejected.

H. HDPE pipe shall be bundled or stacked throughout the shipping, storage and handling process in accordance with AWWA M55, PPI and/or manufacturer's recommendations, whichever is most stringent. Excessive bundling or stacking that results in bends, kinks or uncorrectable ovality shall be rejected. Transport and handle pipe in accordance with AWWA, PPI and/or manufacturer's recommendations, whichever is most stringent.

I. Prior to shipment and again prior to installation, all materials shall be visually inspected for damage, including coatings and surfaces. Any damaged materials shall be repaired to original standards or replaced.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 WATER PIPING AND FITTINGS

A. Polyvinyl Chloride (PVC):

1. All PVC pipe, whether jointed or fusible, shall conform to AWWA C900 and AWWA C905, on all PVC pipe 4” diameter and greater, and ASTM D1785, Schedule 80, on all PVC pipe less than 4” diameter. Testing shall be in accordance with the referenced AWWA standard for all pipe types.
2. All piping shall be made from PVC compound conforming to cell classification 12454 per ASTM D1784.
3. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.
4. Pipe shall be blue in color for potable water use.
5. Nominal laying length:
    a. Jointed PVC pipe: 20 feet.
6. Gasketed Joints:
    a. Joints per ASTM D3139.
    b. Use rubber gaskets manufactured and tested in accordance with ASTM F477.
    c. For all PVC casings at gasoline and petroleum line crossings or where otherwise indicated on Drawings, use petroleum-resistant gaskets in accordance with ASTM F477 or fusible PVC pipe joints.
7. Fittings:
    a. Ductile iron on all PVC pipe 4” diameter and greater.
        1) Refer to specifications for ductile iron fittings in this section, below.
    b. All PVC pipe and fittings less than 4” diameter shall be solvent welded Schedule 80.
    c. Solvent-weld joints are not permitted on pipe 4” diameter and greater.
8. Mechanical Joint Restraints:
    a. Refer to specifications for ductile iron joint restraints in this section, below.

B. Polyethylene Pipe:

1. AWWA C901-08 and ASTM D3035 for sizes up to 3” diameter; AWWA C906 (as applicable) for sizes 4” diameter and above.
2. Each production lot of pipe shall be tested for melt index, density, percent carbon, dimensions and ring tensile strength.
3. Polyethylene pipe and fittings shall be PE 4710 high-density polyethylene meeting ASTM D3350 cell classification PE445574C. The material shall be listed and approved for potable water in accordance with NSF Standard 61.

4. Not less than four permanent co-extruded, equally spaced, blue color stripes in outside surface of pipe.

5. Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock or molded fittings; rated for internal pressure service at least equal to the full service pressure rating of the mating pipe; and tested in accordance with AWWA C906.

    a. HDPE flange and mechanical joint adaptors shall be rated to the same pressure as the mating pipe. Steel slip-on flanges used in conjunction with HDPE flange adaptors shall comply with all specifications for steel flanges set forth in this section.

6. Polyethylene flange or MJ adapters made with sufficient through-bore to be clamped in a butt fusion-joining machine without use of a stub-end holder, as per pipe manufacturer's instructions.

7. All HDPE fabricated MJ adapters shall have stainless steel stiffeners.

8. HDPE pipe and fittings shall have a working pressure (as set forth in AWWA C906) of not less than 200 psi for DR 11, not less than 160 psi for DR 13.5, not less than 138 psi for DR 15.5, and not less than 125 psi for DR 17, with a recurring surge pressure allowance (total pressure) of 1.50 times working pressure and occasional surge allowance (total pressure) of 2.00 times working pressure (surge allowances shall be based on AWWA C906 and/or AWWA M55).

9. Nominal sizes indicated on Drawings for both pipe and fittings denote iron pipe size (IPS) unless otherwise noted.

10. All HDPE pipe and fittings shall be manufactured of PPI listed materials.

11. Pre-fabricated HDPE mitered bends and other fittings shall have internal weld bead completely removed prior to installation, using approved method for weld bead removal.

C. Ductile Iron Pipe, Joints, and Fittings:

1. Manufacturers:

    a. US Pipe

    b. American Pipe

    c. Substitutions: Approved Equal

2. Ductile iron pipe:

    a. To be used at pump station sites, and at site drain outfalls specifically identified as ductile iron on the drawings. Do not use ductile iron pipe at any other location without Engineer's prior written approval.

    b. Pipe Class: AWWA C151, for nominal thickness, rated water working pressure and maximum depth of cover.

    c. 350 psi working pressure.

    d. Cement Mortar Lining: AWWA C104, standard thickness.

    e. Exterior coating:

1) Buried service (site piping only): Bituminous coating, per AWWA C151.

2) Inside and underneath pumping station and surge tank buildings: TNEMEC N140 Pota-Pox Plus, rated for use in corrosive environments.

3. Fittings: Ductile iron.

a. Compact MJ fittings conforming to AWWA C153 or AWWA C110, unless otherwise noted on Drawings.

b. Flanged fittings shall conform to AWWA C110. Do not use flanged fittings for buried installations unless otherwise noted on Drawings.

1) Contractor responsible to ensure that all mating flanges have compatible diameters, bolt sizes and drill patterns. Overdrill bolt holes as necessary, provided such overdrilling is within manufacturer's recommended tolerances.

c. Pressure rating of MJ joints, fittings and gaskets shall be at least 350 psi, unless otherwise noted on the Drawings.

d. Pressure rating of flanged fittings and gaskets shall at least match that of the attached pipe, unless otherwise noted on the Drawings.

e. Marked with pressure rating, nominal diameter of opening, manufacturers' identification, country where cast, and degree of bend.

f. Coatings:

1) All interior and exterior surfaces shall be coated with fusion-bonded epoxy in accordance with AWWA C116.
2) All coatings shall be applied in strict accordance with coating manufacturer's recommendations.
3) All fusion-bonded epoxy coatings shall be factory tested holiday-free.
4) Encase in polyethylene as described in this section.

4. Joints:

a. Mechanical and Push-On Joints: AWWA C111. Only use where expressly allowed on the Drawings. No DI pipe joints shall be allowed underneath or within 5 feet of any structure.

1) All push-on joints shall be fully restrained

2) TR Flex restrained pipe joints

3) TR Flex lockers shall be ductile iron. Redwood or other materials shall not be allowed.

b. Flanged Joints: AWWA C115; ASME B16.1.

5. Mechanical Joint Restraints:

a. Mechanical joint restraints for all fittings and appurtenances, unless otherwise noted on Drawings.

b. Mechanical joint restraints shall be "EBAA Iron, Megalug®" Series 2000PV and 2200, Romac Romagrip, Smith-Blair Cam-Lock, or approved equal, for all pipe 4" diameter and greater.

c. Wedge assemblies and glands shall be fusion bonded epoxy coating in accordance with AWWA C116 or Mega-Bond coated, interior and exterior.

d. Stainless steel 304 bolts, nuts and washers for all buried applications, provided by manufacturer especially for use with their respective components. If fitting manufacturer cannot supply stainless steel bolts contractor may provide bolts from another source; however, contractor is solely responsible to ensure fit and compatibility of said bolts.

6. Jackets:

a. AWWA C105 polyethylene jacket, Installation Method "A".

b. Double-wrap all ductile iron components, unless they are cathodically protected, or pump station and surge tank building risers.

c. Inner PE jacket shall be V-Bio enhanced, minimum thickness: 8 mil

d. Outer PE jacket shall be standard polyethylene, minimum thickness: 8 mil

e. Secure PE jackets with ultra-high molecular weight (UHMW) polyethylene film tape, 10 mil thickness.

1) Do not use duct tape to tape the PE jackets.

D. Steel Pipe and Fittings:

1. Pipe fabrication:

a. For pipe 26" diameter and greater, fabricate arc-welded spiral seam steel pipe: ASTM A139, Grade B, C, D or E. For pipe 26" diameter or less, fabricate pipe per ASTM A-53 B.

b. Fabricated in accordance with AWWA C200, except:

1) Steel plate: ASTM A283, Grade C or D, or ASTM A36.

2) Steel sheet: ASTM A1011, Designation SS, Grade 40, 45 or 50; or ASTM A1018, Designation SS, Grade 40.

3) Standard wall thickness, unless otherwise indicated on Drawings.

2. Fittings and Special Sections:

a. Steel for fittings: ASTM A283, Grade C or D, or ASTM A36 for carbon steel.

b. Welding: Per AWS D1.1. All welding must be completed prior to application of lining and coatings, unless otherwise permitted by the Engineer. In no case shall any welding damage lining or coatings.

c. Dimensions in accordance with AWWA C208.

d. Custom fabricated fittings shall be designed and fabricated in accordance with AWWA M11, with outlet reinforcements per AWWA M11. All other standards and specifications for steel, welds, coatings, flanges and dimensions of component fittings provided herein shall apply equally to custom fabricated fittings.

e. No custom-made fittings shall be used without prior written approval by the Engineer.

