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CITY OF KINDRED
STANDARD SPECIFICATIONS
FOR
CONSTRUCTION

I hereby certify that the attached specifications and details were prepared by me or under my direct supervisions and that I am a duly registered Professional Engineer under the laws of the State of North Dakota.



04.17.2026

Brandon Oye, PE
City Engineer

Date

This document was originally
issued and sealed by
Brandon Oye,
Registration Number
PE-6873
on 04.17.2026 and the original
document is stored
at Kindred City Hall.

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USER NOTES:

These Standard Specifications for Construction have been reviewed by the City Engineer and Public Works, and approved by the Kindred City Council. This review and approval does not eliminate the potential for errors or omissions within these documents. If it appears there are errors or omissions in any of the documents, please contact the City Engineer to discuss prior to utilizing those documents.

In addition, these documents were considered the “Standard” on the date they were reviewed and approved. All standards should be updated when possible to reflect best practices in the field of engineering and construction. If those that use these documents feel that the practices listed within these standards are not current, please contact the City Engineer to discuss prior to utilizing those documents.

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CITY OF KINDRED
STANDARD SPECIFICATIONS FOR CONSTRUCTION

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01 - GENERAL REQUIREMENTS

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Contract description.
2. Owner-furnished products.
3. Contractor's use of Site.
4. Work sequence.
5. Owner occupancy.
6. Specification conventions.

1.2 CONTRACT DESCRIPTION

A. Work of the Project includes construction of municipal facilities for the City of Kindred.

B. Perform Work of each Contract under unit price Contract with Owner according to Conditions of Contract.

C. Work of each separate Contract is identified in the Drawings.

1.3 OWNER-FURNISHED PRODUCTS

A. Owner's Responsibilities:

1. Arrange for and deliver Owner-reviewed Shop Drawings, Product Data, and Samples to Contractor.
2. Arrange and pay for delivery to Site.
3. Upon delivery, inspect products jointly with Contractor.
4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
5. Arrange for manufacturers' warranties, inspections, and service.

B. Contractor's Responsibilities:

1. Review Owner-reviewed Shop Drawings, Product Data, and Samples.
2. Receive and unload products at Site; inspect for completeness or damage jointly with Owner.
3. Handle, store, install, and finish products.
4. Repair or replace items damaged after receipt.

C. Items furnished by Owner for installation by Contractor are shown on the Drawings.

1.4 CONTRACTOR'S USE OF SITE

A. Limit use of Site to allow:

1. Owner occupancy.
2. Use of Site by the public as shown on the Drawings.

B. Construction Operations: Limited to areas indicated on Drawings.

C. Time Restrictions for Performing Work:

1. Monday through Saturday from 7:00 AM to 7:00 PM, unless otherwise noted.
2. Sunday and Holidays by permission only.

D. Utility Outages and Shutdown:

1. Coordinate and schedule electrical and other utility outages with Owner.
2. Outages: Allowed only at previously agreed upon times.

E. Sound Level Restrictions: Per Owner’s Noise Restriction Ordinance.

1.5 WORK SEQUENCE

A. Construct Work in order to accommodate Owner's occupancy requirements during construction period. Coordinate construction schedule and operations with Engineer:

1.6 OWNER OCCUPANCY

A. Schedule and substantially complete designated portions of the Work for occupancy before Substantial Completion of the entire Work.

1. Owner's use and occupancy of designated areas before Substantial Completion of the entire Project do not relieve Contractor of responsibility to maintain specified insurance coverages on a 100 percent basis until date of final payment.

B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

C. Schedule the Work to accommodate Owner occupancy.

1.7 SPECIFICATION CONVENTIONS

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

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION 011000

SECTION 012000 - PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cash Allowances.
2. Mobilization.
3. Testing and Inspection Allowances.
4. Schedule of Values.
5. Application for Payment.
6. Change Procedures.
7. Defect Assessment.
8. Unit Prices.
9. Alternates.

1.2 CASH ALLOWANCES

A. Costs Included in Cash Allowances: Cost of product to Contractor or Subcontractor, less applicable trade discounts; delivery to Site and applicable taxes unless stated otherwise in Allowance Schedule.

B. Costs Not Included in Cash Allowances but Included in Contract Price: Product handling at Site including unloading, uncrating, and storage; protection of products from elements and from damage; and labor for installation and finishing unless stated otherwise in Allowance Schedule.

C. Engineer Responsibilities:
1. Consult with Contractor for consideration and selection of products suppliers and installers.
2. Select products in consultation with Owner and transmit decision to Contractor.
3. Prepare Change Order.

D. Contractor Responsibilities:
1. Assist Engineer in selection of products, suppliers, and installers.
2. Obtain proposals from suppliers and installers and offer recommendations.
3. Upon notification of selection by Owner, execute purchase agreement with designated supplier and installer.
4. Arrange for and process Shop Drawings, Product Data, and Samples. Arrange for delivery.
5. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.

E. Differences in costs will be adjusted by Change Order.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Mobilization:

1. Scope: Preparatory work and operations including, but not limited to:
   a. Movement of personnel, equipment, and supplies;
   b. Establishment of temporary facilities;
   c. All other work and operations that must be performed, or costs incurred, before beginning work on the project.
2. Basis of Measurement: By lump sum (L SUM).
3. Basis of Payment: Partial contract payments will be made for mobilization using the following schedule. When the listed percentage of the original contract amount is earned, the percentage of the amount bid for mobilization, or the percentage of the original contract amount, whichever is less, will be paid.

Original Contract Earned Amount	Pay Lesser of:	
	Mobilization Bid Amount	Total Contract Amount
5%	25%	2.5%
10%	50%	5%
50%	100%	7.5%
75%	100%	--

B. Testing Allowance:

1. Costs Included in Testing and Inspecting Allowances:
   a. Quality Assurance (QA) testing.
   b. Execution of tests and inspecting.
   c. Reporting results.
2. Costs Not Included in Testing and Inspecting Allowance but shall be considered incidental to the contract:
   a. Quality Control (QC) testing.
   b. Cost of engaging testing and inspecting agency.
   c. Costs of incidental labor and facilities required to assist testing or inspecting agency.
   d. Costs of testing services used by Contractor separate from Contract Document requirements.
   e. Costs of retesting upon failure of previous tests as determined by Engineer.
3. Payment Procedures:
   a. Submit one copy of inspecting or testing firm's invoice with next Application for Payment.
   b. Pay invoice upon approval by Engineer.
4. Testing and Inspecting Allowance Schedule:
   a. Include dollar amount shown on the Bid Schedule for payment of testing laboratory services as specified in Section 014000 - Quality Requirements.
5. Differences in cost will be adjusted by Change Order.

1.4 SCHEDULE OF VALUES

A. If requested by Engineer, submit schedule on Progress Estimate schedule on EJCDC C-620.

B. Submit Schedule of Values within 30 days after date of Owner-Contractor Agreement.

C. Format: Provide Schedule of Values for each pay item identified with Lump Sum (L SUM) unit, where basis of payment is not provided in other portions of this specification.

D. Include in each line item amount of allowances as specified in this Section.

E. Include within each line item, direct proportional amount of Contractor's overhead and profit.

F. Revise schedule to list approved Change Orders with each Application for Payment.

1.5 APPLICATION FOR PAYMENT

A. Digitally submit Application for Payment on EJCDC C-620 - Contractor's Application for Payment.

B. Content and Format: Use Schedule of Values for listing items in Application for Payment.

C. Submit provided Application for Payment checklist with each Application for Payment, including the following information:

1. Updated Construction Progress Schedule.
2. Storm Water Pollution Prevention Plan inspection reports.
3. Documented “Bad Weather Days” as identified in the SC-4.05 of the Supplementary Conditions of the Construction Contract.
4. Change Proposal in accordance with Article 11, if within the last 30 days are there any events that would constitute a change in contract times or price in accordance with Article 4.05, Delay’s in Contractor’s Progress, Parts A, C, or F of the General Conditions of the Construction Contract.
5. Weekly payrolls for the application period. (if required by contract)
6. All materials that require Manufacturer’s Certification Letters, in accordance with funding requirements, included in this Pay Application, have been previously submitted or are attached. (if required by contract)

D. Payment Period: Submit at intervals stipulated in the Agreement.

E. Submit submittals with transmittal letter as specified in Section 013300 - Submittal Procedures.

1.6 CHANGE PROCEDURES

A. Submittals: Submit name of individual who is authorized to receive change documents and is responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.

B. Carefully study and compare Contract Documents before proceeding with fabrication and installation of Work. Promptly advise Engineer of any error, inconsistency, omission, or apparent discrepancy.

C. Requests for Interpretation (RFI) and Clarifications: Allot time in construction scheduling for liaison with Engineer; establish procedures for handling queries and clarifications.

1. Engineer may respond with a direct answer on the Request for Interpretation form, or EJCDC C-942 - Field Order.

D. Engineer will advise of minor changes in the Work not involving adjustment to Contract Price or Contract Time by issuing supplemental instructions on EJCDC C-942.

E. Engineer may issue Notice of Change including a detailed description of proposed change with supplementary or revised Drawings and Specifications, a change in Contract Time for executing the change and with the period of time during which the requested price will be considered valid. Contractor will prepare and submit estimate within 7 days.

F. Document requested substitutions according to Section 012500 - Substitution Procedures.

G. Stipulated Sum/Price Change Order: Based on Notice of Change and Contractor's price quotation or Contractor's request for Change Order as approved by Engineer.

H. Unit Price Change Order: For Contract unit prices and quantities, the Change Order will be executed on a fixed unit price basis. For unit costs or quantities of units of that which are not predetermined, execute Work under Work Directive Change. Changes in Contract Price or Contract Time will be computed as specified for Time and Material Change Order or Negotiated Unit Price Change Order.

I. Work Directive Change: Engineer may issue directive, on EJCDC C-940 - Work Change Directive signed by Owner, instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute change.

J. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in Conditions of the Contract. Engineer will determine change allowable in Contract Sum/Price and Contract Time as provided in Contract Documents.

K. Maintain detailed records of Work done on time and material basis. Provide full information required for evaluation of proposed changes and to substantiate costs for changes in the Work.

L. Document each quotation for change in Project Cost or Time with sufficient data to allow evaluation of quotation.

M. Change Order Forms: EJCDC C-941 - Change Order.

N. Execution of Change Orders: Engineer will issue Change Orders for signatures of parties as provided in Conditions of the Contract.

O. Correlation of Contractor Submittals:

1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
2. Promptly revise Progress Schedules to reflect change in Contract Time, revise subschedules to adjust times for other items of Work affected by the change, and resubmit.
3. Promptly enter changes in Record Documents.

1.7 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements.

B. If, in the opinion of Engineer, it is not practical to remove and replace the Work, Engineer will direct appropriate remedy or adjust payment.

C. The defective Work may remain, but unit sum/price will be adjusted to new sum/price at discretion of Owner.

D. Defective Work will be partially repaired according to instructions of Engineer and unit sum/price will be adjusted to new sum/price at discretion of Owner.

E. Individual Specification Sections may modify these options or may identify specific formula or percentage sum/price reduction.

F. Authority of Engineer to assess defects and identify payment adjustments is final.

G. Nonpayment for Rejected Products: Payment will not be made for rejected products for any of the following reasons:

1. Products wasted or disposed of in a manner that is not acceptable.
2. Products determined as unacceptable before or after placement.
3. Products not completely unloaded from transporting vehicle.
4. Products placed beyond lines and levels of the required Work.
5. Products remaining on hand after completion of the Work.
6. Loading, hauling, and disposing of rejected products.

1.8 UNIT PRICES

A. Items of work described herein are specifically listed in the Bid Form for separate measurement and payment.

B. No other item of Work required by the Drawings or Specifications shall be measured or paid for as a separate item, but shall be included as part of the listed unit price item to which the Work pertains. Failure to list all such related Work in the descriptions of unit price items shall not invalidate this stipulation.

C. Items shall include all costs for submittal of shop drawings, product data and operation and maintenance data, and providing start-up and system demonstration, where required.

D. Authority: Measurement methods are delineated in individual Specification Sections.

E. Measurement methods delineated in individual Specification Sections complement criteria of this Section. In event of conflict, requirements of individual Specification Section govern.

F. Take measurements and compute quantities. Engineer will verify measurements and quantities.

G. Unit Quantities: Quantities and measurements indicated on Bid Form are for Contract purposes only. Quantities and measurements supplied or placed in the Work shall determine payment.

1. When actual Work requires more or fewer quantities than those quantities indicated, provide required quantities at contracted unit sum/prices.
2. Measurements and quantities shall not be made or computed on those portions of work attributed to construction exceeding specified tolerances or variances, construction outside plan dimensions, or construction not meeting the Contract intent. Only with prior approval of Engineer shall such measurements and quantities be made or computed.

H. Payment Includes: Full compensation for required labor, products, tools, equipment, plant and facilities, transportation, services and incidentals; erection, application, or installation of item of the Work; overhead and profit.

I. Final payment for Work governed by unit prices will be made on basis of actual measurements and quantities accepted by Engineer multiplied by unit sum/price for Work incorporated in or made necessary by the Work.

J. Measurement of Quantities:

1. Weigh Scales: Inspected, tested, and certified by applicable State weights and measures department within past year.
2. Platform Scales: Of sufficient size and capacity to accommodate conveying vehicle.
3. Metering Devices: Inspected, tested, and certified by applicable State department within past year and calibrated prior to the start of the Work.
4. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel, or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
5. Measurement by Volume: Measured by cubic dimension using mean length, width, and height or thickness.
6. Measurement by Area: Measured by square dimension using mean length and width or radius.
7. Linear Measurement: Measured by linear dimension, at item centerline or mean chord.
8. Stipulated Sum/Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as completed item or unit of the Work.
9. Plan dimensions will be used to calculate the pay quantity for any Contract Item with a “P” designation. Adjustment of a “P” designated quantity will only be made if the dimensions of the Work are revised or the “P” designated quantity is incorrect. Adjustments will only be made for the revised or corrected portions of the “P” designated Contract Item.

10. Determinations of volume will be based on the following:
    a. Excavated Volume (EV) - Cubic Yard
        1) Cross-section method or digital surface model method to measure the material in its original position.
    b. Compacted Volume (CV) - Cubic Yard
        1) Cross-section method or digital surface model method to measure the compacted material in its final position, in accordance with the placement dimensions.
    c. Loose Volume in Vehicular Measure (LV) - Cubic Yard
        1) Measurement of material at the point of delivery will be made to the nearest 0.13 cu yd. Use of vehicles for hauling material may be of any size or type if vehicle body capacity can be easily determined and contents can be viewed. Engineer will determine the struck capacity for each vehicle. Mark the struck or level perimeter line on the inside of the box of each vehicle. Level the load. Provide over-allowance for settlement of the load during transit. Direction may be given to level any load upon its arrival at the point of delivery. Measurement will not be made on material heaped above the struck capacity of the vehicle. Deductions will be made in 0.65 cu. yd. increments on loads that contain less than the struck capacity. Provide hauling vehicles with a conspicuous, legible identification mark.
    d. Stockpiled Volume (SV) - Cubic Yard
        1) Cross section method or the digital surface model method to measure material in the stockpiled position. Shape the stockpile to a condition directed by the Engineer before measurement.

1.9 ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement. The Owner-Contractor Agreement may identify certain Alternates to remain an Owner option for a stipulated period of time.

B. Coordinate related Work and modify surrounding Work. Description for each Alternate is recognized to be abbreviated but requires that each change shall be complete for scope of Work affected.
    1. Coordinate related requirements among Specification Sections as required.
    2. Include as part of each Alternate: Miscellaneous devices, appurtenances, and similar items incidental to or necessary for complete installation.
    3. Coordinate Alternate with adjacent Work and modify or adjust as necessary to ensure integration.

C. Schedule of Alternates as identified in the Drawings.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION 012000

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quality assurance.
2. Product options.
3. Product substitution procedures.

1.2 QUALITY ASSURANCE

A. Contract(s) are based on products and standards established in Contract Documents without consideration of proposed substitutions.

B. Products specified define standard of quality, type, function, dimension, appearance, and performance required.

C. Substitution Proposals: Permitted for specified products except where specified otherwise. Do not substitute products unless substitution has been accepted and approved in writing by Owner.

1.3 PRODUCT OPTIONS

A. See Section 016000 - Product Requirements.

1.4 PRODUCT SUBSTITUTION PROCEDURES

A. Document EJCDC C-200 - Instructions to Bidders specifies time restrictions for submitting requests for substitutions during Bidding period.

B. Engineer may consider requests for substitutions only within 30 days after date of Owner-Contractor Agreement.

C. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.

D. Engineer’s decision of approval or denial of proposed items will be final.

E. Document each request with complete data, substantiating compliance of proposed substitution with Contract Documents, including:

1. Manufacturer's name and address, product, trade name, model, or catalog number, performance and test data, and reference standards.

2. Itemized point-by-point comparison of proposed substitution with specified product, listing variations in quality, performance, and other pertinent characteristics.
3. Reference to Article and Paragraph numbers in Specification Section.
4. Cost data comparing proposed substitution with specified product and amount of net change to Contract Sum.
5. Changes required in other Work.
6. Availability of maintenance service and source of replacement parts as applicable.
7. Certified test data to show compliance with performance characteristics specified.
8. Samples when applicable or requested.
9. Other information as necessary to assist Engineer's evaluation.

F. A request constitutes a representation that Bidder:

1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
2. Will provide same warranty for substitution as for specified product.
3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension that may subsequently become apparent.
5. Will coordinate installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.
6. Will reimburse Owner and Engineer for review or redesign services associated with reapproval by authorities having jurisdiction.

G. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals without separate written request or when acceptance will require revision to Contract Documents.

H. Substitution Submittal Procedure:

1. Submit requests for substitutions.
2. Submit three copies of Request for Substitution for consideration. Limit each request to one proposed substitution.
3. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
4. Engineer will notify Contractor in writing of decision to accept or reject request.