3. Coatings:

a. For small diameter pipes, where it is not practical to apply fusion bonded epoxy coatings, the use of liquid epoxy coatings in accordance with AWWA C210 may be considered in lieu of fusion-bonded epoxy for interior surfaces, with prior approval by the Engineer. The burden shall be upon to Contractor to submit sufficient data and obtain Engineer's approval for such substitutions.

b. All coatings shall be NSF 61-approved.

4. Additional Coatings:

a. Exterior surfaces of all buried non-stainless steel pipe and welded fittings shall include cold-applied tape coating, manufactured and installed in accordance with AWWA C209, applied with a minimum overlap width of 1-inch and a total coating thickness shall be a minimum of 80 mils.

5. Flanges:

a. Flange class as noted on Drawings.

b. Pressure rating of flanges and gaskets shall meet or exceed surge pressure rating of attached pipe.

c. Coatings and linings shall be continuous to the ends of pipe and backs of flanges.

d. Do not apply coatings to mating surfaces of flanges.

e. Gaskets shall be ring-type, per AWWA C207, unless the flanged connection is between PVC and steel, in which case full face type gaskets with outer diameter equal to that of the flange shall be used.

f. Retainers shall be fabricated of phenolic or other suitable material as recommended by manufacturer and conforming to NSF 61, with minimum thickness of 1/8 inch and minimum dielectric strength of 500 volts/mil.

g. Nitrile sealing rings.

h. Steel washers shall be 1/8-inch thick.

i. All bolts, nuts and washers shall be stainless steel 304, unless otherwise noted. All bolts shall be provided by manufacturer especially for use with their respective fittings. If manufacturer cannot supply stainless steel bolts, Contractor may provide bolts from another source; however, Contractor is solely responsible to ensure fit and compatibility of said bolts.

j. Bolt shall be long enough to protrude through the assembled nut at least two threads but not more than ½-inch.

k. Contractor is responsible to ensure that all pipe flanges that connect to valve body flanges have the same dimensions, drill pattern, bolt hole diameter and equal or higher pressure rating as the valves to which they are connected.

1) Overdrill bolt holes as necessary, provided such overdrilling is within manufacturer's recommended tolerances.

l. Contractor shall be responsible to verify compatibility of all flange bolt patterns prior to purchasing materials and shall notify the Engineer in the event that alternate bolt patterns are required to mate flanges.

6. Field Welding Materials:

a. Pipe: AWWA C206.

7. Stainless Steel Pipe and Fittings

a. Use where called-out on Drawings as Stainless Steel

b. Stainless Steel 304

c. Pressure rating: Not less than 350 psi Cold Working Pressure

2.2 TAPPING SLEEVES AND SADDLES,

A. Tapping Sleeves:

1. Manufacturers:

a. Mueller Co.

b. Romac Industries, Inc

c. JCM Industries

d. Ford Meter Box Company, Inc

e. Smith-Blair, Inc

f. Substitutions: Approved equal.

2. Tapping sleeves shall be used for all taps larger than 2-inches.

3. Shall be fusion-bonded epoxy-coated steel sleeves.

4. All sleeves shall be specifically designed for use on the type of pipe that is being tapped.

5. All bands, straps, bolts, nuts and washers shall be SS 304. All bolts shall be provided by manufacturer especially for use with their respective components.

6. Sleeve Working pressure rating: 250 psi

7. Tapping sleeves shall be used on non-fusible PVC, unrestrained bell-and-spigot PVC, and DI pipe only. All taps on fusible PVC pipe or restrained PVC pipe shall be performed using MJ reducing tees.

8. Tapped Outlet: FNPT or MJ, as indicated on Drawings

9. All pipe taps shall be made with an engineer approved tapping machine.

10. Threadolets, where called for on Drawings, shall be welded to the pipe, ground, and blasted (if possible) prior to applying fusion-bonded epoxy coating to the pipe.

B. Tapping Saddles:

1. Manufacturers:

a. Romac Industries, Inc. Model 202-NS

b. Substitutions: Approved equal.

2. Tapping saddles shall be used for taps 2-inches or smaller.

3. Nylon coated ductile iron tapping saddles with stainless steel dual compression straps.

4. All saddles shall be specifically designed for use on the type of pipe that is being tapped.

5. All bands, straps, bolts, nuts and washers shall be SS 304. All bolts shall be provided by manufacturer especially for use with their respective components.

6. Saddle Working pressure rating: 350 psi.

7. Tapping saddles shall be used on non-fusible PVC, unrestrained bell-and-spigot PVC, and DI pipe only. All taps on fusible PVC pipe or restrained PVC pipe shall be performed using MJ reducing tees.

8. Tapped Outlet: FNPT or MJ, as indicated on Drawings

9. All pipe taps shall be made with an engineer approved tapping machine.

10. Threadolets, where called for on Drawings, shall be welded to the pipe, ground, and blasted (if possible) prior to applying fusion-bonded epoxy coating to the pipe.

2.3 UNDERGROUND PIPE MARKERS

A. Furnish materials in accordance with the most recent edition of New Mexico Standard Specifications for Public Works Construction, with latest revisions.

B. Tracer Wire: 12 AWG, high carbon grade steel center, Solid Copper, Single Conductor, 30V, Blue Jacket, 30 mil high-density polyethylene insulation wire or equal, for underground installation. Conductor must be at least 21% conductivity for locate purposes. Break load of 452 lbs.

C. Metal-backed detectable water marker tape: Bright colored, metallized for detection by above-ground metal detector, continuously printed, minimum 6 inches wide by 4-mil thick, manufactured for direct burial service, imprinted with "BURIED WATER SERVICE" in large letters.

2.4 ABOVE-GROUND PIPE MARKERS

A. Carsonite marker posts, blue, with Navajo Tribal Utility Authority (NTUA) decals. Decals to be specified by NTUA and provided by the Contractor. Place markers as specified on the Drawings.

2.5 PIPE SUPPORTS AND ANCHORING

A. Metal for pipe support brackets: ASTM A123/A123M, galvanized structural steel thoroughly coated with bituminous paint.

B. Metal tie rods and clamps or lugs: Galvanized steel sized in accordance with NFPA 24 thoroughly coated with bituminous paint.

2.6 BEDDING AND BACKFILL MATERIALS

A. As specified in Section 31 23 23.

2.7 ACCESSORIES

A. Concrete for Thrust Restraints (where applicable): Conform to Section 03 30 00, with minimum compressive strength of 3,000 psi.

B. Steel rods, bolt, lugs and brackets

1. For applications not in contact with soil: ASTM A36/A36M or ASTM A307 carbon steel.

2. For buried applications: Stainless steel 304.

2.8 SOURCE QUALITY CONTROL

A. Pipe:

1. Polyvinyl chloride (PVC): Factory test all PVC pipe, both jointed and fusible types, in accordance with AWWA C900 or AWWA C905, as applicable.

a. Fusible PVC: In addition to standard AWWA C900/905 testing, the pipe supplier shall perform third party quality assurance for the pipe lot to be provided for the project. Testing shall be per the pipe supplier protocol and include the following tests as a minimum:

1) Heat reversion testing per ASTM F1057

2) Acetone immersion testing per ASTM D2152

3) Flattening testing per AWWA C905

2. HDPE: Factory test all HDPE pipe in accordance with AWWA C901 or AWWA C906, as applicable.

a. ASTM F2634 testing of HDPE factory test fusions, will be required prior to installation. The testing reports must share common, unique identifiers with the shipping bills, in order to establish that 100% of pieces shipped pertain to the same batches that were tested and that the testing reports are truly representative of the actual pieces shipped.

3. Ductile iron: Factory test in accordance with AWWA C151 and AWWA C104.

4. Steel: Factory test in accordance with AWWA C200, ASTM A53, or ASTM A139.

a. Hydrostatic test: Factory test per AWWA C200 to stress steel to 23,000 psi for at least 15 minutes, or longer as needed to allow for thorough inspection. Conduct test after all formed and welded ends have been completed and attached.

b. Repair defects and re-test prior to applying lining and coating.

B. Fittings:

1. Ductile iron (DI): Factory test in accordance with AWWA C153 and AWWA C110, as applicable.

2. Steel:

a. Steel plate fittings: Factory test fittings fabricated from steel plate to stress steel under hydrostatic pressure to 23,000 psi for at least 15 minutes, or longer as needed to allow for thorough inspection.

b. Steel pipe fittings: Fittings fabricated from tested steel pipe do not require hydrostatic testing if girth butt welds are complete penetration welds. Perform dye penetrant test on welds in accordance with ASTM E165.

c. Pipe should conform to ASTM A53, ASTM A139 or AWWA C200.

d. Remove all defects disclosed during testing, re-weld and re-test the fitting.

3. Fusible PVC Sweeps:

a. In addition to the factory testing of the fusible PVC pipe stipulated above prior to bending, every individual fusible PVC sweep shall be inspected for quality at the factory after bending, as follows:

1) Visual inspection for heat damage, kinks, ovality, and other irregularities

2) OD measurements parallel and perpendicular to the plane of the bend, at not less than five (5) locations evenly spaced along the length of the sweep

C. Coatings:

1. All fusion-bonded epoxy coatings shall be factory tested holiday-free.

2. Cure testing for fusion bonded or liquid epoxy coatings: ASTM D4752 and ASTM D3363, Every 1000 sq. ft. of epoxy coating.

3. Holiday testing for epoxy and cold-applied tape coatings:

a. All fusion-bonded epoxy coatings and cold-applied tape coatings on all pipes and fittings shall be holiday tested prior to installation, at no additional cost to the Owner.

b. Perform testing in accordance with NACE Standard SP0274, using electrical holiday tester. Use test voltage below:

Total Coating Thickness (Mils)	Test Voltage (Volts)
20 or less	6000
30	7500
50	9000
70	11500
80 or more	12000

c. All holidays shall be repaired and re-tested, at no additional cost to the Owner.

4. Touch up and repair of Fusion Bonded Epoxy Coatings

a. Applies to all FBE coated valves for field repair of minor holidays, scratches, breaks or other damage to FBE coating.

b. Does not include repair or touch up of systemic or large area holidays in FBE coating. Repair of systematic holidays or damaged areas larger than

three (3) sq. in. will require the damaged coating be ground off and the valve be newly shop-coated.

c. Materials and application:

1) NSF/ ANSI 61 certified, two-part, 100% solids, liquid epoxy coating meeting the requirements of AWWA C210.

a) Manufacturer: 3M Scotchkote Epoxy Coating 323, OAE.

b) If temperature is below 55 degrees Fahrenheit, the metal substrate shall be pre-heated in accordance with coating manufacturer's recommendations prior to applying the coating.

d. Prepare surface and apply per coating manufacturer's instructions for use as a field repair material.

D. All shop welding shall be performed by certified welders.

E. All shop welds shall be tested by ultrasonic or radiographic methods in accordance with AWS D1.1.

F. Engineer reserves right to require additional holiday testing of any and all coated components that are suspected of having holidays in the field prior to installation. Costs of failed tests shall be borne by the Contractor; costs of passed additional tests shall be reimbursable from the Testing Allowance.

2.9 SOURCE QUALITY ASSURANCE

A. Acceptance of materials will be based on compliance with relevant AWWA, ASTM and other relevant standards. Materials must pass all relevant tests prior to acceptance.

B. Compliance with standards will be determined based on:

1. Documentation of factory testing. Such tests must be completed in accordance with relevant AWWA, ASTM, AWS or other applicable standards. All testing must be completed and documented by qualified personnel. The Engineer reserves the right to observe the testing while in process and to demand all testing documentation at any time.

2. Inspection by the Engineer. The Engineer reserves the right to inspect all materials both during and after manufacture.

C. The Engineer reserves the right to demand evidence of certification of all personnel performing shop or field welding on steel pipe and fittings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify existing utility water main size, location, and invert, are as indicated on Drawings.

3.2 PREPARATION

A. Pre-Construction Site Photos:

1. Prior to beginning construction, take photographs or videotape along centerline of proposed pipe trench. The photos or video must include coverage of all areas and adjacent features that may potentially be impacted by the impending construction work.
2. Photographs shall be taken at a minimum of one for each 200 feet of pipe trench. Videos shall cover a maximum of 2,000 feet per video file.
3. Video or photographs shall be taken after Station markers or stakes are in place for the section of pipeline or site(s) to be recorded. Video or photos must include sufficient close-ups of stakes to clearly indicate the location.
4. Prior to groundbreaking on any section of pipeline or site work, video or photographs must be submitted to the Engineer for review and approved. Video or photo documentation must be approved as sufficient by Engineer before groundbreaking may proceed.
5. Show station markers, mailboxes, fences, structures, driveways, signs, culverts, and other existing site features.
6. Include project description, applicable stations or sites, and date taken in the file name of every photograph or video, using the following filename convention: "<project name>_<begin station>_to_<end station>_<date>".
7. Video or photo submittals may be rejected because of failure to include or document any of the items above, a lack of visual or audio clarity, or for any other deficiency that prevents the Owner / Engineer from easily viewing and documenting the pre-construction conditions of the pipeline and sites.
8. If using video, Contractor must submit two (2) copies of the video documentation on DVD format as part of the submittal process. If using photographs, Contractor must submit 2 copies of digital photograph files in DVD format as part of the submittal process.

B. Construction staking:

1. Refer to Section 02 21 13 – Surveying.

3.3 TRENCHING

A. In accordance with Section 31 23 17.

3.4 BEDDING

A. In accordance with Section 31 23 23.

3.5 INSTALLATION – PIPE

A. Install bell-and-spigot PVC pipe in accordance with AWWA C605, AWWA M23 and pipe manufacturer's instructions, whichever is most stringent.

1. Use only lubricants supplied by the pipe manufacturer and apply to both bell and spigot ends of the joint, in accordance with manufacturer's recommendations.
2. Clean the gasket, bell, groove and spigot immediately prior to connecting pipe joints.

3. Do not over-insert pipe joints. Any over-inserted pipe joints shall be removed and the pipe bell and gasket inspected for damage. Any damaged bells or gaskets shall be discarded and replaced.

4. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs. Use only equipment specifically designed for pipe cutting. The use of chisels or hand saws will not be permitted. Grind edges smooth with beveled end for push-on connections.

B. Install HDPE pipe in accordance with ASTM D2774 and AWWA M-55.

C. Install ductile iron piping and fittings according to AWWA C600.

1. Encase all ductile iron pipe and fittings that are not cathodically protected in polyethylene, per AWWA C105, Method "A".

a. Use two (2) separate polyethylene jackets.

1) Inner jacket: V-bio enhanced polyethylene

2) Outer jacket: standard polyethylene

b. No tears, cuts, rips or other breaks in the polyethylene encasement shall be acceptable. No dirt, water or debris inside the encasement shall be acceptable.

c. When installing ductile iron pipe floor penetrations under buildings and concrete slabs, bring both layers of polyethylene into the slab inside the roof felt isolation joint. Trim and tape the PE at the mid-point of the slab thickness (e.g. 6" below the floor for a 12" slab). Wrap two layers of 30# roof felt outside both layers of polyethylene, extending 4" above and 4" below the slab. Trim the felt to 2" above the floor and seal with silicone. Extend PE encasement to PVC transition beyond building foundation.

d. When installing ductile iron floor drain lines, bring both layers of polyethylene into the slab, trim, and tape to pipe just below the inset floor drain.

e. Do not polyethylene encase any ductile iron fitting that has cathodic protection.

f. Use only 10-mil UHMW polyethylene film to tape the PE jackets. Do not use duct tape.

2. All push-on joints, where allowed on Drawings, shall be installed using TR Flex restrained joints. Install restrained joints in accordance with manufacturer's recommendations.

D. Install steel pipe in accordance with AWWA M11. Field weld and test steel pipe, as needed, in accordance with AWWA C206, except as follows:

1. Test field welds by ultrasonic or radiographic method, in accordance with AWS D1.1.

2. Do not field weld pipe without permission from the Engineer.

Any damaged shop-applied coatings shall be repaired in accordance with this Section. In the event, that field repair is required due to damage of shop-applied coating, Contractor shall notify Engineer prior to making the repair.

E. Install cathodic protection for buried ferrous pipe, fittings and valves as indicated in the Corrosion Protection and Monitoring Systems provisions of this Section.

1. .

F. Handle and assemble pipe in accordance with manufacturer's instructions and as indicated on Drawings. Inspect each pipe and fitting prior to lowering into trench to ensure there is no damage to the pipe, fitting or coatings. Repair any damage prior to installation. Clean ends of pipe and remove foreign material from inside of pipe and fittings.

G. Maintain 10 ft horizontal separation of water main from sewer piping in accordance with local code.

H. Lay pipe in straight line and center pipe within trench. Re-lay pipe that is out of alignment.

I. Horizontal and vertical pipe bending, angles and joint deflections

1. All ells shall be one of the following standard angles: 11.25, 22.5, 45, 60 or 90 degrees. No other ell angles shall be allowed.

2. Actual horizontal and vertical angles required in the field shall be accomplished by a combination of allowable DI ells, and/or pipe deflection

3. Lateral pipe bending forces shall be isolated from all fittings.

4. Horizontal and vertical deflections in HDPE pipe shall be accomplished by pipe bending, provided that such bends meet the minimum bending radius recommended by the pipe manufacturer and AWWA (in case of discrepancy, the longer of the two radii shall be used).

5. Steel and ductile iron pipe deflections shall be made at joints, provided pipe manufacturer's allowable deflection limits are not exceeded.