1.5 INSTALLER SUBSTITUTION PROCEDURES

A. Document EJCDC C-200 - Instructions to Bidders specifies time restrictions for submitting requests for substitutions during Bidding period.

B. Document each request with:

1. Installer's qualifications.
2. Installer's experience in work similar to that specified.
3. Other information as necessary to assist Engineer's evaluation.

C. Substitution Submittal Procedure:

1. Submit Request for Substitution for consideration. Limit each request to one proposed substitution.
2. Engineer will notify Contractor in writing of decision to accept or reject request.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION 012500

SECTION 013000 - ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Coordination and Project conditions.
2. Preconstruction meeting.
3. Progress meetings.
4. Closeout meeting.

1.2 COORDINATION AND PROJECT CONDITIONS

A. Coordinate scheduling, submittals, and Work of various Sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Verify that utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate Work of various Sections having interdependent responsibilities for installing, connecting to, and placing operating equipment in service.

C. Coordinate scheduling and work of utility companies to ensure efficient and orderly sequence of installation of construction elements.
1. Private utility companies shall have access to the site during the Contract in order to install their facilities. Initial coordination shall occur at the Preconstruction Conference, followed by schedule coordination as the work progresses in order for private utility installation to proceed in a swift, efficient manner
2. Unless otherwise noted, any removal, relocation, replacement, or bracing of power poles or any other utilities shall be incidental. Contractor to coordinate all utility relocations.

D. Coordination Meetings: In addition to other meetings specified in this Section, hold coordination meetings with personnel and Subcontractors to ensure coordination of Work.

E. Coordinate completion and clean-up of Work of separate Sections in preparation for Substantial Completion and for portions of Work designated for Owner's partial occupancy and for portions of Work designated for Owner's occupancy.

F. After Owner's occupancy of premises, coordinate access to Site for correction of defective Work and Work not complying with Contract Documents, to minimize disruption of Owner's activities.

G. Public Notice: Contractor and Resident Project Representative shall work together to create construction notices. Contractor to deliver construction notices to the affected residents and businesses. Hand-delivered construction notices shall not be placed in mailboxes. Place notices securely in front doors or an equally conspicuous location. Construction notices may include

information about multiple activities, but if the schedule of operations will deviate from the schedule shown on a particular notice, a revised notice must be delivered. At a minimum, construction notices shall detail:

1. Contractor and Engineer contact information.
2. Type of construction activity about to take place and what can be expected.
3. Duration of the activity and when the activity will cease.
4. Next activity that will take place.
5. When normal conditions will be restored.

1.3 PRECONSTRUCTION MEETING

A. Engineer will schedule and preside over meeting after Notice of Award.

B. Attendance Required: Engineer, Owner, City of Kindred representatives, Resident Project Representative, Contractor, major Subcontractors, appropriate governmental agency representatives, and utility companies.

C. Minimum Agenda:

1. Execution of Owner-Contractor Agreement.
2. Submission of executed bonds and insurance certificates.
3. Distribution of Contract Documents.
4. Submission of list of Subcontractors, list of products, schedule of values, Bluebook rates of all equipment, and Progress Schedule.
5. Designation of personnel representing parties in Contract: Contractor, Owner, and Engineer.
6. Communication procedures.
7. Procedures and processing of requests for interpretations, field decisions, field orders, submittals, substitutions, Applications for Payments, proposal request, Change Orders, and Contract closeout procedures.
8. Scheduling.
9. Critical Work sequencing.
10. Scheduling activities of Geotechnical Engineer.
11. Owner’s policies, procedures, and concerns.
12. Funding Agency requirements for construction (if applicable).
13. Use of premises by Owner and Contractor.

D. Engineer will record minutes and distribute to participants within two (2) business days after meeting.

1.4 PROGRESS MEETINGS

A. Schedule and administer weekly meetings throughout progress of the Work.

B. Engineer will make arrangements for meetings, prepare agenda with copies for participants, and preside over meetings.

C. Attendance Required: Engineer, Owner, Contractor (job superintendent), major Subcontractors, and others as appropriate to the agenda topics for each meeting.

D. Minimum Agenda:

1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems, and decisions.
4. Identification of problems impeding planned progress.
5. Review of submittal schedule and status of submittals.
6. Review of off-Site fabrication and delivery schedules.
7. Maintenance of Progress Schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on Progress Schedule and coordination.
13. Other business relating to Work.

E. Engineer will record minutes and distribute to participants within two (2) business days after the meeting.

1.5 CLOSEOUT MEETING

A. Schedule Project closeout meeting with sufficient time to prepare for requesting Substantial Completion. Preside over meeting and be responsible for minutes.

B. Attendance Required: Engineer, Owner, Contractor, major Subcontractors, appropriate governmental agency representatives, and others appropriate to the agenda.

C. Notify Engineer one (1) week in advance of proposed meeting date.

D. Minimum Agenda:

1. Start-up of facilities and systems.
2. Operations and maintenance manuals.
3. Testing, adjusting, and balancing.
4. System demonstration and observation.
5. Operation and maintenance instructions for Owner's personnel.
6. Contractor's inspection of Work.
7. Contractor's preparation of an initial "punch list."
8. Procedure to request Engineer inspection to determine date of Substantial Completion.
9. Completion time for correcting deficiencies.
10. Inspections by authorities having jurisdiction.
11. Certificate of Occupancy and transfer of insurance responsibilities.
12. Partial release of retainage.
13. Final cleaning.
14. Preparation for final inspection.
15. Closeout Submittals:

a. Project record documents.
b. Operating and maintenance documents.
c. Operating and maintenance materials.
d. Affidavits.

16. Final Application for Payment.
17. Contractor's demobilization of Site.
18. Maintenance.

E. Engineer will record minutes and distribute to participants within two days after meeting, to Contractor, Owner, and those affected by decisions made.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION 013000

SECTION 013216 - CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Submittals.
2. Bar chart schedules.
3. Review and evaluation.
4. Updating schedules.
5. Distribution.

1.2 SUBMITTALS

A. Submit digitally to Engineer.

B. Schedule Updates:

1. Overall percent complete, projected and actual.
2. Completion progress by listed activity and sub activity, to within five working days prior to submittal.
3. Changes in Work scope and activities modified since submittal.
4. Delays in submittals or resubmittals, deliveries, or Work.
5. Adjusted or modified sequences of Work.
6. Other identifiable changes.
7. Revised projections of progress and completion.

1.3 BAR CHART SCHEDULES

A. Format: Computer generated Gantt chart schedule, to include at least:

1. Identification and listing in chronological order of those activities reasonably required to complete the Work, including:
   a. Activity location.
   b. Subcontract Work.
   c. Major equipment design, fabrication, factory testing, and delivery dates including required lead times.
   d. Equipment and equipment system test and startup activities.
   e. Project closeout and cleanup.
   f. Work sequences, constraints, and milestones.
2. Listings identified by Specification Section number.
3. Identification of the following:
   a. Horizontal time frame by year, month, and week.
   b. Duration, early start, and completion for each activity and subactivity.

c. Critical activities and Project float.
d. Subschedules to further define critical portions of Work.

1.4 REVIEW AND EVALUATION

A. Participate in joint review and evaluation of schedules with Engineer at each submittal.

B. Evaluate Project status to determine Work behind schedule and Work ahead of schedule.

C. After review, revise schedules incorporating results of review, and resubmit within 10 days.

1.5 UPDATING SCHEDULES

A. Submit updated schedules with each Pay Application and following events impacting the Work.

B. Maintain schedules to record actual start and finish dates of completed activities.

C. Indicate progress of each activity to date of revision, with projected completion date of each activity. Update schedules to depict current status of Work.

D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.

E. Upon approval of a Change Order, include the change in the next schedule submittal.

F. Indicate changes required to maintain Date of Substantial Completion.

G. Submit reports as required to support recommended changes.

H. Prepare narrative report to define problem areas, anticipated delays, and impact on schedule. Report corrective action taken or proposed and its effect including effects of changes on schedules of separate Contractors.

1.6 DISTRIBUTION

A. Following joint review, distribute copies of updated schedules to Contractor's Project site file, to Subcontractors, suppliers, Engineer, Owner , and other concerned parties.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections shown in schedules.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION 013216

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Definitions.
2. Submittal procedures.
3. Construction progress schedules.
4. Proposed product list.
5. Product data.
6. Shop Drawings.
7. Samples.
8. Other submittals.
9. Test reports.
10. Certificates.
11. Manufacturer's instructions.
12. Manufacturer's field reports.
13. Erection Drawings
14. Contractor review.
15. Engineer review.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action.

B. Informational Submittals: Written and graphic information and physical Samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL PROCEDURES

A. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.

B. Transmit each submittal to Engineer with the following data:
1. Transmittal register in table format with the following data columns:
    a. Submittal Item Number
    b. Item Description
    c. Associated Bid Item
    d. Specification Number

2. Product Data Sheets labeled as follows:
   a. Submittal Number
   b. Submittal Item Number

C. Identify:

1. Project, Contractor, Subcontractor and supplier, pertinent Drawing and detail number, and Specification Section number appropriate to submittal.

D. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is according to requirements of the Work and Contract Documents.

E. Schedule submittals to expedite Project, and submit electronic submittals via email as PDF electronic files. Coordinate submission of related items.

F. For each submittal for review, allow 15 days excluding delivery time to and from Contractor.

G. Identify variations in Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.

H. Allow space on submittals for Contractor and Engineer review stamps.

I. When revised for resubmission, identify changes made since previous submission.

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

K. Submittals not requested will not be recognized nor processed.

L. Incomplete Submittals:

1. Engineer will not review incomplete submittals.
2. Complete submittals for each item are required.
3. Delays resulting from incomplete submittals are not the responsibility of Engineer or Owner.

1.4 CONSTRUCTION PROGRESS SCHEDULES

A. As specified in Section 013216 - Construction Progress Schedule.

1.5 PROPOSED PRODUCT LIST

A. Within 15 days after date of Notice to Proceed, 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, indicate manufacturer, trade name, model or catalog designation, and reference standards.

1.6 PRODUCT DATA

A. Product Data: Action Submittal: Submit to Engineer for review for assessing conformance with information given and design concept expressed in Contract Documents.

B. Submit electronic submittals via email as PDF electronic files.

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

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

E. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 017000 - Execution and Closeout Requirements.

1.7 SHOP DRAWINGS

A. Shop Drawings: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.

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

C. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Engineer responsible for designing components shown on Shop Drawings.

1. Include signed and sealed calculations to support design.
2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
3. Make revisions and provide additional information when required by authorities having jurisdiction.

D. Electronic submittals via email as PDF electronic files.

E. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 017000 - Execution and Closeout Requirements.

1.8 SAMPLES

A. Samples: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.

B. Samples for Selection as Specified in Product Sections:

1. Submit to Engineer for aesthetic, color, and finish selection.
2. Submit Samples of finishes, textures, and patterns for Engineer selection.

C. Submit Samples to illustrate functional and aesthetic characteristics of products, with integral parts and attachment devices. Coordinate Sample submittals for interfacing work.

D. Include identification on each Sample, with full Project information.

E. Submit number of Samples specified in individual Specification Sections; Engineer will retain one Sample.

F. Reviewed Samples that may be used in the Work are indicated in individual Specification Sections.

G. Samples will not be used for testing purposes unless specifically stated in Specification Section.

H. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 017000 - Execution and Closeout Requirements.

1.9 OTHER SUBMITTALS

A. Closeout Submittals: Comply with Section 017000 - Execution and Closeout Requirements.

B. Informational Submittal: Submit data for Engineer's knowledge as Contract administrator or for Owner.

C. Submit information for assessing conformance with information given and design concept expressed in Contract Documents.

1.10 TEST REPORTS

A. Informational Submittal: Submit reports for Engineer's knowledge as Contract administrator or for Owner.

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

1.11 CERTIFICATES

A. Informational Submittal: Submit certification by manufacturer, installation/application Subcontractor, or Contractor to Engineer, in quantities specified for Product Data.

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

C. Certificates may be recent or previous test results on material or product but must be acceptable to Engineer.

1.12 MANUFACTURER'S INSTRUCTIONS

A. Informational Submittal: Submit manufacturer's installation instructions for Engineer's knowledge as Contract administrator or for Owner.

B. Submit printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, to Engineer in quantities specified for Product Data.

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

1.13 MANUFACTURER'S FIELD REPORTS

A. Informational Submittal: Submit reports for Engineer's knowledge as Contract administrator or for Owner.

B. Submit report within 5 days of observation to Engineer for information.

C. Submit reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

1.14 ERECTION DRAWINGS

A. Informational Submittal: Submit Drawings for Engineer's knowledge as Contract administrator or for Owner.

B. Submit Drawings for information assessing conformance with information given and design concept expressed in Contract Documents..

C. Data indicating inappropriate or unacceptable Work may be subject to action by Engineer or Owner.

1.15 CONTRACTOR REVIEW

A. Review for compliance with Contract Documents and approve submittals before transmitting to Engineer.

B. Contractor: Responsible for:

1. Determination and verification of materials including manufacturer's catalog numbers.
2. Determination and verification of field measurements and field construction criteria.
3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
4. Determination of accuracy and completeness of dimensions and quantities.
5. Confirmation and coordination of dimensions and field conditions at Site.
6. Construction means, techniques, sequences, and procedures.
7. Safety precautions.
8. Coordination and performance of Work of all trades.

C. Stamp, sign or initial, and date each submittal to certify compliance with requirements of Contract Documents.

D. Do not fabricate products or begin Work for which submittals are required until approved submittals have been received from Engineer.

1.16 ENGINEER REVIEW

A. Do not make "mass submittals" to Engineer. "Mass submittals" are defined as six or more submittals or items in one day or 20 or more submittals or items in one week. If "mass submittals" are received, Engineer's review time stated above will be extended as necessary to perform proper review. Engineer will review "mass submittals" based on priority determined by Engineer after consultation with Owner and Contractor.

B. Informational submittals and other similar data are for Engineer's information, do not require Engineer's responsive action, and will not be reviewed or returned with comment.

C. Submittals made by Contractor that are not required by Contract Documents may be returned without action.

D. Submittal approval does not authorize changes to Contract requirements unless accompanied by Change Order, Field Order, Construction Change Directive, or Work Change Directive.

E. Owner may withhold monies due to Contractor to cover additional costs beyond the second submittal review.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quality control.
2. Tolerances.
3. References.
4. Labeling.
5. Testing and inspection services.
6. Manufacturers' field services.

1.2 QUALITY CONTROL

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

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

C. Perform Work using persons qualified to produce required and specified quality.

D. Products, materials, and equipment may be subject to inspection by Engineer at place of manufacture or fabrication. Such inspections shall not relieve Contractor of complying with requirements of Contract Documents.

E. Supervise performance of Work in such manner and by such means to ensure that Work, whether completed or in progress, will not be subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

1.3 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' recommended tolerances and tolerance requirements in reference standards. When such tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.4 REFERENCES

A. For products or workmanship specified by association, trade, referenced specifications (e.g. State Transportation Standards), or other consensus standards, comply with requirements of standard except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard including any supplements by date of issue current as of date for receiving Bids except where specific date is established by code.

C. Obtain copies of standards and maintain on Site when required by product Specification Sections.

D. When requirements of indicated reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

E. Neither contractual relationships, duties, responsibilities of parties in Contract nor those of Engineer shall be altered from Contract Documents by mention or inference in reference documents.

F. Contract Requirements and General Requirements within the Contract Documents shall take precedence over any General Provisions or General Requirements of reference standards.

1.5 LABELING

A. Attach label from agency approved by authorities having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.

B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label:

1. Model number.
2. Serial number.
3. Performance characteristics.

C. Manufacturer's Nameplates, Trademarks, Logos, and Other Identifying Marks on Products: Not allowed on surfaces exposed to view in public areas, interior or exterior.

1.6 TESTING AND INSPECTION SERVICES

A. Contractor shall pay for testing services from cash allowances specified in Section 012000 - Price and Payment Procedures.

B. Employ services of an independent testing agency or laboratory acceptable to Owner to perform specified testing.

1. Before starting Work, submit testing laboratory name, address, and telephone number, and names of full-time Professional Engineer specialist and responsible officer.
2. Submit copy of report of laboratory facilities' inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of deficiencies reported by inspection.

C. Independent firm will perform tests, inspections, and other services specified for soils, aggregates, concrete, pile testing, riprap, bituminous and concrete paving, water balance of ponds, in individual Specification Sections and as required by Engineer.

1. Laboratory: Authorized to operate at Project location.
2. Laboratory Staff: Maintain full-time Professional Engineer on staff to review services.
3. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.

D. All other required testing such as disinfection, installed pipe and manhole testing, and manufacturer testing shall be the responsibility of the Contractor.

E. Testing, inspections, and source quality control may occur on or off Project Site. Perform off-Site testing as required by Engineer or Owner.

F. Reports shall be submitted by independent firm to Engineer, Contractor, and authorities having jurisdiction, indicating observations and results of tests and compliance or noncompliance with Contract Documents.

1. Submit final report indicating correction of Work previously reported as noncompliant.

G. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.

1. Notify Engineer and independent firm 24 hours before expected time for operations requiring services.
2. Make arrangements with independent firm and pay for additional Samples and tests required for Contractor's use.

H. Employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work according to requirements of Contract Documents.

I. Retesting or re-inspection required because of nonconformance with specified or indicated requirements shall be performed by same independent firm on instructions from Engineer. Payment for retesting or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.

J. Agency Responsibilities:

1. Test Samples of mixes submitted by Contractor.
2. Provide qualified personnel at Site. Cooperate with Engineer and Contractor in performance of services.
3. Perform indicated sampling and testing of products according to specified standards.
4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
5. Promptly notify Engineer and Contractor of observed irregularities or nonconformance of Work or products.
6. Perform additional tests required by Engineer.
7. Attend preconstruction meetings and progress meetings.

K. Agency Reports: After each test, promptly submit copies of report to Engineer, Contractor, and authorities having jurisdiction. When requested by Engineer, provide interpretation of test results. Include the following:

1. Date issued.
2. Project title and number.
3. Name of inspector.
4. Date and time of sampling or inspection.
5. Identification of product and Specification Section.
6. Location in Project.
7. Type of inspection or test.
8. Date of test.
9. Results of tests.
10. Conformance with Contract Documents.