6. Mechanical Joints: contractor to abide by manufacturer's recommended maximum allowable deflection

J. Horizontal and vertical pipe line and grade

1. The horizontal and vertical lines and grades shown on the Drawings indicate the intent of the design. Actual horizontal and vertical lines and grades in the field may deviate from those shown on the Drawings, provided all of the following conditions are met:

a. Actual minimum slope of pipe shall not be less than 0.00100 ft/ft.

b. Actual maximum slope of pipe shall not be greater than 0.40000 ft/ft, except where otherwise noted on the Drawings.

c. Direction of pipe slope shall not differ from that shown on Drawings.

d. Minimum pipe cover of 4 feet shall be maintained throughout the project.

e. Additional minimum cover or specific minimum vertical clearances called out on the Drawings at specific locations, such as wash crossings, road crossings or pipeline crossings, shall be maintained.

f. In the case of horizontal bends, the outer wall of the pipe must remain at least 12 horizontal feet within the permanent right-of-way boundaries.

g. At bends near casings, pipe bending and/or off-set from centerline shall be done on the far side of the PI from the casing, to maximize the length of straight pipe in the sleeve on each side of the casing.

h. In certain locations, the pipe elevation and/or slope must remain as shown on drawings to facilitate pipe draining, maintain pressures, or other performance criteria. In such cases, deviation from the Drawings may not be allowed.

i. All deviations from the Drawings shall be documented by the Contractor and must be approved in advance by the Engineer.

j. All other specifications shall be met.

k. Any exceptions to the foregoing conditions must receive prior written approval by the Engineer.

2. No high points of any magnitude shall be allowed without an approved air valve. If the As-Built survey of the pipeline reveals high points not shown on the Drawings, Contractor shall correct the pipe grade or install additional air valves, as directed by Engineer.

a. Additional air valves required due to unforeseen field conditions not the fault of the Contractor shall be paid for at the prices established in the Bid.

b. Additional air valves or pipe re-installation required due to high points caused through fault of the Contractor shall be provided at no additional cost to the Owner. This includes failure of Contractor to meet lines and grades set forth in the Drawings or failure to meet minimum pipe slope.

K. Install pipe to bear on the trench bottom along entire length of pipe. For jointed pipe, excavate bell holes in the bottom of the trench to prevent the bell from coming into contact with the sub-grade.

L. Do not lay pipe in wet or frozen trench.

M. Direction of pipe bells may be reversed for ease of installation, provided that all pipe material and installation meets applicable AWWA, ASTM, NTUA and material manufacturer's standards. On grades greater than 10%, install jointed pipe uphill.

N. Pipe expansion and contraction

1. Install pipe to allow for expansion and contraction without stressing pipe or joints.

O. Pipe expansion and contraction

1. Install pipe to allow for expansion and contraction without stressing pipe or joints.

2. Allow all HDPE pipe to acclimate to sub-surface soil temperature by laying pipe in trench, embedding and backfilling, then waiting overnight prior to connecting pipe to any fitting or appurtenance (including butterfly valve and air valve assemblies).

P. Do not allow trench water, dirt, debris or other foreign material to enter the pipe during or after installation.

1. Keep pipe ends sealed after joining pipes, both while pipe string is laying on top of ground and after pipe is lowered into trench.

2. Close pipe openings with watertight plugs during work stoppages.

Q. Clean inside of pipe by "pigging" immediately prior to connecting pipe ends to butterfly valves, elbows or other fittings that do not allow the pig to pass through. Seal all exposed pipe ends to prevent contamination after pigging.

1. Flanged ends shall be temporarily sealed using approved blind flanges. Straight pipe ends shall be temporarily sealed using approved pipe covers.

2. Pigging system shall be submitted to Engineer for approval prior to use.

R. Install tracer wire continuous, taped to top of pipeline; coordinate with Sections 31 23 17 and 31 23 23.

S. Install metal-backed detectable water marker tape continuous over top of pipe, buried 18 inches above pipe; coordinate with Section 31 23 17 and 31 23 23.

T. Install thrust blocks at locations indicated on Drawings. Installation of thrust blocks shall not relieve the Contractor of responsibility to provide pipe restraints as indicated on Drawings and Specifications.

U. Flanged Joints: Not to be used in underground installations except within accessible structures or as shown on Drawings.

V. All pipes, fittings and appurtenances must remain within designated permanent rights-of-way. All construction activities must remain within the right-of-way or temporary construction easement. Do not encroach on adjacent properties or culturally sensitive areas.

W. Embed pipe within 100 feet behind pipe-laying operations, unless otherwise permitted by the Engineer.

X. Do not backfill pipe prior to as-built surveying; refer to Section 02 21 13 - Surveying.

3.6 JOINING POLYETHYLENE PIPE

A. HDPE pipes shall be butt-fused in the field in accordance with ASTM F2620.

B. Heat Fusion Joining: Joints between plain end pipes and fitting shall be made by butt fusion. Joints between the main and saddle branch fittings shall be made either using saddle fusion or with a factory-welded fitting. Either procedure used must be recommended by the pipe and fitting manufacturer.

C. Polyethylene pipe and fittings may be joined to other materials by means of:

1. Mechanical Joint (MJ) adapters with steel back-up rings and stainless steel stiffeners, where indicated on Drawings

2. Flange adapters with steel back-up rings, where indicated on Drawings.

D. ID Stiffener and Restraint: A stainless stiffener shall be installed in the bore of the polyethylene pipe when an OD compression mechanical coupling is used and when connecting plain end PE pipe to a mechanical joint pipe, fitting or appurtenance. External clamp and tie rod restraint shall be installed where PE pipe is connected to the socket of a mechanical joint pipe, fitting or appurtenance except where an MJ adapter is used. Stiffeners shall also be used in all HDPE MJ adaptors.

E. Mechanical Joint and Flange Installation: Mechanical joint and flange connections shall be installed in accordance with the manufacturer's recommended procedure. MJ adapter and flanges shall be centered and aligned to the mating component before assembling and tightening bolts. In no case shall MJ gland or flange bolts be used to draw the connection into alignment.

F. Mechanical couplings shall be fully pressure rated and fully thrust restrained such that when installed in accordance with manufacturer's recommendations, a longitudinal load applied to the mechanical coupling will cause the pipe to yield before the mechanical coupling disjoins. External joint restraints shall not be used in lieu of fully restrained mechanical couplings.

G. Do not perform fusions during adverse weather conditions, including high wind, any amount of blowing dust or precipitation events. Protect exposed pipe faces after facing and surface preparation from blowing dust. Design Builder shall have the right to shut down fusing operations if weather conditions are not suitable or if weld quality is suspect. Subcontractor shall not be entitled to additional compensation for any such additional testing or shut-downs; however, shut-downs required by the Design Builder through no fault of the Subcontractor (i.e. due to weather) shall be considered excused weather delays.

1. In the event of inclement weather, a tent, shelter, weld screen may be used to protect the fusion environment from dust, precipitation and heater plate variance. Any such enclosures must be approved by the Design Builder. Design Builder reserves the right to reject such enclosures and shut down operations if the enclosures do not adequately protect the pipe faces or fusion environment.

H. HDPE pipe may be welded into strings ("tie-in joining") and dragged into place, provided that pipe manufacturer's recommendations for maximum length, dragging velocity and other criteria are met.

I. All HDPE pipe butt fusions shall be performed in accordance with PPI Technical Report TR-33 and ASTM F2620 (latest edition). To the extent that these standards allow for accelerated cooling of HDPE butt fusion welds using chilled air, such methods may be used. However, all welds must be made in strict accordance with PPI and ASTM standards. Furthermore, all welds made using accelerated cooling methods must be warranted by the vendor of the cooling equipment for a period of not less than three (3) years after the date of the weld fusion.

J. Internal weld beads from all HDPE welds (on both pipe and fittings) shall be completely removed prior to installation, using Design Builder-approved method for weld bead removal.

K. Protect HDPE at all times during handling, storage, transport, cutting and fusion from oil contamination.

1. Clean or wipe blades of facing equipment in accordance with equipment manufacturer's recommendations. Unless otherwise indicated by the manufacturer, do not use solvents for cleaning, as these can leave residues that can weaken the fusion joints and cause failures.

2. When cutting HDPE pipe with a chainsaw, do not add any liquid to the oil reservoir as this will contaminate the pipe. Direct exhaust from any gas-powered

chain saw away from the pipe to ensure no oil residue forms on the outside of the pipe.

3.7 INSTALLATION - TAPPING SLEEVES AND SADDLES

A. Install tapping sleeves and valves in accordance with Drawings and in accordance with manufacturer's instructions.

B. For dry taps, after drilling into the pipeline, remove all pipe shavings and debris from inside the pipe using a vacuum or other method approved by the Engineer.

C. Do not install tapping sleeves or saddles on fusible or restrained PVC pipe. All taps on fusible or restrained PVC main lines must use MJ reducing tees.