L. Limits on Testing Authority:

1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency or laboratory may not approve or accept any portion of the Work.
3. Agency or laboratory may not assume duties of Contractor.
4. Agency or laboratory has no authority to stop the Work.

1.7 MANUFACTURER'S FIELD SERVICES

A. When specified in individual Specification Sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe Site conditions, conditions of surfaces and installation, quality of workmanship, startup of equipment, testing, adjusting, and balancing of equipment commissioning as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to Engineer 30 days in advance of required observations. Observer is subject to approval of Engineer.

C. Report observations and Site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions.

D. In accordance with Section 013300 - Submittal Procedures, subsection "Manufacturer's Field Reports".

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION 014000

SECTION 014126 - PERMITS REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preconstuction Submittals.
2. Owner Provided Permits.
3. Contractor Obtained Permits.
4. Closeout Submittals.

B. Related Requirements:

1. Section 011000 - Summary.
2. Section 013000 - Administrative Requirements.
3. Section 013300 - Submittal Procedures.
4. Section 015000 - Temporary Facilities and Controls.
5. Section 017000 - Execution and Closeout Requirements.

C. General Permit Requirements:

1. Obtain permits required for the execution of the Work.
2. A list of known permits required is provided in this Section, along with the entity responsible for obtaining the permits. Completeness of the list is not guaranteed by Owner. The absence of information does not relieve Contractor of responsibility for determining and verifying the extent of permits required and for obtaining permits.
3. Furnish copies of permits obtained by the Contractor to the Engineer.
4. Comply with conditions of the permits and with Laws and Regulations applicable to the performance of the Work, in accordance with General Conditions, Paragraphs 7.09 Permits and 7.11 Laws and Regulations.
5. Inform Engineer of conflicts between permit requirements and the Contract Documents. Comply with permit requirements.
6. Copies of permits obtained by Owner will be provided by the Engineer. Maintain a notebook of permits onsite during construction.

1.2 PRECONSTRUCTION SUBMITTALS

A. Furnish submittals in accordance with Section 013300 - Submittal Procedures.

B. Submit copies of permits and approvals for construction as required by Laws and Regulations and governing agencies within 14 days of approval.

C. Submit copies of compliance reports or other documentation whether submitted by Contractor to a regulatory agency or provided to Contractor by a regulatory agency within two (2) business days of receipt.

1.3 SUMMARY OF PERMITS

A. Owner provided permits:

1. As listed on the Drawings.

B. Contractor obtained permits:

1. North Dakota Department of Environmental Quality.
   a. Permit Name: National Pollutant Discharge Elimination System (NPDES) General Construction Permit NDR11-0000.
   b. Permit covers: Construction site stormwater discharges.
   c. Permittee: City of West Fargo.
   d. Prepare a project specific SWPPP and submit to the Engineer in accordance with the General Permit and these Specifications. An electronic template of the SWPPP is available on the North Dakota Department of Environmental Quality web site at https://deq.nd.gov/WQ/2_NDPDES_Permits/7_Stormwater/StW.aspx.
      1) Drawings and selected supporting data for the Storm Water Pollution Prevention Plan (SWPPP) will be provided by Owner.
         a) Supplied Drawings and data represent the minimum requirements established by the Owner, but do not satisfy all permit requirements for the SWPPP.
         b) Contractor must complete all additional information required under the General Permit.
      2) The Engineer will review the SWPPP within seven (7) working days once a complete SWPPP submittal is received.
   e. Submit a Notice of Intent (NOI) to the Engineer for Owner's review and signature. An electronic template of the NOI is available on the North Dakota Department of Environmental Quality web site at https://deq.nd.gov/WQ/2_NDPDES_Permits/7_Stormwater/StW.aspx.
      1) The Engineer will review and submit the NOI to the Owner for signature within 7 working days once a complete NOI is received.
      2) The Engineer will return a signed copy of the NOI to the Contractor.

1.4 CLOSEOUT SUBMITTALS

A. Notice of Termination (NOT): Submit to the Engineer for review and signature prior to transmitting.

B. SWPPP Records: Submit the SWPPP including all revisions, if applicable, to the Engineer along with all inspection reports and documentation required for record keeping and record retention as required by the Permit.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION 014126

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Temporary Utilities:
   a. Temporary sanitary facilities.
   b. Temporary water.

2. Construction Facilities:
   a. Field offices and sheds.
   b. Vehicular access.
   c. Parking.
   d. Progress cleaning and waste removal.
   e. Traffic regulation.
   f. Haul roads.

3. Temporary Controls:
   a. Barriers.
   b. Enclosures and fencing.
   c. Water control.
   d. Dust control.
   e. Erosion and sediment control.
   f. Noise control.
   g. Pollution control.

4. Removal of utilities, facilities, and controls.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Traffic Control

1. Basis of Measurement: By lump sum (L SUM).
2. Basis of Payment: Includes furnishing, installing, and maintaining any traffic control signs, barricades, fencing, and other warning devices; relocating or removing devices as indicated by the Work progress; and providing watch persons to patrol the Work according to the Traffic Control Plan and/or in accordance with this section.
3. Payment will be made as follows:
   a. 25% upon project commencement,
   b. 50% at 50% contract earned, and
   c. 100% at final payment.

B. Temporary Water

1. Basis of Measurement: By lump sum (L SUM).
2. Basis of Payment: Includes supply, installation, disinfection, maintenance, and removal of temporary above-ground water mains and service lines to all affected properties. If Contractor intends to use portions of the existing main as temporary water, any costs associated with isolating and maintaining the existing system to be included in this item.
3. Payment will be made as follows:
   a. 75% upon installation and operation;
   b. 100% upon removal of temporary items and final connection to City water.

1.3 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Existing facility use is not permitted. Provide facilities at time of Project mobilization

1.4 TEMPORARY WATER

A. Provide temporary water service to affected residences and businesses during construction of water main replacement or other related items.

B. Utilize above-ground piping or existing water main.

C. Extend branch piping with outlets located so that water is available by hoses with threaded connections. Provide temporary pipe insulation and heat tape to prevent freezing.

D. Provide adequate pressures and flows such that normal water use is not disrupted.

E. Provide 48 hours notice to Engineer, Owner, and residents prior to water shut-off and switching to temporary water service.

F. Provide 24 hour supervision, including weekends and holidays, of temporary water system by personnel skilled in operation, maintenance, and replacement of system components.

G. Utilize temporary above-ground piping approved by the local authority, meets NSF Standard 61, approved by the manufacturer for above-ground use.

H. Disinfect, with the exception that a minimum chlorine residual of 50 ppm shall be used, and test, for bacteriological quality, temporary above-ground water piping in accordance AWWA Standard C651.

1.5 FIELD OFFICES AND SHEDS

A. Do not use existing facilities for field offices or for storage.

B. Locate field offices and sheds a minimum distance of 30 feet from existing and new structures.

C. Do not use permanent facilities for field offices or for storage.

D. Construction: Portable or mobile buildings, or buildings constructed with floors raised aboveground, securely fixed to foundations with steps and landings at entrance doors.

1. Construction: Structurally sound, secure, weathertight enclosures for office and storage spaces. Maintain during progress of Work; remove enclosures at completion of Work.
2. Thermal Resistance of Floors, Walls, and Ceilings: Compatible with occupancy and storage requirements.
3. Exterior Materials: Weather-resistant, finished in one color acceptable to Engineer.

E. Storage Areas and Sheds: Size to storage requirements for products of individual Sections, allowing for access and orderly provision for maintenance and inspection of products to suit requirements in Section 016000 - Product Requirements.

F. Preparation: Fill and grade Sites for temporary structures sloped for drainage away from buildings.

G. Removal: At completion of Work remove buildings, foundations, utility services, and debris. Restore areas to same or better condition as original condition.

1.6 VEHICULAR ACCESS

A. Construct temporary all-weather access roads from public thoroughfares to serve construction area, of width and load-bearing capacity to accommodate unimpeded traffic for construction purposes.

B. Construct temporary bridges and culverts to span low areas and allow unimpeded drainage.

C. Extend and relocate vehicular access as Work progress requires and provide detours as necessary for unimpeded traffic flow.

D. Locate as approved by Engineer.

E. Provide unimpeded access for emergency vehicles. Maintain 20 foot-wide driveways with turning space between and around combustible materials.

F. Provide and maintain access to fire hydrants and control valves free of obstructions.

G. Provide means of removing mud from vehicle wheels before entering streets.

H. Use designated existing on-Site roads for construction traffic.

1.7 PARKING

A. Provide temporary gravel surface parking areas to accommodate construction personnel.

B. Locate as approved by Engineer.

C. If Site space is not adequate, provide additional off-Site parking.

D. Use of existing on-Site streets and driveways used for construction traffic is permitted. Tracked vehicles are not allowed on paved areas.

E. Do not allow heavy vehicles or construction equipment in parking areas.

F. Permanent Pavements and Parking Facilities:

1. Bases for permanent roads and parking areas may be used for construction traffic.
2. Avoid traffic loading beyond paving design capacity. Tracked vehicles are not allowed.

G. Maintenance:

1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow, ice, and the like.
2. Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original condition.

H. Removal and Repair:

1. Remove temporary materials and construction when permanent paving is usable.
2. Repair existing facilities damaged by use, to original condition.

I. Mud from Site vehicles: Provide means of removing mud from vehicle wheels before entering streets.

1.8 PROGRESS CLEANING AND WASTE REMOVAL

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

B. Sweep the roadway adjacent to the construction area at the end of each day. Sweep paved areas that were used by construction traffic before opening these areas to public traffic. Sweep all newly constructed pavement no more than 24 hours before a scheduled final inspection. Use a vacuum type sweeper to perform this work.

C. Coordinate garbage pickup when construction does not allow pickup by regular means. Collect and deliver waste for disposal if necessary.

1.9 TRAFFIC REGULATION

A. Provide in accordance with latest edition of the MUTCD and North Dakota State Supplements with all its revisions.

B. Signs, Signals, and Devices:

1. Post-Mounted and Wall-Mounted Traffic Control and Informational Signs: As approved by authorities having jurisdiction.
2. Traffic Control Signals: As approved by local jurisdictions.
3. Traffic Cones, Drums, Flares, and Lights: As approved by authorities having jurisdiction.
4. Flag Person Equipment: As required by authorities having jurisdiction.

C. Flag Persons: Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

D. Flares and Lights: Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

E. Haul Routes:

1. Consult with authorities having jurisdiction and establish public thoroughfares to be used for haul routes and Site access.
2. Confine construction traffic to designated haul routes.
3. Provide traffic control at critical areas of haul routes to regulate traffic and to minimize interference with public traffic.

F. Traffic Signs and Signals:

1. Provide signs at approaches to Site and on Site, at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.
2. Provide, operate, and maintain traffic control signals to direct and maintain orderly flow of traffic in areas under Contractor's control and areas affected by Contractor's operations.
3. Relocate signs and signals as Work progresses, to maintain effective traffic control.

G. Removal:

1. Remove equipment and devices when no longer required.
2. Repair damage caused by installation.
3. Remove post settings to depth of 2 feet.

1.10 HAUL ROADS

A. Take whatever steps necessary to insure that no overloading occurs.

B. Insure that no city, county, state or other restrictions are violated.

C. Become familiar with all local regulations before starting construction.

D. Repair any road damaged to the original condition at the contractor's expense, to the satisfaction of the engineer.

1.11 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to allow for Owner's use of Site, and to protect existing facilities and adjacent properties from damage from construction operations.

B. Tree and Plant Protection: Preserve and protect existing trees and plants designated to remain.

1. Protect areas within drip lines from traffic, parking, storage, dumping, chemically injurious materials and liquids, ponding, and continuous running water.
2. Provide 6-foot-high barriers around drip line, with access for maintenance.
3. Replace trees and plants damaged by construction operations.

1.12 WATER CONTROL

A. Grade Site to drain. Maintain excavations free of water. Provide, operate, and maintain necessary pumping equipment.

B. Protect Site from puddles or running water. Provide water barriers as required to protect Site from soil erosion.

1.13 DUST CONTROL

A. Execute Work by methods that minimize raising dust from construction operations.

1.14 NOISE CONTROL

A. Provide methods, means, and facilities to minimize noise produced by construction operations.

1.15 POLLUTION 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. Comply with pollution and environmental control requirements of authorities having jurisdiction.

1.16 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, and materials before Final Application for Payment inspection.

B. Remove underground installations to minimum depth of 2 feet. Grade Site as indicated on Drawings.

C. Clean and repair damage caused by installation or use of temporary Work.

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

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Products.

B. Product delivery requirements.

C. Product storage and handling requirements.

D. Product options.

E. Equipment electrical characteristics and components.

1.2 PRODUCTS

A. At minimum, comply with specified requirements and reference standards.

B. Specified products define standard of quality, type, function, dimension, appearance, and performance required.

C. Furnish products of qualified manufacturers that are suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise. Confirm that manufacturer's production capacity can provide sufficient product, on time, to meet Project requirements.

1.3 PRODUCT DELIVERY REQUIREMENTS

A. Transport and handle products according to manufacturer's instructions.

B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.

C. Provide equipment and personnel to handle products; use methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Store and protect products according to manufacturer's instructions.

B. Store products with seals and labels intact and legible.

C. Store sensitive products in weather tight, climate-controlled enclosures in an environment suitable to product.

D. For exterior storage of fabricated products, place products on sloped supports aboveground.

E. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

F. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.

G. Provide equipment and personnel to store products; use methods to prevent soiling, disfigurement, or damage.

H. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

I. Storage of materials on City streets is not allowed unless approved by Engineer. Contractor shall be responsible for obtaining any storage or staging areas as needed for their operations.

1.5 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Products complying with specified reference standards or description.

B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and complying with Specifications; no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit Request for Substitution for any manufacturer not named, according to Section 012500 - Substitution Procedures.

1.6 PRODUCTS ON CONTACT WITH DRINKING WATER

A. All products (treatment chemicals and materials) that may come into contact with water intended for use in a public water system shall be certified to American National Standards Institute (ANSI) /National Sanitation Foundation (NSF) International Standards 14, 60, 61, or 372 as appropriate.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION - Not Used

END OF SECTION 016000

SECTION 017000 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Field engineering.
2. Closeout procedures.
3. Starting of systems.
4. Demonstration and instructions.
5. Testing, adjusting, and balancing.
6. Operation and maintenance data.
7. Manual for materials and finishes.
8. Manual for equipment and systems.
9. Spare parts and maintenance products.
10. Product warranties and product bonds.
11. Examination.
12. Preparation.
13. Execution.
14. Protecting installed construction.
15. Final cleaning.

1.2 FIELD ENGINEERING

A. Owner will furnish field engineering services to the extent indicated.

B. Owner will strive to complete the work within the time frames and guidelines given below. However, time frames and guidelines are not guaranteed.

C. Provide any additional field engineering services if necessary.

D. Protect all survey control, reference points and staking. Reset any survey point that is disturbed at own expense. Survey control includes any control point, property pin, section corner, or any other monuments either existing or set by the Owner's representative that are necessary to properly layout the project. Allow a minimum of two working days to complete field engineering for survey point replacement.

E. "Working day" is defined as a calendar day on which work can be reasonably completed.

1. Working day does not include:
   a. Holidays: Memorial Day; Independence Day; Labor Day; Thanksgiving, Christmas Day; New Year's Day.
   b. Saturdays unless the contractor submits a written request which shows a schedule of Work that includes Saturday.

c. Sundays.
d. Days where weather or site conditions cause unfavorable working conditions as deemed by the engineer.

F. Hours of operation: 7:30 AM to 7:00 PM or as daylight permits, whichever is shorter.

G. Owner will provide stakes with minimum completion times as listed below:

1. Water Mains/ Force Mains
   a. Centerline with offsets at 50’ intervals (1 hour per 100’).
   b. Cut stakes to top of pipe with hubs, if plan calls for specified grades (0.5 hour per 100’).
   c. Curb Stop Locations (0.25 hour per curb stop).
2. Storm-Sanitary Sewers
   a. Centerline stakes with offsets and cuts to inverts at 50’ intervals (1 hour per 100’).
   b. Manholes with offsets (0.25 hour per manhole).
   c. Inlets with offsets (0.25 hour per inlet).
   d. Wye locations (0.10 hour per location).
   e. Service ends with grades (0.10 hour per location)
3. Streets
   a. Initial dirt grade stakes with lath every 100’ and at high and low points (0.5 hour per 100’).
   b. Subgrade blue tops for centerline and curb and gutter (1.25 hour per 100’ at 25’ stations).
   c. Centerline gravel blue tops (0.75 hour per 100’ at 25’ stations).
   d. Curb & gutter flow line stakes with offsets every 25’ (1 hour per 100’ per side).
   e. Concrete paving grade stakes with offset at 25’ intervals plus high and low points (1 hour per 100’ per side of paving).
4. Lift Station
   a. Location & elevation of rim and invert centerline of wet well, dry well, and/or check valve manhole (4 hours per lift station).
5. Buildings
   a. Location & elevation of corners of first floor with offsets.
   b. Location & elevation of corners of footing with offsets.
6. Sidewalks/Bike paths
   a. Elevation & location of “Outside” finished edge (one edge) of Sidewalk or bike path @ 25’ stationing (1 hour per 100’).
7. Channels/Embankments
   a. Centerline cut/fill, daylights, and temporary construction easement limits (every 200’).
   b. Culvert alignment, lengths, and invert elevations with offsets.
   c. Structure locations and invert elevations with offsets.
8. Ponds/Lakes
   a. Location and elevation of bottom of lake/pond, location and elevation of contour defining bottom of rock or planting area used to protect slopes, and topsoil stripping location. Plus 3 elevation control points.

H. Minimum Completion times are based on “typical” construction conditions such as: accessible site; site unobstructed from equipment, dirt piles, etc.; intact survey control; fair weather; etc.