D. Do not allow non-stainless components of tapping saddles or sleeves to come in contact with soil.

3.8 INSTALLATION – BOLTS

A. Apply heavy duty anti-seize to lubricate all stainless steel bolts.

B. Anti-seize compound shall be recommended by manufacturer for use with stainless steel.

3.9 INSTALLATION – STAINLESS STEEL THREADED PIPES AND APPURTENANCES

A. All threaded stainless steel pipes, valves, and fittings shall be wrapped with Teflon graphite tape and/or coated with anti-seize compound approved by manufacturer specifically for use with stainless steel threads.

3.10 THRUST RESTRAINT

A. Concrete Wall Anchors shall be used for thrust restraint.

B. All thrust blocks shall bear against undisturbed earth.

3.11 BACKFILLING

A. In accordance with Section 31 23 23.

3.12 PIPELINE RIGHT-OF-WAY GRADING

A. Mound spoils over pipe as indicated on Drawings. Provide a level 5 ft break in earthen mound every 50 ft to prevent surface runoff from accumulating on the uphill side of the mound.

B. Establish finished grade to provide a minimum of four (4) foot of cover over the pipe. Measure depth of cover from final surface grade to top of pipe barrel.

1. At certain locations, such as wash crossings, road crossings, utility line crossings or to prevent high points, the Drawings indicate greater than 4 ft minimum cover. At such locations, Contractor shall maintain the site-specific minimum cover.

C. Do not place fill material or raise the finished grade above existing grade in the flow lines of washes or surface water drainages, regardless of size.

D. Finished grade along pipeline right-of-way and temporary construction easement shall have a maximum longitudinal slope of 4:1 and maximum side slope of 4:1, unless otherwise noted on Drawings.

E. The pipeline right-of-way shall be leveled from side-to-side to slow down surface run-off from causing erosion rills perpendicular to the pipeline, as well as to make the ROW accessible to the Owner for future maintenance.

1. The entire disturbed right-of-way shall be re-seeded and reclaimed after construction. Do not build any new roads. Refer to Section 32 92 19 – Seeding for re-seeding requirements.

2. The right-of-way shall not be open to the general public and shall have minimal impact on the environment. Upon completion of construction, the right-of-way shall be reclaimed to visually blend in with the surrounding environment and minimize its visual impact.

F. All construction activities, including clearing and grading, must remain within the designated right-of-way and temporary construction easement. Do not encroach on adjacent properties or culturally sensitive areas.

3.13 TAPPING EXISTING WATER DISTRIBUTION FACILITIES

A. Obtain permission to tap from Reclamation.

B. Obtain permission to tap from the Navajo Tribal Utility Authority (NTUA). A blank Permission to Tap application form is provided in Appendix H. Contractor shall not connect to existing system without written permission from NTUA and the Engineer to proceed with connection to the existing system.

C. Obtain permission to tap from owner prior to tapping existing tanks.

D. Coordinate with NTUA's designated representative regarding schedule, means and methods, maximum allowable shut-off time, water usage rates (both gpm and gpd) and other parameters stipulated by NTUA.

E. Contractor is advised that a Water Use Permit from Navajo Nation Water Code Administration is required for use of the NTUA water. Contact Monte Chee at (928) 786 – 2395 or mchee_71@yahoo.com for more information.

F. Perform all work in conformance with the tapping permit and all written and verbal instructions from NTUA personnel, including notification and coordination with NTUA, maximum water usage rates, time and duration of shut-offs, and disinfection requirements.

G. Minimize shut-off time during connections to existing facilities. Contractor shall have all tools and materials for actual field conditions as well as foreseeable problems on hand in order to minimize shut-off time.

H. Prevent contamination of existing facilities with trench water, mud, debris, chemicals or other substances.

I. All new materials shall be thoroughly cleaned and disinfected with a strong (50 ppm) chlorine solution prior to connecting to existing NTUA facilities.

3.14 INITIAL FILLING OF PIPELINE

A. "Initial filling" refers to first introduction of water and evacuation of air in the pipeline.

B. Initial filling of pipeline shall not exceed maximum instantaneous flow rate (in gpm) or maximum daily fill rate (in gpd) set forth by NTUA and the Engineer in the field.

C. Unless otherwise directed by the Engineer, the maximum allowable instantaneous flow rate shall be 950 gpm. Note that actual allowable maximum fill rate based on availability of water from NTUA's existing facilities may be significantly less than this amount. Contractor shall schedule sufficient time for filling and flushing to account for actual water availability from NTUA.

3.15 DISINFECTION OF POTABLE WATER PIPING SYSTEM

A. Flush and disinfect system in accordance with Section 33 13 00.

3.16 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. The Subcontractor shall be required to hydrostatic pressure test all water mains, appurtenances and plumbing trains.

1. Notify Bureau of Reclamation and NTUA 7 days before applying pressure to pipeline.
2. Do not perform leak tests when water is ponded on ground surface from major rain or snow storm, unless approved by Engineer.
3. Conduct hydrostatic pressure testing with potable water, or water from a source approved by Recalmation.
4. Vent all air from the pipeline prior to pressurization.
5. Fully restrain the pipeline, including permanently installed items and any temporary appurtenances used for testing, prior to pressurization.
6. Perform testing in accordance with applicable standards:

a. Test pressure: In accordance with the Hydrostatic Pressure and Leakage Test Calculations provided in Appendix G to Contract Documents.

b. PVC pipe: Simultaneous hydrostatic pressure and leakage test. The system shall be pressure tested in-ground in accordance with AWWA C605 and M23, with the exceptions noted below:

1) Test duration: 2 hours minimum.
a) Engineer may require longer duration test (up to 24 hours) if there is any doubt as to integrity of a particular section of pipe or appurtenances.

c. HDPE pipe: Pressurized leakage test. HDPE pipe shall be hydrostatically tested above-ground prior to installation to ensure proper fusion prior to HDD installation, and again buried after installation and connection to adjacent PVC sections.

1) During the above-ground testing, the sections of HDPE shall be tested in accordance with ASTM F2164 and AWWA M55, with the exceptions noted below:

1) Test duration: 2 hours minimum.
a) Engineer may require longer duration test (up to 8 hours) if there is any doubt as to integrity of a particular section of pipe or appurtenances.

2) The above-ground leakage test of HDPE pipe shall be completed at an ambient temperature of 80° F or below. Subcontractor shall submit testing plan to Design Builder if planned leakage test to be completed at an ambient temperature above 80° F.
3) During the buried testing, follow the specifications for PVC hydrostatic and leakage testing as outlined in Section 3.18 B.1.b.
4) Low Pressure air testing may be allowed, depending on methods and approval by Reclamation. If contractor chooses to perform above ground low pressure air testing, contractor to submit testing plan to the engineer and owner.

d. Ductile iron pipe: AWWA C600

e. Steel pipe: AWWA C200

7. In no case shall the test pressure exceed the manufacturers' recommended maximum safe test pressure for the pipe, fittings or appurtenances.

8. No observable leakage is allowed, if leakage is detected halt test. Measurable leakage must be within the maximum allowable limits set forth by applicable AWWA and ASTM standards including AWWA C605 Sec. 10.3.6 and as presented in the Reach 10.3.1 Hydrostatic Pressure and Leakage Test Calculations.

9. Any leaks detected during testing shall be repaired after pipe is depressurized. After repairs are completed, another full duration test shall be performed on the section of the pipeline to which the repairs were made.

10. All hydrostatic pressure tests must be witnessed by NTUA personnel. Contractor is responsible for coordination of testing schedule with NTUA to allow NTUA's representative to be present.

11. Repeat test until acceptance criteria is achieved.

C. Qualifications of polyethylene fusion personnel:

1. Prior to production of heat fusion joints, the heat fusion joint machine operator shall be certified by the machine manufacturer or representative thereof who is approved by the Design Builder.

2. Each fusion machine operator shall receive training on the use of the specific fusion machine and the bonding procedure and shall perform at least one pipe-to-pipe bond and one pipe-to-fitting bond (if used) on each machine they are required to use. All bonds made as part of operator certification shall be visually inspected and tested in accordance with the fusion quality testing specifications set forth in this section.

3. A fusion machine operator's qualification shall remain in effect for a period of six months from the date of qualification. The entity certifying an operator's qualifications shall retain the ability to revoke an operator's qualification if it is determined that there is a specific reason to question the operator's ability to make joints that meet project specifications.

D. Polyethylene pipe fusion machine data loggers:

1. All polyethylene pipe fusion machines shall be equipped with data loggers to record, at a minimum, joint temperature, pressure and time.

2. Data loggers shall be used during all joint fusions.

3. The Subcontractor shall provide data on any and all fusion joints upon request of the Design Builder.

E. Fusion Quality Testing on Polyethylene pipe: The Subcontractor shall verify field fusion quality by making and testing a trial fusion as follows:

1. Frequency: Minimum of one trial fusion per crew per week or at any other time requested by the Design Builder, up to a maximum of 10% of welds. Changes in weather during course of day, including increase in wind velocity or blowing dust, precipitation events or severe changes in temperature, may require additional tests at the discretion of the Design Builder. Changes to fusion machine shall also require additional tests.