I. Submit survey requests on provided request form. Verify with the owner's representative on-site to determine if the request is reasonable and necessary. Survey requests will only be accepted by the prime contractor's designated representative. Survey requests from sub-contractors shall be coordinated through the prime contractor's designated representative. Specify the date/time that the site is ready, the date/time the staking shall be completed by, specific items to be staked by referencing plan alignments and stationing, and the direction for offsets.

J. Give sufficient notice of need for the establishment of field engineering. Make efforts to allow the staking at the earliest possible time.

K. Correct any mistakes that may be caused by disturbance or removal of survey stakes or control points.

L. Verify along with the Owner's representative, that completed survey complies with the survey request; and check the survey for accuracy with respect to the plans and specifications.

M. If the site is not ready for requested survey work at the time specified on the Survey Request form or by the allotted time established by the Survey Request form, the Contractor shall be charged a fee that may be deducted from the Owner's contract with the Contractor for that particular project. The fee shall be the cost of mileage, overhead, labor, etc. required for the survey crew to arrive at the site and reestablish itself at an alternate work site.

1.3 CLOSEOUT PROCEDURES

A. Prerequisites to Substantial Completion: Complete following items before requesting Certification of Substantial Completion, either for entire Work or for portions of Work:

1. Submit maintenance manuals, Project record documents, and other similar final record data in compliance with this Section.
2. Complete facility startup, testing, adjusting, balancing of systems and equipment, demonstrations, and instructions to Owner's operating and maintenance personnel as specified in compliance with this Section.
3. Conduct inspection to establish basis for request that Work is substantially complete. Create comprehensive list (initial punch list) indicating items to be completed or corrected, value of incomplete or nonconforming Work, reason for being incomplete, and date of anticipated completion for each item. Include copy of list with request for Certificate of Substantial Completion.
4. Obtain and submit releases enabling Owner's full, unrestricted use of Project and access to services and utilities. Include certificate of occupancy, operating certificates, and similar releases from authorities having jurisdiction and utility companies.
5. Deliver tools, spare parts, extra stocks of material, and similar physical items to Owner.
6. Make final change-over of locks and transmit keys directly to Owner. Advise Owner's personnel of change-over in security provisions.
7. Discontinue or change over and remove temporary facilities and services from Project Site, along with construction tools, mockups, and similar elements.
8. Perform final cleaning according to this Section.

B. Substantial Completion Inspection:

1. When Contractor considers Work to be substantially complete, submit to Engineer:
   a. Written certificate that Work, or designated portion, is substantially complete.
   b. List of items to be completed or corrected (initial punch list).
2. Within seven (7) days after receipt of request for Substantial Completion, Engineer and Owner will make inspection to determine whether Work or designated portion is substantially complete.
3. Should Engineer and Owner determine that Work is not substantially complete:
   a. Engineer will promptly notify Contractor in writing, stating reasons for their opinion.
   b. Contractor shall remedy deficiencies in Work and send second written request for Substantial Completion to Engineer.
   c. Engineer and Owner will re-inspect Work.
   d. Redo and Inspection of Deficient Work: Repeated until Work passes Engineer's and Owner's inspection.
4. When Engineer and Owner finds that Work is substantially complete, Engineer will:
   a. Prepare Certificate of Substantial Completion accompanied by Contractor's list of items to be completed or corrected as verified and amended by Engineer and Owner (final punch list).
   b. Submit Certificate to Owner and Contractor for their written acceptance of responsibilities assigned to them in Certificate.
5. After Work is substantially complete, Contractor shall:
   a. Allow Owner occupancy of Project under provisions stated in Certificate of Substantial Completion.
   b. Complete Work listed for completion or correction within time period stipulated.
6. Owner will occupy completed work as specified in Section 011000 - Summary.

C. Prerequisites for Final Completion: Complete following items before requesting final acceptance and final payment.

1. When Contractor considers Work to be complete, submit written certification that:
   a. Contract Documents have been reviewed.
   b. Work has been examined for compliance with Contract Documents.
   c. Work has been completed according to Contract Documents.
   d. Work is completed and ready for final inspection.
2. Submittals: Submit following:
   a. Final punch list indicating all items have been completed or corrected.
   b. Final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
   c. Specified warranties, workmanship/maintenance bonds, maintenance agreements, and other similar documents.
   d. Accounting statement for final changes to Contract Sum.
   e. Contractor's affidavit of payment of debts and claims.
   f. Contractor affidavit of release of liens.
   g. Consent of surety to final payment.
3. Perform final cleaning for Contractor-soiled areas according to this Section.

D. Final Completion Inspection:

1. Within seven (7) days after receipt of request for final inspection, Engineer and Owner will make inspection to determine whether Work or designated portion is complete.
2. Should Engineer and Owner consider Work to be incomplete or defective:
    a. Engineer will promptly notify Contractor in writing, listing incomplete or defective Work.
    b. Contractor shall remedy stated deficiencies and send second written request to Engineer that Work is complete.
    c. Engineer and Owner will re-inspect Work.
    d. Redo and Inspection of Deficient Work: Repeated until Work passes Engineer's and Owner's inspection.

1.4 STARTING OF SYSTEMS

A. Coordinate schedule for startup of various equipment and systems.

B. Notify Engineer seven (7) days prior to startup of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.

D. Verify that tests, meter readings, and electrical characteristics agree with those required by equipment or system manufacturer.

E. Verify that wiring and support components for equipment are complete and tested.

F. Execute startup under supervision of manufacturer's representative or Contractors' personnel according to manufacturer's instructions.

G. When specified in individual Specification Sections, require manufacturer to provide authorized representative who will be present at Site to inspect, check, and approve equipment or system installation prior to startup and will supervise placing equipment or system in operation.

H. Submit a written report according to Section 013300 - Submittal Procedures that equipment or system has been properly installed and is functioning correctly.

1.5 DEMONSTRATION AND INSTRUCTIONS

A. If required by Specifications, demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.

B. Demonstrate Project equipment, instructed by manufacturer's representative who is knowledgeable about the Project.

C. Video Recordings: Provide high-quality color video recordings of demonstration and instructional sessions. Engage commercial videographer to record sessions. Include classroom instructions, demonstrations, board diagrams, and other visual aids. Include menu navigation.

D. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

E. Use operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

F. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time at designated location.

G. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

H. Required instruction time for each item of equipment and system is specified in individual Specification Sections.

1.6 TESTING, ADJUSTING, AND BALANCING

A. Owner will appoint and employ services of independent firm to perform testing, adjusting, and balancing. Contractor shall pay for services from cash allowance specified in Section 012000 - Price and Payment Procedures.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit in PDF composite electronic indexed file.

B. Prepare PDF cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," title of Project.

C. Internally subdivide PDF contents with bookmarks.

D. Drawings: Provide PDF drawings.

E. Contents: Prepare table of contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:

1. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and major equipment suppliers.
2. Part 2: Operation and maintenance instructions arranged by system and subdivided by Specification Section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Include the following:
    a. Significant design criteria.
    b. List of equipment.
    c. Parts list for each component.
    d. Operating instructions.
    e. Maintenance instructions for equipment and systems.
    f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

g. Safety precautions to be taken when operating and maintaining or working near equipment.

3. Part 3: Project documents and certificates, including the following:
   a. Shop Drawings and product data.
   b. Air and water balance reports.
   c. Certificates.
   d. Warranties and bonds.

1.8 MANUAL FOR MATERIALS AND FINISHES

A. Submit preliminary draft or proposed formats and outlines of contents before start of Work. Engineer will review draft and return one copy with comments.

B. For equipment or component parts of equipment put into service during construction and operated by Owner, submit documents within ten (10) days after acceptance.

C. Submit completed volumes before Substantial Completion. Draft copy be reviewed and returned after Substantial Completion, with Engineer comments. Revise content of document sets as required prior to final submission.

D. Submit in PDF composite electronic indexed file of final manual within ten (10) days after final inspection.

E. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Include information for re-ordering custom-manufactured products.

F. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

G. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Include recommendations for inspections, maintenance, and repair.

H. Additional Requirements: As specified in individual product Specification Sections.

I. Include listing in table of contents for design data, with tabbed fly sheet and space for insertion of data.

1.9 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer will review draft and return one copy with comments.

B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten (10) days after acceptance.

C. Submit one copy of completed volumes before Substantial Completion. Draft copy will be reviewed and returned after Substantial Completion, with Engineer comments. Revise content of document sets as required prior to final submission.

D. Submit in PDF composite electronic indexed file of final manual within ten (10) days after final inspection.

E. Each Item of Equipment and Each System: Include description of unit or system and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.

F. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications.

G. Include color-coded wiring diagrams as installed.

H. Operating Procedures: Include startup, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and special operating instructions.

I. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

J. Include servicing and lubrication schedule and list of lubricants required.

K. Include manufacturer's printed operation and maintenance instructions.

L. Include sequence of operation by controls manufacturer.

M. Include original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

N. Include control diagrams by controls manufacturer as installed.

O. Include Contractor's coordination drawings with color-coded piping diagrams as installed.

P. Include charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

Q. Include list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

R. Include test and balancing reports as specified in Section 014000 - Quality Requirements.

S. Additional Requirements: As specified in individual product Specification Sections.

T. Include listing in table of contents for design data with tabbed dividers and space for insertion of data.

1.10 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Furnish spare parts, maintenance, and extra products in quantities specified in individual Specification Sections.

B. Deliver to place in location as directed by Owner; obtain receipt prior to final payment.

1.11 PRODUCT WARRANTIES AND PRODUCT BONDS

A. Obtain warranties and bonds executed in duplicate by responsible Subcontractors, suppliers, and manufacturers within ten (10) days after completion of applicable item of Work.

B. Execute and assemble transferable warranty documents and bonds from Subcontractors, suppliers, and manufacturers.

C. Verify documents are in proper form, contain full information, and are notarized.

D. Co-execute submittals when required.

E. Submit prior to final Application for Payment.

F. Time of Submittals:

1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten (10) days after acceptance.
2. Make other submittals within ten (10) days after date of Substantial Completion, prior to final Application for Payment.
3. For items of Work for which acceptance is delayed beyond Substantial Completion, submit within ten (10) days after acceptance, listing date of acceptance as beginning of warranty or bond period.

1.12 PROJECT RECORD DOCUMENTS

A. Maintain on Site one set of the following record documents; record actual revisions to the Work:

1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other modifications to the Contract.
5. Reviewed Shop Drawings, product data, and Samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress, not less than weekly.

E. Specifications: Legibly mark and record, at each product Section, description of actual products installed, including the following:

1. Manufacturer's name and product model and number.
2. Product substitutions or alternates used.
3. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction as follows:

1. Include Contract modifications such as Addenda, supplementary instructions, change directives, field orders, minor changes in the Work, and change orders.
2. Include locations of concealed elements of the Work.
3. Identify depth of buried utility lines and provide dimensions showing distances from permanent facility components that are parallel to utilities.
4. Dimension ends, corners, and junctions of buried utilities to permanent facility components using triangulation.
5. Identify and locate existing buried or concealed items encountered during Project.
6. Measured depths of foundations.
7. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
8. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
9. Field changes of dimension and detail.
10. Details not on original Drawings.

G. Submit PDF electronic files of marked-up documents to Engineer before Substantial Completion.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.

C. Examine and verify specific conditions described in individual Specification Sections.

D. Verify that utility services are available with correct characteristics and in correct locations.

3.2 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance according to manufacturer's instructions.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer-required or -recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

3.3 EXECUTION

A. Comply with manufacturer's installation instructions, performing each step in sequence. Maintain one set of manufacturer's installation instructions at Project Site during installation and until completion of construction.

B. When manufacturer's installation instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Verify that field measurements are as indicated on approved Shop Drawings or as instructed by manufacturer.

D. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1. Secure Work true to line and level and within specified tolerances, or if not specified, industry-recognized tolerances.
2. Physically separate products in place, provide electrical insulation, or provide protective coatings to prevent galvanic action or corrosion between dissimilar metals.
3. Exposed Joints: Provide uniform joint width and arrange to obtain best visual effect. Refer questionable visual-effect choices to Engineer for final decision.

E. Allow for expansion of materials and building movement.

F. Climatic Conditions and Project Status: Install each unit of Work under conditions to ensure best possible results in coordination with entire Project.

1. Isolate each unit of Work from incompatible Work as necessary to prevent deterioration.
2. Coordinate enclosure of Work with required inspections and tests to minimize necessity of uncovering Work for those purposes.

G. Mounting Heights: Where not indicated, mount individual units of Work at industry recognized standard mounting heights for particular application indicated.

1. Refer questionable mounting heights choices to Engineer for final decision.
2. Elements Identified as Accessible to Handicapped: Comply with applicable codes and regulations.

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

I. Clean and perform maintenance on installed Work as frequently as necessary through remainder of construction period. Lubricate operable components as recommended by manufacturer.

3.4 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual Specification Sections.

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

C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

D. Use durable sheet materials to protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects.

E. 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.

F. Prohibit traffic from landscaped areas.

3.5 FINAL CLEANING

A. Clean debris from roofs, gutters, downspouts, and drainage systems.

B. Clean Site; sweep paved areas, rake clean landscaped surfaces.

C. Remove waste and surplus materials, rubbish, and construction facilities from Site.

END OF SECTION 017000

02 - EXISTING CONDITIONS

SECTION 024200 - REMOVAL AND SALVAGE OF CONSTRUCTION MATERIALS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes.

1. Removal, abandonment, and salvaging construction materials.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Removal of Manholes and Inlets:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, removal, disposal offsite, backfilling, and compaction.

B. Removal of Cleanouts:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, removal, disposal offsite, backfilling, and compaction.

C. Removal of Pipe:

1. Basis of Measurement: By linear foot (LF).
2. Basis of Payment: Includes excavation, removal of pipe, removal of end sections, small appurtenances, disposal offsite, backfilling, and compaction.
    a. Removal of ACP paid as a separate bid item.

D. Abandonment of Pipe:

1. Basis of Measurement: By linear foot (LF).
2. Basis of Payment: Includes excavation, filling pipe with flowable fill, plugging pipe ends, backfilling, and compaction.

E. Abandonment of Manholes and Inlets:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, removing top 4’ of manhole section, plugging pipe ends, filling manhole with sand, backfilling, and compaction.

F. Abandonment of Valves and Hydrants:

1. Basis of Measurement: By each (EA).

2. Basis of Payment: Includes excavation, cutting and removal of valve box or hydrant and stand pipe to a minimum of 3 feet below finish grade, disposal offsite, filling remainder of structure with sand, backfilling, and compaction.
    a. Existing valves or hydrants are to be abandoned if located in water main abandonment areas, otherwise complete full removal of valves or hydrants.

G. Abandonment of Water Service:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes verification of curb stop operation and valve seal, closure of curb stop, excavation, cutting and removal of curb stop box to a minimum of 3 feet below finish grade, disposal offsite, backfilling, and compaction.
    a. Water services with tracer wire utility locating appurtenances and flush mount terminal boxes:
        1) Lower existing flush mount terminal box and curb stop box below finish grade (do not cut curb stop box).
        2) Install a turf box in green spaces or a utility casting in pavements. Turf boxes and utility casting to be supplied by the Owner.
    b. Existing water services are to be abandoned if located in water service abandonment areas, otherwise complete full removal of water service.

H. Abandonment of Sewer Service:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, capping or plugging existing pipe, and/or cutting and removal of and capping clean out or televising riser to a minimum of 3 feet below finish grade, disposal offsite, backfilling, and compaction.
    a. Sewer services with tracer wire utility locating appurtenances and flush mount terminal boxes:
        1) Lower existing flush mount terminal box and cut and cap clean out or televising riser below finish grade.
        2) Install a turf box in green spaces or a utility casting in pavements. Turf boxes and utility casting to be supplied by the Owner.
    b. Existing sewer services are to be abandoned if located in sewer service abandonment areas, otherwise complete full removal of sewer service.

I. Removal of Casting, Valves, and Hydrants:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, removal, disposal offsite, backfilling, and compaction.

J. Removal of Aggregate Surfacing:

1. Basis of Measurement: By square yard (SY).
2. Basis of Payment: Includes excavation, removal, and disposal offsite.

K. Removal of Asphalt:

1. Basis of Measurement: By square yard (SY).
2. Basis of Payment: Includes excavation, removal, disposal offsite, and saw cutting.

L. Removal of Concrete:

1. Basis of Measurement: By square yard (SY).
2. Basis of Payment: Includes excavation, removal of concrete pavement, driveways, sidewalks, and valley gutters, disposal offsite, and saw cutting.

M. Removal of Curb & Gutter:

1. Basis of Measurement: By linear foot (LF).
2. Basis of Payment: Includes excavation, removal, disposal offsite, backfilling, and compaction.

N. Removal of Riprap:

1. Basis of Measurement: By square yard (SY).
2. Basis of Payment: Includes excavation, removal, disposal offsite, backfilling, and compaction.

O. Remove and Reset Mailbox:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes removal, storing offsite, resetting, backfilling, and compaction.

P. Removal of Fence:

1. Basis of Measurement: By linear foot (LF).
2. Basis of Payment: Includes removal and disposal offsite.

Q. Remove and Reset Fence:

1. Basis of Measurement: By linear foot (LF).
2. Basis of Payment: Includes removal, storage, setting new posts, resetting fence, and all accessory connectors.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.

B. Identify salvage area for placing salvaged materials.

3.2 PREPARATION

A. Call Local Utility Line Information service within the statutory timelines before performing Work.

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

3.3 PROTECTION

A. Protect buildings, structures, utilities, trees, shrubs, plant growth and features designated to remain.

B. Protect bench marks, survey control points, and existing structures from damage or displacement.

3.4 ABANDONMENT

A. Abandon items as indicated on the Drawings.

3.5 REMOVAL

A. Remove items as indicated on the Drawings.

B. Neatly saw cut edges at right angles, full depth prior to removal.

C. Dispose all materials removed, but not incorporated into the Work, in accordance with all applicable federal, state or local regulations.

D. When indicated, reset items as indicated on the plans. If items to be reset are damaged, replace with equivalent products.

E. Maintain temporary access to pedestrians and vehicular traffic in pavement removal locations. This includes building temporary access ramps, blading, watering and repairing soft areas as necessary.

F. Disconnect Water Service

1. Excavate connection of water service to water main.
2. Turn corporation stop on water service saddle.
3. If not removing water service piping, cut pipe near corporation stop.
4. Backfill excavation.

G. Disconnect Sewer Service

1. Excavate connection of sewer service to sewer main.
2. Cut Service pipe at wye connection.
3. Plug wye with pvc cap, muni plug, or concrete, as required for pipe material type.
4. Backfill excavation.

3.6 SALVAGING OF MATERIALS AND PRODUCTS

A. Remove and salvage items as indicated on the Drawings.

B. Deliver to Owner all items or materials designated to be removed and salvaged; including, but not limited, to the following or as indicated on the drawings:

1. Any items as directed by the Engineer.
2. Signage
3. Inlet and manhole castings.
4. Valve boxes.
5. Gate valves.
6. Fire hydrants.

END OF SECTION 024200

SECTION 028213.33 - ASBESTOS ABATEMENT FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removal of ACP or ACM-contaminated pipeline and pipeline coatings.
2. Cutting of ACP or pipelines containing or coated with ACM.
3. Monitoring of Work area during cutting and cleaning operations.

1.2 DEFINITIONS

A. ACM: Asbestos Containing Material.

B. ACP: Asbestos Cement Pipe.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Removal of Asbestos Cement Pipe:

1. Basis of Measurement: By linear foot (LF).
   a. Measured along piping and including fittings and appurtenances.
2. Basis of Payment: Includes excavation, cleaning, cutting, removal of ACP of all sizes, packaging, transport, disposal, and any other items required to maintain compliance with applicable local, state, and federal regulations.

1.4 REFERENCE STANDARDS

A. Occupational Safety and Health Administration (OSHA):

1. 29 CFR Part 1926 - Safety and Health Regulations for Construction.
2. 40 CFR Part 763, Subpart E, Appendix E, Section 1- Polarized Light Microscopy.
3. 42 CFR Part 84, Subpart K - Non-Powered Air-Purifying Particulate Respirators.

B. U.S. Environmental Protection Agency:

1. National Emission Standards for Hazardous Air Pollutants (NESHAPs).

C. North Dakota Department of Environmental Quality

1. Interoffice Memo Dated August 13, 2018: Removal or Abandonment In-Place of Asbestos Cement Pipe.

2. Guideline 12 - Asbestos Disposal in North Dakota Landfill Facilities.
3. North Dakota Administrative Code (NDAC) 33.1-15-13-02 Emissions Standards for Asbestos.
4. Emission Standards for Asbestos NDAC 33-20 Solid Waste Management Rules.

1.5 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information on respirators and air monitor.

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

D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

E. Qualifications Statements:

1. Submit qualifications for contractor, on-Site representative, and disposal firm.
2. Submit qualifications for testing laboratory.

1.6 QUALITY ASSURANCE

A. Perform Work according to NESHAPs, OSHA (HAZWOPER), State of North Dakota, and NDDEQ standards.

1.7 QUALIFICATIONS

A. Contractor: Company specializing in repairing, modifying, cleaning, or removing ACP or ACM-coated pipe as specified in this Section with minimum three years' documented experience.

B. On-Site Representative: A North Dakota certified/licensed asbestos abatement contractor and supervisor shall be the on-site representative.

C. Supervisor and/or Inspector: Certified by the State of North Dakota.

D. Disposal Firm: Company specializing in packaging and hauling ACM to disposal site.

E. Active Waste Disposal Site: Solid waste disposal site permitted to accept ACM waste.

F. Testing Laboratory: Company participating in National Voluntary Laboratory Accreditation Program for asbestos, administered by National Institutes of Standards and Technology.

1.8 DELIVERY, STORAGE, AND HANDLING

A. In accordance with ND DEQ guidelines and requirements for transporting, handling, storing, and protecting ACP and ACM.

B. Respirators Not in Use:

1. Store in sanitary location that protects respirators from dust, sunlight, heat, extreme cold, excessive moisture, and potentially damaging chemicals.
2. Place in plastic bags or closed containers.

PART 2 - PRODUCTS

2.1 RESPIRATORS

A. Description:

1. Comply with 42 CFR Part 84, Subpart K.
2. Type: Half-face mask; reusable after washing.
3. Maintenance: Replaceable filters and cartridges only.
4. Single-use respirators are not acceptable.

B. Filters: Top air inlet.

C. Performance and Design Criteria:

1. Application: Asbestos abatement for concentrations up to 10 times permissible exposure limit (PEL).
2. Design: Low profile.

2.2 AIR MONITOR

A. Description:

1. Type: Laser.
2. Power Source: Batteries.
3. Screen: LCD.
4. Output: Greater than 0.5 micron and 2.5 micron particulates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide notification to the North Dakota Division of Waste Management by completing and submitting a Notification of Demolition and Renovation (ND DEQ SFN 17987) at least 10 working days prior to removing, cutting, or damaging ACP or ACM.
1. Provide a copy of the notification application and ND DEQ response letter to the Owner and Engineer.

B. Consult with a State certified asbestos inspector to determine if asbestos cement pipe (ACP) is friable or non-friable.

C. Retain a State certified/licensed asbestos abatement contractor to remove and dispose of ACP/ACM that is in a friable condition or removed by mechanical means.

D. Perform ACP or ACM removal without damage to or contamination of adjacent Work or existing area.

E. Perform cleaning operations without taking pipeline out of service.

3.2 APPLICATION

A. Removal of Pipe:

1. Cutting:
   a. Utilize appropriate cutting methods.
   b. Do not crush or burst.
   c. Keep the material wet during all times of pipe cutting/removal to minimize asbestos fiber release.
   d. Maintain supply of fresh water near cutting operation to keep freshly cut areas of ACP or ACM damp while cutting piping.
   e. Remove and dispose of all wet soil appropriately.
2. Disposal:
   a. Individually wrap each joint of piping and pipe ends prior to loading.
   b. Transport removed piping to a restricted, central, staging area to cut for transport or disposal.
   c. Deposit bagged pipeline pieces in leak-proof metal collection box secured with tarpaulin covers. Use appropriate warning labels.
   d. Transport filled boxes to an approved landfill. Recycling is prohibited.
   e. A licensed and certified asbestos supervisor will accompany transport vehicles to manage transport process.
   f. Maintain waste manifest records. Send copies of all records to the Regulatory State Agency as required.

B. Abandonment of Pipe:

1. Abandoning:
   a. Purge entire pipe to be abandoned.
   b. Fill the entire abandoned pipe with flowable fill, grout, or material approved by the Engineer, and in a manner as to fill the entire pipe with no voids.
2. Grouting and Capping:
   a. Plug all ends of the abandoned pipe by either grouting closed, plugging, or capping.

3.3 FIELD QUALITY CONTROL

A. Sample Testing:

1. Test pipe or pipe coating for asbestos prior to repairing, modifying, or removing pipelines.
2. Remove samples of pipe or coating along entire length of piping to be removed and have testing laboratory determine quantity of asbestos that may be present.

END OF SECTION 028213.33

31 - EARTHWORK

SECTION 310513 - SOILS FOR EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Subsoil materials.
2. Topsoil materials.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT - Not Used

1.3 REFERENCE STANDARDS

A. ASTM International:

1. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3).
2. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
3. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit name of imported materials source.

1.5 QUALITY ASSURANCE

A. Furnish each subsoil and topsoil material from a single source throughout Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Subsoil:

1. Type S1:
   a. Excavated and reused material or imported borrow

b. Graded.
c. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
d. No frozen earth or foreign matter.
e. Organic content of less than 3 percent for material placed below structures.
f. Organic content of less than 5 percent for materials placed within 3 vertical feet of the top of finished pavement subgrades.

2. Type S2:
a. Clay backfill material.
b. Materials shall be free from frozen or organic material, debris, or stones having a diameter larger than 3 inches.
c. Clay material shall be classified as Lean Clay (CL) according to USCS classification.
d. High Plasticity Clay (CH), per USCS classification standards, may be acceptable pending approval by Engineer.

B. Topsoil:

1. Type S3:
a. Excavated and reused material.
b. Graded and single screened.
c. Free of roots, rocks larger than 1/2 inch, subsoil, debris, weeds, and foreign matter.

2. Type S4:
a. Imported, suitable topsoil material borrow.
b. Friable loam, single screened.
c. Reasonalby free of roots, rocks larger than 1/4 inch, subsoil, debris, weeds, and foreign matter.
d. pH: 5.5 to 7.5.
e. Inorganic Material: Minimum 4 percent and maximum 15 percent.

2.2 SOURCE QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Testing and Analysis:

1. Subsoil Material: Comply with ASTM D698 and ASTM D6938.
2. If tests indicate materials do not meet specified requirements, change material and retest.

PART 3 - EXECUTION

3.1 APPLICATION

A. Stockpiling:

1. Stockpile excavated material meeting requirements for subsoil and topsoil materials.

2. Stockpile materials on Site at locations as indicated or designated by Engineer.
3. Stockpile in sufficient quantities to meet Project schedule and requirements.
4. Separate differing materials with dividers or stockpile apart to prevent intermixing of soil types or contamination.
5. Stockpile topsoil maximum 8 feet high.
6. Direct surface water away from stockpile to prevent erosion or deterioration of materials.
7. Stockpile unsuitable or hazardous materials on impervious material and cover to prevent erosion and leaching until they are disposed.

3.2 CLEANING

A. Section 017000 - Execution and Closeout Requirements: Requirements for cleaning.

B. Stockpile:

1. Leave unused materials in neat, compact stockpile as directed by Engineer or Owner. Slopes not to exceed 4:1.
2. Remove stockpile and leave area in clean and neat condition as directed by Engineer or Owner.
3. Grade Site surface to prevent freestanding surface water.

END OF SECTION 310513

SECTION 310516 - AGGREGATES FOR EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Coarse Aggregate Materials.
2. Fine Aggregate Materials.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Rock Bedding:
1. Basis of Measurement: By linear foot (LF) or cubic yard (CY).
2. Basis of Payment: Includes labor, equipment, furnishing, placing, and compacting.
   a. Course Aggregate Type A6 to be used to aid in the installation of water or sanitary sewer piping in areas of high groundwater.
   b. To be used at Engineer's discretion and only paid for it approved by Engineer prior to installation.

1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base, and Surface Courses.

B. ASTM International:

1. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3).
3. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
4. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
5. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit name of imported materials source.

C. Supplier's Certificate: Certify that products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Furnish each aggregate material from a single source throughout Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Coarse Aggregate Materials:

1. Type A1 - Class 5 (Aggregate Base): Conforming to State of North Dakota Department of Transportation Standard Specification for Road and Bridge Construction, Section 816.
   a. Grading:
      1) Percent Passing According to Sieve Size:
         a) No. 200: 6 - 10

2. Type A2 - Class 3M (Pipe Bedding and Cover): Conforming to State of North Dakota Department of Transportation Standard Specification for Road and Bridge Construction, Section 816.

3. Type A3 - Class 13 (Aggregate Surfacing): Conforming to State of North Dakota Department of Transportation Standard Specification for Road and Bridge Construction, Section 816.

4. Type A4 - Class 43 (Drainage Aggregate): Conforming to State of North Dakota Department of Transportation Standard Specification for Road and Bridge Construction, Section 816.

5. Type A5 - Salvaged Base Course (Recycled Base): Conforming to State of North Dakota Department of Transportation Standard Specification for Road and Bridge Construction, Section 817.

6. Type A6 - Crushed Aggregate:
   a. Washed, crushed rock.
   b. Nominal size: 1.25 inches.

7. Type A7 - Pea Rock:
   a. Stone: Natural and washed.
   b. Quality: Free of clay, shale, and organic matter.
   c. Grading:
      1) Comply with ASTM C136.
      2) Minimum Size: ¼ inch.
   d. Maximum Size: 5/8 inch.

8. Type A8 - Reclaim:
    a. On site blended asphalt and aggregate base produced by reclaimer.
    b. Grading:

Sieve Size	Percent Passing
2 inch	97-100
1-1/2 inch	90-100

B. Fine Aggregate Materials:

1. Type A9 - Sand
    a. Description: Natural river or bank sand.
    b. Quality: Washed, free of silt, clay, loam, friable, or soluble materials, and organic matter.
    c. Grading:
        1) Comply with ASTM D2487; Group Symbol SW.
        2) Percent Passing According to Sieve Size:
            a) No. 4: 100
            b) No. 14: 10 to 100
            c) No. 50: 5 to 90
            d) No. 100: 4 to 30
            e) No. 200: 0

2.2 SOURCE QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Testing and Analysis:

1. Aggregate Material: Comply with ASTM C136/C136M, ASTM D698, ASTM D6938.
2. If tests indicate materials do not meet specified requirements, change material and retest.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Stockpiling:

1. Stockpile materials on Site at locations as indicated or designated by Engineer.
2. Stockpile excavated material meeting requirements for coarse and fine aggregate materials.
3. Stockpile in sufficient quantities to meet Project schedule and requirements.
4. Separate different aggregate materials with dividers or stockpile apart to prevent intermixing of aggregate types or contamination.
5. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

3.2 CLEANING

A. Section 017000 - Execution and Closeout Requirements: Requirements for cleaning.

B. Stockpile:

1. Leaving unused materials in neat, compact stockpile as directed by Engineer or Owner.
   a. Slopes not to exceed 4:1.
2. Remove stockpile and leave area in clean and neat condition as directed by Engineer or Owner
3. Grade Site surface to prevent freestanding surface water.

END OF SECTION 310516

SECTION 310519.13 - GEOTEXTILES FOR EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonwoven geotextile material.
2. Woven geotextile material.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Geotextiles:

1. Basis of Measurement: By square yard (SY), in place.
   a. In place measurement does not include overlapping material.
2. Basis of Payment: Includes all materials, equipment, and labor to furnish, install, and test geotextile material.

1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.

B. ASTM International:

1. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
2. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
3. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
4. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
5. ASTM D4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile.
6. ASTM D6241 - Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products.
7. ASTM D4873 - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.
8. ASTM D4886 - Standard Test Method for Abrasion Resistance of Geotextiles (Sand Paper/Sliding Block Method).

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information including tensile strength, elongation, thickness, UV resistance, and other material specifications.

C. Shop Drawings: Indicate fabric layout, seam locations, and overlap details in installation drawings.

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

E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

1.5 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of geotextile material, including placement depth.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for maintenance materials.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Comply with ASTM D4873.

D. Store materials according to manufacturer instructions.

E. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 GEOTEXTILE MATERIALS

A. Type as specified in Section 858 of the NDDOT Standard Specifications for Road and Bridge Construction:

1. Type S1: Used for separating materials for stabilization.
2. Type RR: Used for placement under riprap.
3. Type R1: Used for earth reinforcement.
4. Type D1: Used for subsurface drain pipes.

2.2 ACCESSORIES

A. Securing Pins and Staples:
1. Square or circle top; 8 gauge; 6” long, galvanized.

2.3 SOURCE QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Provide shop inspection and testing of completed assembly.

C. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that underlying surface is smooth and free of ruts or protrusions that could damage geotextile material.

3.2 PREPARATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Subgrade Material and Compaction Requirements: As specified in the Earthwork Schedule.

3.3 INSTALLATION

A. Geotextile Material:

1. Lay and maintain smooth and free of tensile stresses, folds, wrinkles, or creases.
2. Ensure that material is in direct contact with subgrade.
3. Orientate with long dimension of each sheet parallel to the channel, culvert, and/or roadway.
4. Minimum Unseamed Joints Overlap: 18 inches.

B. Securement Pins:

1. Channels and Culverts:
   a. Insert through geotextile midway between edges of overlaps and minimum 6 inches from free edges.
   b. Minimum Spacing:
      1) Slopes Steeper than 3 Horizontal on 1 Vertical: 24 inches o.c.
      2) Slopes 3 Horizontal on 1 Vertical to 4 Horizontal on 1 Vertical: 3 feet o.c.
      3) Slopes Flatter than 4 Horizontal on 1 Vertical: 5 feet o.c.
   c. Ensure that washer bears against geotextile.

2. Roadway:
   a. Insert through geotextile at corners and 15’ intervals along edges.

C. Penetrations: As recommended by geotextile manufacturer.

D. Repairing Damaged Geotextiles:

1. Repair torn or damaged geotextile by placing patch of same type of geotextile over damaged area minimum of 36 inches beyond edge of damaged area, and fasten as recommended by geotextile manufacturer.
2. Remove and replace geotextile rolls which cannot be repaired.

E. Fill and Cover:

1. Place fill to prevent tensile stress or wrinkles in geotextile.
2. Place an 8-inch loose initial lift of the material above the geosynthetic.
3. Use low ground pressure equipment to spread the initial lift of material.

3.4 PROTECTION

A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Ballast: Adequate to prevent uplift of material by wind.

C. UV Exposure: Do not leave material uncovered for more than 14 days after installation.

D. Do not use staples or pins to hold geotextiles in place where located adjacent to other geosynthetic layers that could be damaged.

E. Do not operate equipment directly on top of geotextile.

END OF SECTION 310519.13

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removing designated trees, shrubs, stumps, roots, hedges, brush, vegetation, and other plant life.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Site Clearing:

1. Basis of Measurement: By acre (AC).
2. Basis of Payment: Includes clearing site of all plants, shrubs, trees (unless a bid item is provided), stumps, loading and removing waste materials from site.

B. Removal of Trees

1. Basis of Measurement: By each
2. Basis of Payment: Includes clearing site, loading and removing waste materials from site.
   a. Schedule as follows measured 24” above the ground:

Diameter	Pay Item Designation
8” or less	Site Clearing
Over 8” ≤ 12”	Removal of Trees 10”
Over 12” ≤ 24”	Removal of Trees 18”
Over 24”	Removal of Trees 30”

3. If no bid item is provided for Removal of Landscaping, include the cost in Site Clearing.

C. Removal of Landscaping:

1. Basis of Measurement: By each (SY).
   a. Includes all Work for each individual area.
2. Basis of Payment: Includes clearing site of all plants, shrubs, vegetation, edgers, loading and removing waste materials from site.
3. If no bid item is provided for Removal of Landscaping, include the cost in Site Clearing.