2. Procedure: The trial fusion shall be allowed to cool completely; then test coupons shall be cut out and tested in using Tensile Impact Method accordance with ASTM F2634.

   a. For convenience, Subcontractor may use other, non-ASTM field tests to gather immediate general information regarding weld quality; however, such tests shall not replace the ASTM F2634 test. Only the ASTM F2634 test shall be used by the Design Builder as a basis of whether to accept or reject any welds.

3. Rejection of fusion joints:

   a. Any joint that exhibits a yield point lower than that of the unfused pipe or that fails in a brittle mode is considered unacceptable.

   b. If the tensile impact test of the trial fusion fails, all field fusions represented by the trial fusion shall be rejected. The Subcontractor, at his expense, shall make all necessary corrections to equipment, set-up, operation, and fusion procedure, and shall re-make the rejected fusions. In the event that some or all of the rejected joints are already installed, the Subcontractor shall remove and re-install the pipe at no additional cost to the Design Builder.

F. Testing of field welds on steel pipe and fittings shall be by ultrasonic or radiographic method in accordance with AWS D1.1.

1. The Engineer reserves the right to demand evidence of welder's certification for all personnel performing field welding of steel pipe and fittings.

G. Thermal contraction and expansion of HDPE pipe:

1. Design Builder reserves the right to unbolt any flange or mechanical joint attached to HDPE pipe (including all butterfly valve assemblies) to check for tensile or compressive loading due to thermal contraction or expansion of the HDPE pipe. Excessive tension, indicated by pull-back of the HDPE end, or excessive compression of the flange shall be cause for the Subcontractor to excavate the HDPE pipe, lengthen or shorten the pipe as necessary, and re-bury. Subcontractor shall not grout the pipe penetrations of valve vaults until authorized by the Design Builder, to allow for proper testing. Refer to Section 33 12 16.C – Water Utility Valves.

H. Compaction Testing: Refer to Section 31 23 23 – Backfill.

I. All tracer wire must be field checked for continuity after all excavation is completed, but prior to Final Completion of the project. All breaks in continuity shall be corrected.

J. When tests indicate Work does not meet specified requirements, remove Work, replace and retest at no additional cost to the Owner.

3.17 TOLERANCES

A. Line and grade surveying tolerances:

1. See Section 02 21 13 – Surveying.

B. Flange alignment tolerances as specified in AWWA C207 and AWWA M11.

END OF SECTION

SECTION 33 12 16

WATER UTILITY VALVES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Butterfly Valves
2. Gate Valves.
3. Ball Valves
4. Orifice Plates.
5. Air Valves.
6. Inflow Preventor
7. Dismantling Joints
8. Blowoff Valve Assemblies.
9. Valve boxes.
10. Pipe Supports
11. Valve vaults.
12. Accessories.
13. Corrosion Protection.

B. Related Sections:

1. Section 03 30 00 - Cast-in-Place Concrete.
2. Section 31 22 13 - Rough Grading.
3. Section 31 23 23 - Backfill.
4. Section 33 11 13 - Public Water Transmission Systems.
5. Section 33 13 00 - Disinfection of Water Utility Transmission Systems.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Air Valve Assemblies:

1. Basis of Measurement: Each.
2. Basis of Payment: Includes excavation, air valve assembly, concrete vault and foundation, hatch, identification placards, warning tags, fittings, accessories and backfill.

B. Main Line Butterfly Valve Assemblies:

1. Basis of Measurement: Each.

2. Basis of Payment: Includes excavation, main line butterfly valves, by-pass valves, by-pass piping, orifice plates, adaptors, fittings, valve boxes, lids, meter cans, collars, warning placards, accessories, and backfill.

C. Blowoff Valve Assemblies:

1. Basis of Measurement: Each.

2. Basis of Payment:

a. 6-inch Blowoff valve with above grade discharge: Includes excavation, 6-inch piping, orifice plate, valve vault, tee above-grade discharge pipe, gravel pack, accessories and backfill.

D. Cathodic Protection:

1. Refer to Section 33 11 13

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO M 306-10 - Standard Specification for Drainage, Sewer, Utility and Related Castings

B. ASTM International (ASTM)

1. ASTM A48 – Standard Specification for Gray Iron Castings

2. ASTM A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

3. ASTM A536 – Standard Specification for Ductile Iron Castings

4. ASTM A564 – Standard Specification for Hot Rolled and Cold Finished Age Hardening Stainless Steel Bars and Shapes

5. ASTM B62 – Standard Specification for Composition Bronze or Ounce Metal Castings

6. ASTM B148 – Standard Specification for Aluminum Bronze Sand Castings

7. ASTM C478 – Circular Precast Reinforced Concrete Manhole Sections

8. ASTM C857 – Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

9. ASTM F593 – Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

10. ASTM F594 – Standard Specification for Stainless Steel Nuts.

11. ASTM A312 – Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipe

12. ASTM D3363 – Standard Test Method for Film Hardness by Pencil Test

13. ASTM D4752 – Standard Practice for Measuring MEK Resistance of Ethyl Silicate Zinc Rich Primers by Solvent Rub

14. ASTM D638 – Standard Test Method for Tensile Properties of Plastics

C. American Water Works Association (AWWA):

1. AWWA C207 – Standard for Steel Pipe Flanges for Waterworks Service
2. AWWA C515 – Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
3. AWWA C550 - Protecting Epoxy Interior Coating for Valves and Hydrants.
4. AWWA C605 - Underground Installation of Polyvinyl Chloride PVC Pressure Pipe and Fittings for Water.
5. AWWA M11 – Steel Pipe: A Guide for Design and Installation
6. AWWA M23 – PVC Pipe – Design and Installation

D. American National Standards Institute

1. ANSI B16.1 Gray Iron Pipe Flanges and Flanged Fittings

E. NACE International (NACE)

1. SP0274 – High-Voltage Electrical Inspection of Pipeline Coatings Prior to Installation.

F. NSF International/ American National Standard (ANSI):

1. NSF/ANSI Standard 61 - Drinking Water Components - Health Effects.

G. Society for Protective Coatings:

1. SSPC-SP1 – Solvent Cleaning
2. SSPC-SP2 – Hand Tool Cleaning

1.4 SUBMITTALS

A. Design Data: Submit manufacturer's latest published literature. Include illustrations, installation instructions, maintenance instructions and parts lists.

B. Manufacturer’s Certificates: Submit Statement of Compliance, supporting data from material suppliers attesting that valves and accessories provided meet or exceed AWWA Standards and specification requirements.

C. Submit proofs on all signs, placards, and tags prior to fabrication.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves.

B. Provide Operation and Maintenance Data for each type of valve installed.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with applicable New Mexico Standards and the National Fire Protection Act (NFPA).

B. Valves: Mark valve body with manufacturer's name and pressure rating.

1.7 DELIVERY, STORAGE AND HANDLING

A. Prepare valves and accessories for shipment according to AWWA Standards and seal valve ends to prevent entry of foreign matter into product body.

B. Deliver and store valves in shipping containers with labeling in place.

C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior and exterior surfaces.

D. Coated valves and appurtenances shall be shipped on bunks and secured with nylon belt tie down straps or padded banding over braces, and shall be stored on padded skids or other suitable means to prevent damage to coatings.

E. Coated valves shall be handled with wide belt slings, padded forks or other means to prevent damage to coatings. Chains, cables or other equipment likely to damage coatings or valves shall not be used.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.9 MAINTENANCE MATERIALS

A. Furnish two (2) tee wrenches to Owner (required length) for each valve type.

PART 2 PRODUCTS

2.1 GENERAL

A. All valves shall be American made, unless otherwise specified.

B. All non-stainless steel and iron valves and appurtenances shall be fusion bonded epoxy coated, interior and exterior, conforming to AWWA C550 and NSF 61.

C. All valves and coatings shall be NSF 61-certified.

D. All bolts, nuts, and washers (where required) shall be stainless steel 304, unless otherwise specified, and shall be provided by the valve or fitting manufacturer especially for use with their respective valves or fittings. If manufacturer cannot supply stainless steel bolts for the MJ or flange connection, Contractor may provide bolts from another source; however, Contractor is solely responsible to ensure fit and compatibility of said bolts.

2.2 BUTTERFLY VALVES

A. Manufacturers:

1. Henry Pratt Co.

a. Groundhog

2. Val-Matic Valve and Manufacturing Corporation

a. Series 2400

3. Substitutions: Not permitted.

B. 250 psi Butterfly Valves:

1. Conforming to AWWA C504, Pressure class AWWA 250B, MSS SP 67 and NSF 61.

2. Rated to 250 psi full differential working pressure.

3. Shell test pressure 500 psi.

4. Leak test at 250 psi.

5. Body: Ductile iron, drilled in accordance with ANSI B16.1 Class 125, stainless steel shaft. Body wall thickness shall be in accordance with AWWA C504.