A. Salvage Landscaping:

1. Basis of Measurement: By each (SY).
2. Basis of Payment: Includes salvage and removal of landscaping items and placing in a safe location. Items include, but are not limited to, blocks, pavers, bricks, stones, fabric and timbers.

B. Clearing & Grubbing:

1. Basis of Measurement: By lump sum (L SUM)
2. Basis of Payment: Includes demolition, loading, removal from site all vegetation and unwanted debris not to remain within full extents of construction limits, as directed on the plans, and as specified by the Engineer. Partial payment may be made as approved by Engineer in the field to the nearest 25%.

1.3 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data for herbicide. Indicate compliance with applicable codes for environmental protection.

1.4 QUALITY ASSURANCE

A. Conform to applicable code for environmental requirements, disposal of debris, burning debris on site, and use of herbicides.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.

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

C. Identify waste area for placing removed materials.

3.2 PREPARATION

A. Call Local Utility Line Information service at not less than two working days before performing Work.

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

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 bench marks, 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 to minimum depth of 24 inches.

B. Remove trees, stumps, roots, hedges, brush, vegetation, and shrubs indicated. Remove stumps, root system to depth of 24 inches.

C. Clear undergrowth and deadwood, without disturbing subsoil.

3.5 REMOVAL

A. Remove debris, rock, and extracted plant life from site.

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

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

END OF SECTION 311000

SECTION 312300 – EXCAVATION AND FILL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Soil densification.
2. Excavating for paving, roads, and parking areas.
3. Excavating for slabs-on-grade.
4. Excavating for landscaping.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Topsoil:
1. Basis of Measurement: By Cubic Yard. Measured by surface area at depth specified in the plans.
2. Basis of Payment: Includes furnishing all equipment, labor, and incidentals to excavate, stockpile, and respread topsoil as specified.

B. Topsoil Imported:
1. Basis of Measurement: By Cubic Yard. Measured by surface area at depth specified in the plans.
2. Basis of Payment: Includes furnishing all materials, transport, equipment, labor, royalties. and incidentals to import and spread topsoil as specified.

C. Common Excavation:
1. Basis of Measurement: By Cubic Yard
2. Basis of Payment: Includes furnishing all equipment, labor, and incidentals to excavate and compact embankment in grading areas as specified.

D. Excavation Waste:
1. Basis of Measurement: By Cubic Yard
2. Basis of Payment: Includes furnishing all equipment, transportation, labor, and incidentals to excavate, haul, and dispose of excess or unsuitable soils as specified.

E. Borrow Excavation:
1. Basis of Measurement: By Cubic Yard
2. Basis of Payment: Includes furnishing all materials, transport, equipment, labor, and incidentals to excavate, transport, place, and compact embankment as specified.

F. Import Excavation:
1. Basis of Measurement: By Cubic Yard

2. Basis of Payment: Includes furnishing all materials, transport, equipment, labor, royalties, and incidentals to import, place, and compact embankment as specified.

G. Subcut Excavation:
1. Basis of Measurement: By Cubic Yard.
2. Basis of Payment: Includes furnishing all materials, equipment, labor, and incidentals to remove and dispose of unsuitable soils as specified.

H. Subgrade Preparation:
1. Basis of Measurement: By Square Yard.
2. Basis of Payment: Includes furnishing all, equipment, labor, and incidentals to complete the work as specified.

I. Clay Liner
1. Basis of Measurement: By Square Yard at plan quantity.
2. Basis of Payment: Includes furnishing all, equipment, labor, and incidentals to excavate and compact the liner per the depth indicated.

1.3 REFERENCES

A. 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 013300 - Submittal Procedures: Requirements for submittals.

B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

1.5 QUALIFICATIONS

A. Prepare excavation protection plan when necessary under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

PART 2 - PRODUCTS

2.1 Subsoil

A. Ensure existing subsoil adheres to Type S1 as specified in Section 310513 – Soils for Earthwork.

B. Provide imported borrow according to Type S2 as specified in Section 310513 – Soils for Earthwork.

2.2 Topsoil

A. Ensure existing topsoil adheres to Type S3 as specified in Section 310513 – Soils for Earthwork.

B. Provide imported topsoil according to Type S4 as specified in Section 310513 – Soils for Earthwork.

2.3 Include all water required for dust control and to obtain proper moisture content and compaction in the associated bid items.

PART 3 - EXECUTION

3.1 PREPARATION

A. Call Local Utility Line Information service at not less than two working days before performing Work.
   1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Identify required lines, levels, contours, and datum.

C. Notify utility company to remove and relocate utilities.

D. Protect utilities indicated to remain from damage.

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

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

3.2 EXCAVATION

A. Topsoil
1. Remove topsoil to its full depth or a depth up to 6 inches, whichever is less, from all excavation and embankment areas.
   a. Do not remove the subsoil or other deleterious material with topsoil.
   b. Stockpile that are to remain permanently must have mowable slopes not to exceed a steepness of 4:1.
2. Scarify the surface to a depth of 2 inches before replacing topsoil.
3. Uniformly spread the stockpiled topsoil to a depth, as specified in the plans, over the disturbed areas.
4. Remove excess excavated topsoil not intended for reuse from the Site.
5. Remove excavated materials not meeting requirements for topsoil materials from Site.

B. Topsoil Imported
1. Scarify the surface to a depth of 2 inches before replacing topsoil.
2. Spread topsoil to minimum depth, as specified in the plans, over the disturbed areas.
3. Use all existing stockpiled topsoil before importing topsoil.

C. Subcut
1. Engineer will determine whether subcutting operations will be required to correct extremely wet subgrade conditions.
2. Haul unsuitable material from the entire width and depth of the excavation as directed by the Engineer.
3. Scarify the subcut areas to a depth as indicated in the plans.
4. Allow sufficient time for Engineer to cross-section or measure in some other form the subcut area before backfilling.
5. Aerate the subcut/excavation area to achieve a uniform working platform prior to backfilling operations.
6. Place fill per requirements specified for Fills and Embankments.

D. Fills and Embankments
1. Scarify and compact subgrade per requirements above for subcut.
2. Place fill in level successive horizontal layers as indicated in the plans.
   a. Use motor graders or other equipment acceptable to the Engineer to spread the material uniformly.
   b. Accomplish compaction with equipment specifically made to uniformly compact the soil.
   c. Use hand tampers to compact areas inaccessible to rollers
3. Provide continuous leveling, and disking to assure uniform soil distribution, moisture, and density control.
4. Provide benching when material is placed against slopes 4:1 or steeper.
   a. Place horizontal cuts as close together as slopes permit with a minimum step width of 24 inches.
   b. Begin each horizontal cut at the intersection of the original ground and the vertical sides of the previous cut.

c. Compact excavated material along with embankment material.
d. Include the cost of benching in the price bid for other items.

E. Subgrade Preparation
1. Upon completion of cross section scarify the entire subgrade to depth as indicated in the plans.
2. Fill any low areas with suitable material.
3. Use hand tampers to compact areas inaccessible to rollers.
4. Complete fine grading ahead of paving operations to allow adequate time for final check for finish grade and compaction.
5. Proof roll all pavement subgrades prior to aggregate placement, along all travel lanes to verify the uniformity of the underlying subgrade throughout the roadway section and to check the presences of localized soft or weak zones.
6. Do not start paving until results of compaction tests are known, the final grade has been checked and the Contractor has been given notice to proceed by the Engineer.
7. Engineer may direct contractor to re-perform proof roll at their discretion at no additional cost.

F. Boulevard Filling and Grading
1. Remove all debris from behind the curb.
2. For new construction projects bring boulevard dirt to a straight grade from the plan specified depth below the sidewalk to the plan specified depth below the back of curb.
3. For reconstruction projects grade boulevards uniformly and place moderately compacted topsoil as specified on the plans.
4. Raise all curb stops to finished grade.
   a. Correct any deficiencies noted by the Engineer with no additional compensation.
5. Use native topsoil free of sod, hard lumps, gravel, rocks, subsoil, or other undesirable materials.
6. Backfill boulevards as soon as the adjacent concrete slabs, curbs, sidewalks, or driveways achieve 75% of their design strength.

G. Clay Liner
1. Excavate to clay liner thickness as indicated on the drawings.
2. Remove any unsuitable soils under clay liner as directed by the Engineer.
3. Place and compact clay liner with suitable soils.
4. Maintain proper moisture of clay liner until filling operations are complete.
5. Refer to geotechnical report.

H. Excess Material
1. Any remaining material following excavation and embankment to become the contractor’s property, removed, and disposed from the project site.
2. On projects where the city retains ownership of the excess material stockpile on the project site in location(s) shown on the plans or identified by the Engineer in the field. No material may leave the project limits without approval of the Engineer.

3.3 TOLERANCES

A. Vertical Tolerance
   1. Subgrade: 0.08'
   2. Finished Grade: 0.04’

3.4 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Testing:
   1. Compaction Testing:
      a. Comply with the requirements in the plans.
      b. Frequency of Compaction Tests: as described in the plans.
      c. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.
      d. Perform laboratory material tests in accordance with ASTM D698.
   2. Proof Roll:
      a. Prior to performing proof roll, smooth subgrade surface.
      b. Under the observation of the Engineer with a fully loaded, tandem axle dump truck with a weight of approximately 25 tons, or an approved equal. Proof roll at a vehicle speed of between 1 ½ and 3 miles per hour along the pavement subgrades such that unrolled areas between wheel paths are not wider than 1 foot. Typical yielding should be limited to 1 ½-inches for pavement subgrades, provided the underlying subgrade does not display permanent deformation. Correct areas that display excessive yielding, pumping or rutting during the proof roll. Repeat proof roll procedures until accepted by the Engineer.

3.5 PROTECTION

A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

C. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

D. Protect Boulevard grading from equipment weighing more than the average lawn-building equipment during placing and leveling of the topsoil.

END OF SECTION 312300

SECTION 312316.13 - TRENCHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating trenches for utilities
2. Compacted fill from top of utility bedding to subgrade elevations.
3. Backfilling and compaction.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT - Not Used

1.3 REFERENCES

A. 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 D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
3. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
4. 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 013300 - Submittal Procedures: Requirements for submittals.

B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

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

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

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Occupational Safety and Health Administration (OSHA) standards.

1.6 QUALIFICATIONS

A. Prepare excavation protection plan when necessary under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

B. Prepare excavation under the direction of a Competent Person in accordance with OSHA standards and comply with requirements of OSHA 29 CFR, Part 1926, Subpart P, requirements for excavation and trenching operations.

C. OSHA requires a Registered Professional Engineer to evaluate slopes or excavations over 20 feet in depth.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 COORDINATION

A. Section 013000 - 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. Subsoil Fill: Type S1 or S2, as specified in Section 310513 - Soils for Earthwork.

B. Structural Fill: Type A1, as specified in Section 310516 - Aggregates for Earthwork.

C. Granular Fill: Type A2, as specified in Section 310516 - Aggregates for Earthwork.

D. Bedding and Cover: Type A2, as specified in Section 310516 - Aggregates for Earthwork.

PART 3 - EXECUTION

3.1 LINES AND GRADES

A. Lay pipes to lines and grades indicated on Drawings.

1. Engineer reserves the right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

B. Use laser-beam instrument with qualified operator to establish lines and grades.

3.2 PREPARATION

A. Call Local Utility Line Information service at not less than two working days before performing Work.

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

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

C. Establish temporary traffic control when trenching is performed in public right-of-way. Relocate controls as required during progress of Work and in accordance with Section 015000 – Temporary Facilities and Controls.

3.3 APPLICATION

A. Trenching:

1. Excavate subsoil required for utilities
2. Remove lumped subsoil, boulders, and rock up to 18-inch diameter.
3. Do not advance open trench more than 200 feet or as approved by the Engineer ahead of installed pipe.
4. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.
5. Excavate bottom of trenches maximum to width indicated on Drawings.
6. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe.
7. Do not interfere with 45 degree bearing splay of foundations.
8. When Project conditions permit, slope side walls of excavation starting as indicated on the drawings. When side walls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this section.
9. When subsurface materials at bottom of trench are unsuitable, Notify Engineer, and request instructions.
10. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Fill Type S1 or S2 and compact to density equal to or greater than requirements for subsequent backfill material.
11. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
12. Correct over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Engineer.
13. Remove excess subsoil not intended for reuse, from site.
14. Remove excess subsoil not intended for reuse, from site.
    a. If directed by Engineer, stockpile excess subsoil in area designated on site in accordance with Section 310513.

B. Sheeting and Shoring:

1. Where project conditions do not permit sloping or benching, sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

2. Adhere to all OSHA standards.
3. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
4. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
5. Design sheeting and shoring to be removed at completion of excavation work. If approved by Engineer, sheeting may be left in place.
6. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
7. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

C. Backfilling:

1. Backfill trenches to contours and elevations with unfrozen fill materials.
2. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
3. Place material in continuous layers, in maximum lifts as indicated in the Earthwork Schedule in the Drawings.
4. Employ placement method that does not disturb or damage property outside of construction limits.
5. Maintain optimum moisture content of fill materials to attain required compaction density.
6. Do not leave more than 50 feet of trench open at end of working day.

3.4 TOLERANCES

A. Section 014000 - Quality Requirements: Tolerances.

B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1/2 inch (0.04 feet) from required elevations.

C. Top Surface of General Backfilling: Plus or minus 1 inch (0.08 feet) from required elevations.

3.5 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Perform laboratory material tests in accordance with ASTM D698.

C. Perform in place compaction tests in accordance with the Drawings.

D. When tests indicate Work does on meet specified requirements, remove Work, replace, compact, and retest.
1. Costs for retesting, as specified in Section 012000 - Price and Payment Procedures.

E. Frequency of Tests as indicated in the Drawings.

3.6 PROTECTION OF FINISHED WORK

A. Section 017000 - Execution and Closeout Requirements: Protecting finished work.

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

END OF SECTION 312316.13

SECTION 312500 - EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Erosion Control Blanket.
2. Turf Reinforcement Mat.
3. Fiber Rolls.
4. Flotation Curtain.
5. Stabilized Construction Entrance.
6. Concrete Washout.
7. Inlet Protection.
8. Dewatering Structures.
9. Storm Water Management.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Erosion Control Blanket and Turf Reinforcement Mat:

1. Basis of Measurement: By square yard.
2. Basis of Payment: Includes furnishing all materials, equipment, labor, maintenance, and incidentals.
   a. Payment Schedule:
      75% at Installation
      100% at Removal

B. Silt Fence:

1. Basis of Measurement: By linear foot.
2. Basis of Payment: Includes furnishing all materials, equipment, labor, installation maintenance, incidentals, inspection, and removal.
   a. Payment Schedule:
      75% at Installation
      100% at Removal

C. Fiber Roll, Rock Logs, and Composite Rolls:

1. Basis of Measurement: By linear foot.
2. Basis of Payment: Includes furnishing all materials, equipment, labor, installation maintenance, incidentals, inspection, and removal.
   a. Payment Schedule:
      75% at Installation
      100% at Removal

D. Flotation Curtain:

1. Basis of Measurement: By linear foot.
2. Basis of Payment: Includes furnishing all materials, equipment, labor, installation maintenance, incidentals, and removal.
   a. Payment Schedule:
      75% at Installation
      100% at Removal

E. Stabilized Construction Entrance:

1. Basis of Measurement: By each.
2. Basis of Payment: Includes furnishing all materials, equipment, labor, installation maintenance, incidentals, and removal.
   a. Payment Schedule:
      75% at Installation
      100% at Removal

F. Inlet Protection:

1. Basis of Measurement: By each.
2. Basis of Payment: Includes all materials, equipment, labor, incidentals to install, maintain, and remove inlet protection devices.
   a. Payment Schedule:
      75% at Installation
      100% at Removal

G. Storm Water Management:

1. Basis of Measurement: By lump sum.

2. Basis of Payment:
   a. Includes preparation and administration of Storm Water Pollution Prevention Plan (SWPP) and obtaining NPDES General Permit for Storm Water Discharge Associated with Construction Activity. Includes cost for all Best Management Practices except where individual items of Measurement and Payment are provided.
   b. Payment Schedule:
      1) 25% upon project commencement.
      2) 50% upon 50% of contract earned.
      3) 100% upon final payment.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO M288 – Table 1 Geotextile Strength Property Requirements.

B. ASTM International:
1. ASTM D968 – Standard Test Method for Abrasion Resistance of Organic Coatings by Falling Abrasive

2. ASTM D792 – Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
3. ASTM D1248 – Standard Specification for for Polyethylene Plastics Extrusion Materials for Wire and Cable.
4. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Coating Systems.
5. ASTM D1505 - Standard Test Method for Density of Plastics by the Density-Gradient Technique.
6. ASTM D2152 – Standard Test Method for Adequacy of Fusion of Extruded Poly(Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion.
7. ASTM D3354 – Standard Test Method for Blocking Load of Plastic Film by Parallel Plate Method.
8. ASTM D3786 – Standard Test Method for Bursting Strength of Textile Fabrics – Diaphragm Bursting Strength Tester Method
9. ASTM D4355 – Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc-Type Apparatus.
10. ASTM D4491 – Standard Test Method for Water Permeability of Geotextiles by Permittivity.
11. ASTM D6460 – Standard Test Method for Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Earthen Channels from Stormwater-Induced Erosion.
12. ASTM D6475 – Standard Test Method for Measuring Mass per Unit Area of Erosion Control Blankets.
13. ASTM D6525 – Standard Test Method for Measuring Nominal Thickness of Rolled Erosion Control Products.
14. ASTM D6566 – Standard Test Method for Measuring Mass Per Unit Area of Turf Reinforcement Mats.
15. ASTM D6818 – Standard Test Method for Tensile Properties of Rolled Erosion Control Products

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

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

C. Contractor weekly and rainfall event inspections forms.

1.5 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

1.6 QUALITY ASSURANCE

A. Perform Work according to related sections of the North Dakota Department of Transportation Standard Specifications for Road and Bridge Construction.

PART 2 - PRODUCTS

2.1 Erosion Control Blanket

A. Provide erosion control blanket (ECB) of organic biodegradable mulch material such as straw, curled wood excelsior, coconut fiber, or any combination of these materials. Provide ECB that has a consistent thickness of mulch material evenly distributed over the entire area. Secure the ECB materials on at least one side with netting. Use netting of photodegradable polypropylene or other plastic material fused to the strand intersections. Provide ECB that has a minimum width of 48 inches and is weed and pest free.

B. Provide ECB that meets the requirements of the tables below for the type specified in the plans.

Type	**ECB 1**		**ECB 2**	
Material	100% Straw	100% Excelsior Fibers	100% Straw	100% Excelsior Fibers
fiber Length 80% Must Be Greater Than	3 inches	80%> 6 inches	3 inches	6 inches
Min Thickness ASTM D6525	0.25 inch	0.25 inch	0.25 inch	0.25 inch
Net Opening Minimum (inch)	0.5 x 0.5	0.75 x 0.75	0.5 x 0.5	0.75 x 0.75
Max Shear Stress at 0.50 inches of soil loss ASTM D6460	N/A	1.50 lbs/sf	1.50 lbs/sf	1.75 lbs/sf
Slope Gradient Application	≤ 3H:1V	< 3H:1V - 2H:1V	≤ 2H:1V	< 2H:1 - 1.5H:1V
Net Backing Type	Rapid Photodegradable Polypropylene		Polypropylene	
Functional Longevity	≤ 3 months		≤ 12 months	
Min Machine Direct Tensil Strength ASTM D6818	50 lbs/ft		75 lbs/ft	
Type	**ECB 3**		**ECB 4**	
Material	70% Straw and 30% Coconut	100% Excelsior Fibers	100% Coconut Fibers	100% Excelsior Fibers
fiber Length 80% Must Be Greater Than	3 inches	80%> 6 inches	3 inches	80%> 6 inches
Min Thickness ASTM D6525	0.25 inch	0.25 inch	0.25 inch	0.50 inch

Max Shear Stress at 0.50 inches of soil loss ASTM D6460	1.75 lbs/sf	2.00 lbs/sf	2.25 lbs/sf	2.25 lbs/sf
Slope Gradient Applica-tion	≤ 1.5H:1V	≤ 1.5H:1V	≤ 1H:1V	≤ 1H:1V
Net Backing Type	Polypropylene		Black UV Stabilized Polypropylene	
Functional Longevity	12 to 24 months		> 24 months	
Min Machine Direct Tensil Strength ASTM D6818	100 lbs/ft		125 lbs/ft	

C. Wood Excelsior Blanket
1. Provide wood excelsior blanket that consists of a machine-produced blanket of curled wood excelsior in which 80 percent of the fibers are 6 inches or longer. Provide a wood excelsior blanket that is smolder-resistant without the use of additives.

D. Straw Blanket
1. Provide straw blanket that consists of agricultural straw in which 80 percent of the fibers are at least 3 inches in lengths. Ensure the straw is certified by an accredited agency to be 100 percent weed free.

E. Straw and Coconut Blanket
1. Provide a machine-produced straw and coconut blanket that consists of 70 percent straw and 30 percent coconut fibers by weight in which 80 percent of the fibers are 3 inches or longer.

2.2 Turf Reinforcement Mat

A. Provide turf reinforcement mat (TRM) that is three-dimensional structure of entangled filaments. Use filaments that are either bonded by heat fusion at the intersections or stitched with polypropylene, nylon, or polyester threads between two UV-Stabilized nettings. Provide TRM that promotes and maintains the integrity of the grass root system.

B. Provide TRM that meets the requirements of the table below for the type specified in the plans.

Type	**TRM 1**	**TRM 2**
Matrix Fill Material	Wood Excelsior, Coconut or Polymer Fibers	100% Stabilized Polypropylene
Min Mass Unit Area ASTM D6475 (natural fibers) D6566 (synthetics)	0.625 lbs/sy	0.625 lbs/sy
Minimum Thickness ASTM D6525	0.25 inch	0.5 inch
Minimum Roll Width	6.5 ft	6.5 ft
Size of Net Opening	0.5 x 0.5 inch	0.5 x 0.5 inch

Max Shear Stress at 0.50 inches of soil loss ASTM D6460	6.0 lbs/sf	8.0 lbs/sf
ASTM D6818	125 lbs/ft	150 lbs/sf

2.3 Silt Fence

A. Posts: Do not use silt fence with posts pre-attached. Use posts that have a minimum length of 4 feet.
   1. Wood Posts: Use either minimum 2-inch diameter round wood posts or 1.5 x 1.5 inch rectangular wood posts.
   2. Steel Posts: Use steel posts that are a minimum of 0.95 pounds per foot and have projections for fastening wire or fabric.

B. Filter fabric: Provide filter fabric as specified in AASHTO M288. Use fabric with a minimum width of 36 inches. Protec the filter fabric from moisture and ultraviolet exposure before placement.

C. Silt Fence Supported: Use wire backing or monofilament silt fence when installing supported fence.
   1. If backing for a silt fence is required, use a steel wire fence fabric meeting the following:
      a. A minimum of 32 inches wide;
      b. Has a maximum opening size of 6 x 6 inches; and
      c. Is a minimum of 14 gauge, grade 60.

2.4 Fiber Rolls

A. Provide fiber rolls that are composed of degradable netting that contains compressed hay or straw that is seed and noxious weed free, or wood excelsior.

2.5 Flotation Silt Curtain

A. Provide materials in accordance with the following;

Material Property	**Requirement**
Curtain fabric	Impermeable vinyl-coated nylon
Grab Tensile Strength	500 lb
Flotation	8 inch diameter marine quality expanded polystyrene
Net Buoyancy per Foot	20 lb
Top Load Carrying Components	Fabric plus 5/16 inch galvanized steel cable 9,800 lb min break strength
Ballast (min)	5/16 inch galvanized chain
Connections Between Sections	Aluminum collar reinforced quick disconnect

2.6 Stabilized Construction Entrance

A. Composed of 1 to 2 inch crushed rock, crushed concrete, or wood material.

B. Geosynthetic Fabric: Type R1 in accordance with section 858 of the North Dakota Department of Transportation Standard Specifications for Road and Bridge Construction.

2.7 Concrete Washout.

A. Aggregate – 2" minimum washed rock.

B. Geosynthetic Fabric: Riprap geotextile fabric as specified in Section 310519.13 – Geotextiles for Earthwork.

2.8 Inlet Protection.

A. Constructed Inlet Protection.
   1. Inlet Protection Type A-1.
      a. Fence Post – minimum 5' long free of excess deformation.
      b. Wire Mesh Reinforcement – Free from rust and in good general condition at time of installation.
      c. Geotextile Fabric – woven monofilament product having a water flow rate of 100-110 gpm/sf (ASTM D4491), a minimum 70% UV resistance (ASTM D4355), and a minimum Mullen burst rating of 300 psi (ASTM D3786).
   2. Inlet Protection Type A-2.
      a. 2"x4" wood frame made from hard wood that is sturdy and free from cracking.
      b. Geotextile Fabric – woven monofilament product having a water flow rate of 100-110 gpm/sf (ASTM D4491), a minimum 70% UV resistance (ASTM D4355), and a minimum Mullen burst rating of 300 psi (ASTM D3786).

B. Manufactured Inlet Protection
   1. Inlet Protection Type B.
      a. Preformed liner low density polyethylene barrier with mounting frame.
      b. Conform to the following standards: ASTM D3354, ASTM D792/1505, ASTM D968, ASTM D1248, ASTM D1308, and ASTM D2152.
      c. Frame as specified by the supplier.
      d. Geotextile Fabric – woven monofilament product having a water flow rate of 100-110 gpm/sf (ASTM D4491), a minimum 70% UV resistance (ASTM D4355), and a minimum Mullen burst rating of 300 psi (ASTM D3786).
   2. Inlet Protection Type C.
      a. Preassembled protection device designed for drop inlet protection.
      b. Consists of reusable, open topped receptacle that rests inside a storm sewer inlet casting allowing the grating to be reinstalled in the casting.
      c. If needed incorporate a rear deflector plate into the unit to protect open back castings from sediment.
      d. Include a filtration system to filter storm water.
      e. Include an overflow large enough to minimize/ eliminate street flooding during rain events.
      f. Approved manufacturers:

1) Wimco.
2) Lang IPD.
3) Flexstorm.
4) Approved Equal.

3. Inlet Protection Type C-2.
   a. Consists of a sediment control plate meeting H20 loading per OSHA 1910.23.
   b. Paint ¼" perforated steel lid yellow.
   c. Provide a two position HDPE basket that is able to be fixed in the up or down position.
   d. Attach a 400-micron filter bag to the basket.
   e. Approved manufacturers:
      1) Wimco.
      2) Lang IPD.
      3) Flexstorm.
      4) Approved Equal.
4. Inlet Protection Type D.
   a. Sewn geotextile fabric unit fitted to the individual grate.
   b. Includes lifting straps to allow manual inspection of the storm water system.
   c. Utilize an orange monofilament fabric.
   d. Approved manufacturers
      1) Dandy Products.
      2) Approved Equal.

2.9 Dewatering Structure

A. Dewatering Structure Type 1.
   1. Aggregate: ¼ inch average diameter pea gravel
   2. Fiber rolls or silt fence as described within.

B. Dewatering structure Type 2.
   1. Geotextile Fabric: minimum flow rate of 8 gpm/sf (ASTM D4491), a minimum 80% UV resistance (ASTM D4355), and a minimum Mullen burst rating of 300 psi (ASTM D3786).
   2. Rip Rap: 12" – 18" minimum diameter rock.
   3. Aggregate: 3/16" average diameter rock.
   4. Stakes: minimum 5-inch height and comprised of hard wood that is sturdy and free of cracking.

C. Dewatering Structure Type 3.
   1. Sediment filter bag: Non-woven geotextile material of appropriate size and flow characteristics to treat the capacity of water being pumped. To be determined by manufacturer specifications in accordance with the pump being used.

2.10 Accessories

1. Staples: Use staples for ECM and TRM that are constructed of 11 gauge or heavier steel wire and that are either U-shaped measuring 1 inch across the top and at least 8 inches along each leg, or that are T-shaped measuring at least 4 inches across the top and at least 8 inches in length.

2.11 SOURCE QUALITY CONTROL (AND TESTS)

A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.

3.2 Erosion Control Blanket and Turf Reinforcement Mat

A. Remove all rocks or clods greater than 1 inch in diameter, and all sticks and deleterious material from the area to be covered.

B. ECB and TRM 1
1. Complete seeding prior to placing ECB and TRM.

C. TRM 2
1. If the TRM requires soil filling, fill the TRM with topsoil, compost, or a blend of each.
2. Place seed and fertilizer on the soil filled TRM.
3. Apply hydraulic mulch or place ECB on the seeded TRM.
4. Place the ECB with the netting on top and the fibers in contact with the soil.
5. On embankments shorter than 10 feet, unroll ECB horizontally or vertically to the slope.

D. Repair
1. Restore the damaged area to the proper contour.
2. Re-seed the affected area.
3. Replace the ECB and TRM with the required type.

3.3 Silt Fence

A. Installation.
1. Install continuous silt fence transverse to the flow and following the contours of the site.
2. Place the fence so water cannot flow around the end of the fence.
3. If joining two sections of filter fabric, overlap at support posts a minimum of 18 inches in such a manner that prevents silt from passing through the fence.

B. Maintenance.
1. Remove sediment when it reaches 1/3 of the exposed height of any section of the silt fence, or as directed by the Engineer.
2. The Engineer may direct the installation of additional silt fence if removing the sediment deposit is not feasible.
3. Inspect the silt fence within 24 hours of each rainfall greater than 0.25 inches and at least daily during prolonged rainfall events.
4. Submit a silt fence inspection report within 24 hours of each inspection.

5. Immediately repair or remove and replace ineffective silt fence.

C. Removal.
1. Do not remove the silt fence without the Engineer's approval.
2. Level, smooth, seed, and mulch the removal area to match existing conditions.

3.4 Fiber Rolls

A. Install in accordance with detail in drawings.

B. Maintenance.
1. Remove sediment when it reaches 1/3 of the exposed height of any section of the fiber roll, or as directed by the Engineer.
2. The Engineer may direct the installation of a second fiber roll if removing the sediment deposit is not possible.
3. Inspect Fiber rolls within 24 hours of each rainfall greater than 0.25 inches and at least daily during prolonged rainfall.
4. Submit a fiber rolls inspection within 24 hours of each inspection.
5. Remove and replace fiber rolls when necessary.

C. Removal.
1. Do not remove fiber roll without the Engineer approval.
2. Level, smooth, seed, and mulch the removal area to match existing conditions.

3.5 Flotation Silt Curtain

A. Installation
1. Attach anchor lines to the flotation device.
2. Still water.
   a. Secure both ends of the curtain on land using the anchor points.
   b. Use anchor buoys if bottom anchors are used.
   c. Tow out the curtain in the furled condition and attach to the anchor points.
   d. Sed additional anchor points as necessary and attach them firmly to the curtain to maintain the desired location of the curtain.
   e. Release the furling lines to let the curtain skirt drop.
3. Moving Water.
   a. Set all anchor points.
   b. Ensure the anchor points keep the curtain in the desired location.
   c. Use anchor buoys on all anchor points.
   d. Start securing the furled curtain to the anchor points on the upstream side and work downstream.
   e. Make any necessary adjustments.
   f. Release the furling lines to let the curtain skirt drop.
   g. Do not install the curtain across the entire width of a flowing channel.

B. Maintenance.
1. Discontinue work if the silt curtain sinks below the surface or detaches from the anchor points or buoys. Repair or replace the curtain before continuing work.

2. Remove silt curtain before the water freezes for winter. Replace silt curtain in the spring once ice is out.

C. Removal.
1. Place bank protection before removing the silt curtain.
2. If bank protection is not specified, complete final grading of the adjacent slopes and install sediment control devices at the toe of the slope before removing the silt curtain.

3.6 Stabilized Construction Entrance

A. Remove topsoil before construction of stabilized construction access.

B. If the access restricts water flow, provide temporary drainage through the stabilized construction access.

C. Maintenance.
1. Maintain the stabilized construction access so that it retains its effectiveness.
2. Add material as needed.

D. Removal.
1. After removal, restore the disturbed area to its original condition.
2. Spread topsoil, seed, and mulch.

3.7 Concrete Washout

A. Installation.
1. Locate concrete washout within the project limits.
2. Excavate the required depth shown on the drawings.
3. Install Geosynthetic barrier.
4. Install a barrier fence around excavated area.
5. Install rock washing area as shown on the drawings.

B. Maintenance.
1. Clean washout when 80% of its capacity is achieved.
2. Dispose of all removed material off site.

C. Removal.
1. Do not remove concrete washout without the approval of the Engineer.
2. Level, smooth, seed, and mulch the removal area to match existing conditions.

3.8 Inlet Protection

A. Seasonal Considerations
1. Remove all devices installed in a street section that have the potential to cause damage to snow removal equipment by November 1st and reinstall as directed by the Engineer in the spring.
2. This work is considered normal maintenance and no additional compensation will be paid.

B. Protect newly installed sewer inlets from sediment laden runoff by installation of an inlet protection device within a maximum of 48 hours after installation.

C. Ensure all inlets are protected over a weekend.

D. Protect existing inlets that will receive water from the construction site prior to commencing land disturbing activities.

E. Maintain or replace all inlet protection at the direction of the Engineer.

F. Inlet protection will only be paid for once for each inlet protected, regardless of whether multiple types of devices are used on an inlet over the course of a project.

G. No additional compensation will be paid due to Contractor carelessness or modification to the anticipated phasing of construction.

H. Constructed inlet protection.
   1. Inlet Protection Type A1.
      a. Install metal posts no more than 3 feet apart to support wire mesh and geotextile fabric.
      b. Install fabric in one continuous piece wrapped around the posts, overlapped across the last gap, its ends securely fastened to separate posts.
      c. Ensure the assembly provides for the wire mesh and geotextile fabric to be securely in contact with the existing ground to prevent sediment laden water from running under the device.
      d. This device is intended to protect inlets within the future paving section. The Contractor is responsible for maintaining and disposal.
   2. Inlet Protection Type A2.
      a. Primarily used around all inlets not in a street section, such as rear yard inlets.
      b. Securely fasten geotextile fabric to wooden 2”x4” or prefabricated frame.
      c. Ensure the assembly provides for the wire mesh and geotextile fabric to be securely in contact with the existing ground to prevent sediment laden water from running under the device.
      d. This device remains on site requiring maintenance by the Contractor throughout the project and becomes the responsibility of the developer/property owner to maintain upon final completion of the project.

I. Manufactured Inlet Protection.
   1. Ensure devices are equipped with an emergency overflow to minimize the threat of street flooding during an intense rainfall event.
   2. Ensure all manufactured devices are installed per manufacturers instructions.
   3. Inlet Protection Type B.
      a. Primarily used to protect inlets within future paving sections.
      b. Fit frame into the top of a cones section of a catch basin.
      c. Wrap device with geotextile sock approximately 2 times the circumference of the barrel.
      d. This device will remain the property of the Contractor.
   4. Inlet Protection Type C.
      a. Remove the inlet grate.
      b. Insert the device into the casting frame.

c. Install grate into casting frame over top of device.
d. This device remains on site requiring maintenance by the Contractor throughout the project and becomes the responsibility of the developer/property owner to maintain upon final completion of the project.