C. Valve Ends:

1. Mechanical joint or flanged, as indicated on Drawings.

2. Flanged ends shall be drilled in accordance with ANSI Class 125/150 bolt pattern.

3. Pressure rating not less than that of valve body.

D. Disc: Epoxy-coated cast iron, with stainless steel 316 edge.

E. Seat: Resilient Buna N.

F. Shafts: Shall be sized, designed and constructed in conformance with AWWA C504 for pressure class AWWA 250B. Shafts shall be SS ASTM A-276 Type 304.

G. Actuator:

1. Direct buried service.

2. Manual actuators shall conform to AWWA C504 for pressure class AWWA 250B.

3. Actuators shall be buried service type with square operating nut, shall be of traveling nut, self-locking type able to hold valve in any intermediate position without fluttering or creeping. Actuators shall have external travel stops for open and closed position adjustment. Internal stops which require actuator cover and grease removal shall not be used.

4. Actuator shall have mechanical stops able withstand input torque of 450 ft-lb against each stop.

5. Open left, close right.

6. Buried service actuators shall be grease packed.

H. Where valve is direct buried at a depth greater than 4 feet, provide valve stem extensions, complete with extension stem stabilizers, until depth of extension nut at least matches depth of operating nuts on valves installed at four-foot depth.

2.3 RESILIENT WEDGE GATE VALVES

A. Manufacturers:

1. Mueller Company

a. A-2361

2. Substitutions: Approved Equal

B. Resilient Wedge Gate Valves: AWWA C515, NSF 61, American-made; ductile iron.

1. Resilient seats.

2. Stem: Non-rising bronze stem.

3. Operating Nut: Square; open counterclockwise unless otherwise indicated.

4. Gearing

a. Bevel geared for horizontal installation.

b. Spur geared for vertical installation.

5. Valve Ends:

a. Mechanical joint or flanged or threaded, as indicated on Drawings.

b. Flanged ends shall be drilled in accordance with ANSI Class 125/150 bolt pattern, unless otherwise noted on Drawings.

c. Pressure rating not less than that of valve body.

6. Working pressure rating: 350 psi.

7. Pressure testing: Seat test – 525 psi for 15 seconds, test seat from each side of valve separately per UL262. Shell test pressure: 700 psi.

8. Inside and outside of valve fully coated with Fusion Bonded Epoxy, 10 mils nominal, conforming to AWWA C550 and NSF 61 requirements.

C. Where waterline is buried at a depth greater than 4 feet, provide valve stem extensions, complete with extension stem stabilizers, until depth of extension nut matches depth of operating nuts on valves installed at four-foot depth.

2.4 6-INCH BALL VALVE FOR BLOWOFF VALVES

A. Manufacturers:

1. Val-Matic Valve and Manufacturing Corporation

a. Series 4200

b. Substitutions: Approved equal.

2. Pressure Rating:

a. Rated to 150 psi full differential working pressure.

b. Shell test pressure 300 psi.

c. Leak test at 150 psi.

d. Ductile iron body with ductile iron ball

e. Stainless steel trim and external fasteners

3. Coating: Fusion bonded epoxy conforming to AWWA C550 and NSF 61; interior/exterior.

4. Valve Ends:

a. Flanged ends drilled in accordance with ANSI Class 125 bolt pattern.

b. Pressure rating not less than that of valve body.

B. Actuator for Blowoff

1. Direct buried service with 2” operating nut.

2.5 ORIFICE PLATES

A. Stainless steel 304

B. Thickness 3/8” or as shown on plans

C. Orifice shall be beveled at 45° angle, 3/16” deep on downstream side.

D. Fabrication:

1. Blowoff Valve Orifice Plates: Orifice plates shall be fabricated and drilled with a single concentric hole of the proper diameter for each installation as indicated on the Drawings. Both faces of the plate shall be machined smooth to remove all burrs, ridges and other imperfection in the flow area. Mating edges shall be machined to the same tolerances as flange mating faces (see Section 33 11 13). The orifice holes shall be machined to a tolerance of +/- 15 mils.

2.6 AIR VALVES

A. 2-inch combination air release valve:

1. Manufacturer:

a. Val-Matic Valve and Manufacturing Corporation. Model 202.C.2, single body Type.

b. Substitutions: Not permitted

2. Working pressure: 300 psi

3. Inlet: 2” NPT

4. Ductile iron body, cover and baffle; stainless steel trim, float, and fasteners.

5. Seat: Resilient Buna N.

6. Outlet:

a. Large orifice: 2”

b. Air release orifice: 3/32”

7. Stainless steel 304 piping, valve, and fittings

8. Internal and external coatings shall be fusion bonded epoxy conforming to NSF-61 requirements.

2.7 INFLOW PREVENTOR

A. Inflow Preventor for a 2-inch combination air release valve:

1. Manufacturer
   a. Valmatic Model 1300 Series
2. Female NPT thread
3. Materials
   a. The upper and lower chambers shall be constructed of ASTM A536, Grade 65-45-12 ductile iron.
   b. Float checks and trim shall be constructed of Type 316 stainless steel.
   c. Resilient seats shall be EPDM with fiberglass reinforcement.
4. Redundant float actuated closure members.
5. Heavy duty basket type screen.
6. FBE coated wall bracket shall be provided.
7. Stainless steel braided hose to attach to Air Valve.

2.8 DISMANTLING JOINTS

1. Manufacturer:
   a. ROMAC, Model DJ400
   b. Substitutions: Approved Equal
2. Flanges: ANSI Class 150
3. NSF 61 Certified fusion bonded epoxy coating
4. Color: Blue
5. Integral Tie Rods
6. 304 stainless steel fasteners (nuts, bolts, tie-rods)
7. Working pressure: 275 psi

2.9 BLOWOFF VALVE ASSEMBLIES

A. Components of blowoff valve assembly shall be as provided elsewhere in project specifications.

2.10 VALVE BOXES

A. 12-inch diameter Valves and Smaller: Cast iron, two-piece, slip type.

B. Valves larger than 12-inch diameter: Domestic cast iron, three-piece, slip type; round base.

C. Where waterline is buried at a depth greater than 4 feet, provide valve box extensions as required.

D. Cast iron lid marked “Water”.

E. Heavy duty, traffic rated.

F. Valve boxes with warning placards shall have locking lids with standard pentagon nut.

G. Underground Water Valve Locking Device
1. Protech Nail II or equal

2.11 PIPE SUPPORTS

A. Manufacturer:

1. Standon, S92 Series

2. Substitutions: Approved Equal

B. 304 stainless steel

C. Size per drawings

D. 8”x8”x3/8” thick base plate bolted to chamber floor

2.12 VALVE VAULTS

A. Concrete manhole sections conforming to ASTM C478 and ASTM C857.

1. Bell and spigot joints.

2. Symmetrical reinforcement only.

3. Soil-tight gasket conforming to ASTM C-990.

4. Embedded ladder rungs.

B. Concrete shall conform to Section 03 30 00 – Cast-in-Place Concrete.

C. Concrete shall be 4000 psi.

D. Manufactured or cut to lengths shown on Drawings.

E. “Mouse hole” or circular cut-outs to accommodate main line pipe inside vaults, if needed, shall be pre-cast.

F. Pre-fabricated reinforced flat, slab-type lids with hinged, lockable hatches as shown on Drawings.

1. Shallow well manhole covers, where indicated on Drawings, shall be 24” diameter, as provided by Four Corners Precast, OAE. Steel pipe used for shallow well covers may be domestic or import.

G. Square access covers:

1. Shallow Well Type

H. Foam insulation.

1. 2” minimum thickness
2. Spray Foam Insulation.
   a. 2-lb closed cell, two-component, rigid polyurethane.
   b. R Value per inch of 6.6 or greater (K factor 0.15 or less).
   c. Suitable for application to low temperature substrates (15°F).
   d. Waterproof mixture in sealant
3. Sheet insulation may be considered by the Engineer as a substitute if demonstrated to meet or exceed the properties of spray foam insulation, including resistance to moisture build up or condensation behind the insulation. The burden to demonstrate the properties of any substitute shall be borne by the Contractor.

I. Two-way draft damper

1. Manufacturers:
   a. Val-Matic, Frost Safe, VM-1504
   b. Substitutions: Approved Equal
2. Field replaceable disc that opens fully to provide full flow area in both directions without requiring annular clearance with the body.
3. Contains no hinges or seats subject to freezing

2.13 ACCESSORIES

A. Concrete for thrust restraints, blocks and collars: Concrete type specified in Section 03 30 00.

2.14 STEEL PIPES AND FITTINGS

A. All steel pipes and fittings shall be Stainless Steel 304, unless otherwise noted.

B. Pressure rating: At least 350 psi Cold Working Pressure, unless otherwise noted.

2.15 STAINLESS STEEL THREAD PROTECTION

A. All stainless steel threads shall be protected with Teflon graphite tape and/or anti-seize compound approved by manufacturer specifically for use with stainless steel threads.

2.16 CORROSION PROTECTION

A. Refer to Section 33 11 13.

2.17 SOURCE QUALITY CONTROL

A. Coatings:

1. Cure testing for fusion bonded or liquid epoxy coatings: ASTM D4752 and ASTM D3363, Every 1000 sq. ft. of epoxy coating.

2. Holiday testing for epoxy coatings:

   a. All fusion-bonded epoxy coatings on all valves shall be holiday tested prior to installation, at Contractor's expense.

   b. Perform testing in accordance with NACE Standard SP0274, using electrical holiday tester. Use test voltage below:

Total Coating Thickness (Mils)	Test Voltage (Volts)
20 or less	6000
30	7500
50	9000
70	11500
80 or more	12000

   c. All holidays shall be repaired and re-tested, at no additional cost to the Owner.

3. Touch up and repair of Fusion Bonded Epoxy Coatings

   a. Applies to all FBE coated valves for field repair of minor holidays, scratches, breaks or other damage to FBE coating.

   b. Does not include repair or touch up of systemic or large area holidays in FBE coating. Repair of systematic holidays or damaged areas larger than three (3) sq. in. will require the damaged coating be ground off and the valve be newly shop-coated.

   c. Materials and application:

      1) NSF/ ANSI 61 certified, two-part, 100% solids, liquid epoxy coating meeting the requirements of AWWA C210.

         a) Manufacturer: 3M Scotchkote Epoxy Coating 323, OAE.

         b) If temperature is below 55 degrees Fahrenheit, the metal substrate shall be pre-heated in accordance with coating manufacturer's recommendations prior to applying the coating.

   d. Prepare surface and apply per coating manufacturer's instructions for use as a field repair material. EXECUTION

2.18 EXAMINATION

A. Determine exact location and size of valves from Drawings; obtain clarification and directions from Engineer prior to execution of work.

B. Verify invert elevations prior to excavation and installation of valves.

2.19 PREPARATION

A. Identify required lines, levels, contours and datum locations.

B. Locate, identify, and protect utilities to remain from damage.

C. Do not interrupt existing utilities without permission or without making arrangements to provide temporary utility services.

1. Notify Engineer not less than 48 hours in advance of proposed utility interruption.

2. Do not proceed without written permission from the Engineer.

D. Perform trench excavation, backfilling and compaction in accordance with Sections 31 23 17 and 31 23 23.

2.20 INSTALLATION

A. Valve scribing: All valve collars shall be scribed with the valve data.

1. Valve collars shall be etched using a 4-inch grinder, with Engineer's approval in field.

2. All valve collars ("main line valves") and ARV Vaults shall be etched with the following valve data:

a. Flow directional arrows

b. Station number in standard "STA XXX+XX" format, including the abbreviation "STA" in front of the number

c. Pipe size (if different from valve size) and material

d. Valve size and type (i.e. ARV, VB, GV, BFV)

e. Number of turns to operate.

B. Valve Vaults

1. Thoroughly clean vault section ends with wire brush prior to joining sections.

2. Place vault sections with bell down.

3. Seal all vault sections with sealant approved by Engineer.

4. Grout lids as directed by Engineer.

5. Field apply foam insulation in accordance with manufacturer's instructions and recommendations. Personnel applying spray foam insulation shall be sufficiently trained by the manufacturer, the Center for the Polyurethane Industry, the Spray Polyurethane Foam Alliance, or similarly competent certifying body.

C. Apply heavy duty anti-seize to lubricate all stainless steel bolts. Anti-seize compound shall be recommended by manufacturer for use with stainless steel bolts.

D. Air Valve Assemblies

1. Install in accordance with AWWA standards and manufacturer's recommendations

2. After drilling into the main line, remove all pipe cuttings and other debris with a vacuum or other method approved by the engineer prior to installing the valve assembly.
3. Install air valve assemblies in vertical position.
4. Where indicated at high points in pipe on Drawings, install at actual high points, as determined by as-built pipeline survey data.
5. Secure assemblies to Unistruts as shown on Drawings to prevent lateral movement or stresses.
6. Reducing tees located in corrosive soil zones shall be cathodically protected.
7. Galvanized steel air vents shall be painted blue as follows:
    a. Minimum surface preparation: SSPC-SP1
    b. Primer: 1 coat Sherwin Williams Galvite HS, OAE
        1) 3.0-4.5 mils dry film thickness
    c. Finish: Two coats Sherwin Williams Industrial Enamel (B54 Series), OAE
        1) 2.0-4.0 mils dry film thickness
    d. Follow all other paint manufacturer recommendations for preparation and application.

E. Gate Valves and Butterfly Valves:

1. Install in accordance with AWWA standards and manufacturer's recommendations
2. Install valves in conjunction with pipe laying; set valves plumb.
3. Assemble complete valve assembly and place in open excavation at proper line and grade.
4. Provide buried valves with valve boxes or meter boxes installed as shown on drawings above finished grade.
    a. Any valve box lids, meter can lids, or collars that do not meet grade requirements shown on Drawings shall be removed and replaced.
5. Install valve stem risers, collars and valve box extensions as required to match finished grade.
6. Gate valves and butterfly valves shall require the same joint restraint lengths as dead-ends of similar size and pipe material.

F. Blowoff Valves:

1. Above grade discharges:
    a. All buried metallic pipes and fittings shall be cold-applied tape-wrapped in accordance with Section 33 11 13 – Public Water Transmission Systems.

b. Above-ground piping shall be painted blue, in accordance with this Section.

G. Assemble steel flanged joints in accordance with AWWA M11 and AWWA C207.

H. No high points in the pipe of any magnitude shall be allowed without an appropriate vacuum/ air valve. If the As-Built survey of the pipeline reveals high points not shown on the Drawings, Contractor shall correct the pipe grade or install additional air valves, as directed by Engineer.

1. Additional air valves required due to unforeseen field conditions not the fault of the Contractor shall be paid for at the prices established in the Bid. Contractor shall promptly report such conditions to the Engineer.

2. Additional air valves required due to high points caused through fault of the Contractor shall be provided at no additional cost to the Owner. This includes failure of Contractor to meet lines and grades set forth in the Drawings or failure to meet minimum pipe slope.

a. If the required air valve is located on a fusible or restrained section of main line, a reducing tee is required in lieu of tapping sleeve.

b. If a reducing tee is required within a corrosive soil zone, Contractor shall provide cathodic protection for the tee at no additional cost to the Owner.

3. Engineer shall determine which type of air valve is required at a given location.

I. Tracer wire:

1. For direct buried valves with surface valve box lids, tape tracer wire to outside of valve box up to last section of box. Bring tracer wire into the valve box above the operating nut. Coil 18” tracer wire inside valve box under the lid.

2. For direct buried valves with valve box lids inside meter cans, bring tracer wire into the meter can outside of the valve box. Coil 18” tracer wire inside meter can.

3. For all valve vaults, coil min. 24” tracer wire against wall on each side of vault.

J. All shallow well manhole covers, valve box lids, meter can lids, and other cast iron appurtenances visible from surface shall be painted blue as follows.

1. Minimum surface preparation: SSPC-SP2

2. Primer: Sherwin Williams Kem Kromik Universal Metal Primer, OAE

a. One coat, 3.0-4.0 mils dry film thickness

3. Finish: Sherwin Williams Industrial Enamel (B54 Series), OAE

a. Two coats, 2.0-4.0 mils dry film thickness

4. Follow all other paint manufacturer recommendations for preparation and application.

2.21 CORROSION PROTECTION

A. Refer to Section 33 11 13 and Drawings for designation of corrosive soil zones in which buried valve assemblies require cathodic protection and/or corrosion monitoring and for specifications for design, materials, installation, energizing and testing of cathodic protection systems.

B. Ferrous components not in contact with soil do not require cathodic protection.

C. Stainless steel components do not require cathodic protection.

D. Do not use polyethylene encasement for valves or fittings that have cathodic protection.

2.22 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Flush and disinfect system in accordance with Section 33 13 00.

2.23 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. Perform pressure test on domestic site water transmission system in accordance with AWWA C605.

C. All valves, including butterfly valves, gate valves, ball valves and air valves shall be manually actuated through their full cycle to ensure proper operation prior to installation.

1. The Contractor shall provide the Engineer the opportunity to witness all valve actuations prior to valve installation.

D. Inspect coatings of all valves immediately prior to installation and repair all damaged coatings.

E. Properly align all pipes, valves and fittings prior to making connections. Do not install any pipes or fittings with internal longitudinal or shear stresses. Engineer reserves the right to disassemble any flange, joint, or union to check for internal stresses. Contractor shall correct any connection with internal stress at no additional cost to the Owner.

F. All tracer wire must be field checked for continuity after all excavation is completed, but prior to Final Completion of the project.

END OF SECTION