5. Inlet Protection Type C-2.
   a. Primarily used to protect inlets within future paving sections.
   b. Fit frame into the top of a cones section of a catch basin.
   c. Wrap device with geotextile sock approximately 2 times the circumference of the barrel.
   d. This device will remain the property of the Contractor.
6. Inlet Protection Type D.
   a. Remove grate from each inlet.
   b. Stand the grate on end. Move the top lifting straps out of the way and place the grate into the sack unit so that the grate is below the top straps and above the lower straps.
   c. Holding the lifting devices insert the grate into the inlet being careful not to damage the bag unit.
   d. Remove all accumulated sediment and debris from vicinity of unit after each rain event or as directed by Engineer.
   e. Remove sediment and debris from sack once it is 1/3 full.
   f. This device will remain the property of the Contractor and will be removed upon completion of the project.

3.9 Dewatering Structure.

A. Dewatering Structure Type 1.
   1. Determine the appropriate size of the of the dewatering structure based on the discharge capacity of the pump being used for dewatering.
   2. Locate an area of established grass or prepare an area for use by removing all trash and debris.
   3. Lay geotextile fabric of appropriate size to cover the entire area to be used for dewatering.
   4. Fill the area with ¼” pea rock to a minimum depth of 6”.
   5. Surround the perimeter of the drainage area with silt fence or fiber roll.
   6. Cease all pumping activities if fiber roll (if used) is overtopped by pumped water.
   7. Remove and dispose of sediment and install additional pea rock to restore functionality if buildup of soil and sediment deter the function of the dewatering structure.

B. Dewatering Structure Type 2.
   1. Determine the appropriate size of the of the dewatering structure based on the discharge capacity of the pump being used for dewatering.
   2. Excavate to required dimensions and install straw bales butted tightly together and staked in place.
   3. Place geotextile fabric as straw bales are installed.
   4. Locate the pump discharge and place rip rap of sufficient size and depth to resist movement and prevent erosion where pumped water will enter the structure.
   5. Build a spillway out of 12”-18” diameter rocks, with a minimum depth of 6” depth from the top of the structure.
   6. Place a 6” thick later of 3/16” aggregate on the inside of the spillway.

7. Monitor the structure during pumping activities.
8. Cease pumping activities once water nears the spillway until dewatering area has discharged to the level of the excavated area.
9. Removed buildup of soil and sediment when excavation area is filled to ½ its depth.
10. Replace any decomposed, torn, or collapsed material immediately.

C. Dewatering Structure Type 3.
1. Place prefabricated sediment containment filter bag on an area of established grass or on a prepared 6" minimum depth aggregate base.
2. Orient bag in such a manner as to divert flow away from construction area and discharge filtered water into a swale, grass field, or secondary sediment containment system.
3. Monitor sediment containment bag during pumping activities.
4. Cease all pumping activities when the bag is filled, in accordance with manufactures specifications, until the bag has discharged the water pumped into it.
5. Remove and dispose of soil and sediment to restore functionality if buildup deters in anyway.

3.10 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect erosion control devices on a weekly basis and after each runoff event. Make necessary repairs to ensure erosion and sediment controls are in good working order.

3.11 CLEANING

A. Section 017000 - Execution and Closeout Requirements: Requirements for cleaning.

B. Do not damage structure or device during cleaning operations.

C. Do not permit sediment to erode into construction or site areas or natural waterways.

D. Maintain all erosion and sedimentation control items as specified in this Section. Correct all deficiencies identified by inspection or as directed by Engineer within 24 hours. If corrective actions are not completed within 72 hours of notification, Engineer may deduct liquidated damages of $500 per day from the contract amount until the non-compliance is corrected.

3.12 PROTECTION

A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.

END OF SECTION 312500

SECTION 313716.13 - RUBBLE-STONE RIPRAP

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Riprap placed loose.

B. Related Requirements:

1. Section 310519.13 - Geotextiles for Earthwork: Protective barrier.
2. Section 312213 - Rough Grading: Removal of topsoil and filling associated with contouring of Site.
3. Section 312300 – Excavation and Fill: Excavating for riprap.
4. Section 312316.13 - Trenching: Trenching and backfilling for Site utilities.
5. Section 334213 - Pipe Culverts: Excavating, bedding, and backfilling requirements for pipe culverts and accessories.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Riprap:

1. Basis of Measurement: By cubic yard of total riprap volume. Measured by the surface area at the depth specified in the plans.
2. Basis of Payment: Includes supply, excavation, geotextile fabric, and placing of riprap.

1.3 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit supplier information regarding size distribution and types for rock for riprap.

1.4 QUALITY ASSURANCE

A. Furnish each riprap material from single source throughout Work of this Section.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Riprap:

1. Description:
   a. Shall be durable field or quarry stone, sound, hard, and free of seams, cracks, or other structural defects and being generally round or cubical in shape.
      1) Field Stone - Shall be any field stone not made of sandstone, shale, and soft limestone, or not easily abraded or crushed, with no cracks or flaws that would cause the stone to split or breakup during loading, hauling and placing.
      2) Quarry Stone - Shall be quarried from an undisturbed deposit of rock that, if properly processed, would meet the requirements of concrete coarse aggregate for soundness and abrasion. Local deposits of sandstones or limestones and similar stone of sedimentary origin shall not be used as riprap stone.
      3) Free of soil and other debris.
      4) Recycled concrete is not allowed.
2. Size:
   a. Riprap shall meet the following gradations:

		Approx. % of Total Mass				
		Smaller than Given Mass				
Mass	Size	Class of Riprap				
pounds	inches	I	II	III	IV	V
2000	30	--	--	--	--	100
1000	24	--	--	--	100	--
650	21	--	--	--	--	75
400	18	--	--	100	--	--
250	15	--	--	--	75	50
120	12	--	100	75	50	--
50	9	--	75	50	--	--
15	6	100	50	--	--	10
5	4	--	--	--	10	--
2	3	50	--	10	--	--
--	2	--	10	--	--	--
--	1	10	--	--	--	--

   b. Lagoon Riprap shall meet the following gradations:

Size-Inches	Percent Passing
9	100
8	70-100
6	50-80
3	15-30
2	0-10
Passing 0.4 Sieve	0-2

B. Geotextile fabric as specified in Section 310519.13 – Geotextiles for Earthwork.

PART 3 - EXECUTION

3.1 APPLICATION

A. Place geotextile fabric over substrate as specified in Section 310519.13 - Geotextiles for Earthwork.

B. Place riprap where indicated on Drawings.

C. Place riprap into position and remove foreign material from surfaces.

D. Do not place riprap over frozen or spongy subgrade surfaces.

E. Installed Thickness: As indicated on Drawings. Riprap placed in excess of the specified thickness shall be at the Contractor's expense.

F. Place in uniformly disturbed manner as to insure material is secure and without tendency to move.

3.2 FIELD QUALITY CONTROL

A. The finished surface of the riprap shall present a generally even distribution of stone sizes over the entire riprap areas with no one area of any appreciable size deviating from the plan gradation by plus or minus 6 inches.

B. The Engineer will visually check riprap gradations. If requested by the Engineer, testing firm will test gradation based on mass. Compliance shall be within 10 percent of the percentages indicated. If riprap does not meet the gradation submitted by the Contractor, testing costs will be the responsibility of the Contractor and will not be reimbursed by the Owner under the Materials Testing allowance.

END OF SECTION 313716.13

32 - EXTERIOR IMPROVEMENTS

SECTION 320116 - FLEXIBLE PAVING REHABILITATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Milling asphalt pavement.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Asphalt Milling:

1. Basis of Measurement: By square yard (SY).
2. Basis of Payment: Includes milling existing asphalt to width and depth as indicated on Drawings, removing and stockpiling millings, and cleaning surface of all debris.

1.3 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Do not perform Work when weather conditions will not permit successful completion of the Work.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Milling Machine:

1. Use a self-propelled milling machine with a control system that automatically adjusts the elevation and transverse slope of the milling head.
2. Provide a 30 foot minimum length skid, rolling traveling straightedge, or other approved device to establish the grade reference for control of the milling head.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect existing improvements, overhanging trees, and plant life from damage.

3.2 APPLICATION

A. Asphalt milling:

1. Mill asphalt pavement to the depth and width as indicated on Drawings.
   a. Do not disfigure adjacent Work.
2. Mechanically sweep pavement surfaces prior to opening to traffic.
3. Clean pavement surfaces of loose foreign matter and verify surfaces are dry.

3.3 PROTECTION OF FINISHED WORK

A. Section 017000 - Execution and Closeout Requirements: Protecting finished work.

B. Coordinate milling and paving operations so that no section of milled roadway has public or construction traffic operating on it for more than five (5) days.

1. If public or construction traffic operates on the milled surface for more than five (5) days, repair the roadway at no additional cost to the Owner.

END OF SECTION 320116

SECTION 320117.61 - SEALING CRACKS IN ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preparation of surface, routing and sealing of cracks.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Asphalt Crack Sealing:

1. Basis of Measurement: By linear foot (LF).
2. Basis of Payment: Includes surface cleaning, routing cracks, placing backing material, sealant material and blotter material, and protection and repair or replacement of sealant material.

B. Asphalt Mastic Crack Repair:

1. Basis of Measurement: By linear foot (LF).
2. Basis of Payment: Includes surface cleaning, routing, sealant material, aggregate reinforcing material, blotter material, installation, protection, and repair or replacement of sealant material.

C. Asphalt Crack Rehabilitation:

1. Basis of Payment: by linear foot (LF).
2. Basis of Payment: Includes milling crack full depth at specified width, surface cleaning, tack, asphalt pavement, and compaction.

1.3 REFERENCES

A. ASTM International:

1. ASTM D113 - Standard Test Method for Ductility of Bituminous Materials.
2. ASTM D5249 - Standard Specification for Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints.
3. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on sealing material and blotter material.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Section 016000 - Product Requirements: Environmental conditions affecting products on site.

B. Routing and sealing of asphalt pavement will be permitted only during daylight hours between May 1 and October 30.

C. Routing with a star bit type router will not be allowed when the air temperature is below 55 degrees F.

D. Application of the sealant material will not be allowed when the air temperature is below 45 degrees F.

E. Hot air lancing will be required immediately prior to sealant application when temperature and humidity may cause condensation in the reservoir during application of the sealant.

F. Work will not be allowed when pavement is wet.

PART 2 - PRODUCTS

2.1 SEALANT MATERIAL

A. Manufacturers:

1. Koch Materials Company
   P.O. Box 2338
   Wichita, KS 67201
2. Crafco Inc.
   20 N. Roosevelt Ave.
   Chandler, AZ 85226
3. W.R. Meadows, Inc.
   300 Industrial Drive
   Hampshire, IL 60140
4. Or Approved Equal.

B. Hot-Poured Elastic Joint Seal:

1. Polymer modified asphalt.
2. ASTM D6690, type IV.

3. Conforms to the requirements of the State of North Dakota Standard Specifications for Road and Bridge Construction.
4. Koch 9030, Crafco RoadSaver 231, W.R. Meadows SealTite 3405M, or Approved Equal.

2.2 MASTIC CRACK REPAIR

A. Manufacturers:

1. Maxwell Products (Gap Mastic B)
   650 South Delong St.
   Salt Lake City, UT 84104
2. Crafco, Inc (Mastic One)
   6165 W. Detroit St.
   Chandler, AZ 85226
3. Or Approved Equal.

B. Description:

1. Polymer modified asphalt, aggregate reinforced repair system conforming to ASTM D8260.
2. Maxwell Gap-Mastic B, Crafco MasticOne, or Approved Equal.

2.3 ACCESSORIES

A. Blotter Material: Sand, tissue paper, or specialized de-tackifying material compatible with the sealant.

B. Backing Material:

1. ASTM D5249, type I.
2. Sized to properly fit the crack width and depth necessary to obtain the specified reservoir dimensions. Multiple sizes may be required.

2.4 EQUIPMENT

A. Routing Equipment:

1. Mechanical powered cutting type router. Hand methods or plow type methods will not be accepted.
2. Capable of cutting a reservoir to the required dimensions.

B. Air Blasting Equipment:

1. 125 CFM minimum air output.
2. ¾ inch minimum diameter nozzle.

C. Heating Equipment:

1. Melting vat capable of heating and maintaining sealant material or mastic material to the manufacturer's recommended application temperature.
2. Continuous agitator.
3. Sealant temperature thermometer.

D. Sealant Applicator:

1. Hot pressure fed type applicator.
2. Purpose designed flat plate or over banding applicator tips may be used with the approval of the Engineer.

E. Squeegee: Shaped to provide an over banding finish.

F. Mastic Applicator:

1. Drag boxes of various widths and capacities to properly seal cracks of varying length.

PART 3 - EXECUTION

3.1 PREPARATION

A. Mechanically sweep pavement surfaces immediately prior to commencement of Work. Clean pavement surfaces of loose foreign matter. Verify surfaces are dry.

B. Protect existing improvements, overhanging trees, and plant life from damage.

C. Route traffic to temporary detours, or confine work area to one half of the road at a time.

D. Routed reservoirs or cracks left overnight are to be re-cleaned immediately before the backing material or sealant is applied.

E. Remove and reseal any sealant damaged by traffic.

3.2 INSTALLATION

A. Routing (Crack Sealing):

1. Cracks which are less than ½ inch in width or depth will require routing to a width and depth of ½ inch .
2. Cracks which are ½ inch or greater in width and depth will not require routing.
   a. Thoroughly clean foreign material to equal a depth equal to the width of the crack.

3. The wall of the finished reservoir is to be vertical and the reservoir bottom is to be flat.

B. Crack Sealing:

1. Cracks 3/8 inch or more in width which exists below the cleaned or routed reservoir to be filled with a backing material to insure a nominal sealant depth equal to the width of the reservoir.
2. Place sealant material within 72 hours of routing.
3. There is to be no visible signs of moisture on the roadway surface or in the reservoir at the time the sealant is applied.
4. Abide by the sealant manufacturer's recommended handling, mixing and application instructions and temperature restrictions.
5. When applying the sealant, the reservoir is to be overfilled and squeegeed to provide an over banding finish film of sealant on the roadway surface 1 to 3 inches on both sides of the reservoir.
6. Apply blotting material immediately after sealant is placed.

C. Routing (Mastic Crack Repair):

1. Cracks which are less than 1 inch in width or depth will require routing to a width and depth of 1 inch.
2. Cracks which are 1 inch or greater in width and depth will not require routing.
   a. Thoroughly clean foreign material to equal a depth equal to the width of the crack.
3. The wall of the finished reservoir is to be vertical and the reservoir bottom is to be flat.

D. Mastic Crack Repair:

1. Abide by manufacturer's recommended handling, mixing and application instructions and temperature restrictions.
2. Clean surface of oil, dirt, weeds, and other residue.
3. Spread even coat of mastic material over the entire work area, keeping surface as level and smooth as possible. Use heated box and flat iron finishing tools to smooth away any imperfections. Apply banding finish of mastic on the roadway surface 6 inches on both sides of the crack.

E. Asphalt Crack Rehabilitation:

1. Asphalt Milling:
   a. Mill asphalt pavement full depth along crack to be rehabilitated a minimum of 24 inches wide or to the width as shown in the Details and as specified in Section 320116 - Flexible Pavement Rehabilitation.
2. Asphalt Paving:
   a. Complete asphalt patching as specified in Section 321216 - Asphalt Paving.

3.3 FIELD QUALITY CONTROL

A. Check adhesion of sealant by pulling up cooled sealant.

1. Unbonded sealant that can be pulled up by hand is to be removed and the crack resealed.

B. Re-apply sealant or mastic to areas that are settled or insufficient material was applied.

3.4 PROTECTION OF FINISHED WORK

A. Section 017000 - Execution and Closeout Requirements: Protecting finished work.

B. Do not permit traffic over surface where material is applied until blotter material is applied and material has cooled sufficiently to withstand traffic.

END OF SECTION 320117.61

SECTION 321123 - AGGREGATE BASE COURSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aggregate Base Course.
2. Full Depth Reclamation.
3. Blended Materials.

B. Related Sections:

1. Section 312316.13 - Trenching: Compacted fill under base course.
2. Section 312300 - Excavation and Fill: Compacted fill under base course.
3. Section 310516 - Aggregates for Earthwork.
4. Section 310519.13 - Geotextiles for Earthwork.
5. Section 321216 - Asphalt Paving.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Aggregate Base Course:

1. Basis of Measurement: By cubic yard (CY) or ton (TON)
   a. By the section dimensions in the Drawings and in-place compacted volumes.
2. Basis of Payment: Includes supplying aggregate base material, stockpiling, placing, blading, testing, and compacting.

B. Aggregate Surface Course:

1. Basis of Measurement: By cubic yard (CY) or ton (TON)
   a. By the section dimensions in the Drawings and in-place compacted volumes.
2. Basis of Payment: Includes supplying aggregate surfacing material, stockpiling, placing, blading, testing, and compacting.

C. Full Depth Reclamation:

1. Basis of Measurement: By square yard (SY)
   a. By the section dimensions in the Drawings and in-place compacted volumes.
2. Basis of Payment: Includes blending, compacting, and maintaining reclaimed surface.

D. Remove & Relay Blended Material:

1. Basis of Measurement: By square yard (SY)
   a. By the section dimensions in the Drawings and in-place compacted volumes.

2. Basis of Payment: Includes removing blended material, hauling, stockpiling, placing, blading, testing, and compacting.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.

B. ASTM International:

1. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
2. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
3. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
4. ASTM D2940 - Standard Specification for Graded Aggregate Material For Bases or Subbases for Highways or Airports.
5. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Materials Source: Submit name of aggregate 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.

PART 2 - PRODUCTS

2.1 AGGREGATE MATERIALS

A. Aggregate Base: Type A1 as specified in Section 310516.00 - Aggregates for Earthwork.

B. Recycled Base: Type A5 as specified in Section 310516.00 - Aggregates for Earthwork.

C. Reclaim: Type A8 as specified in Section 310516.00 - Aggregates for Earthwork.

2.2 ACCESSORIES

A. Geotextile Fabric: As specified in Section 310519.13 - Geotextiles for Earthwork.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify compacted substrate is dry and ready to support paving and imposed loads.

C. Verify substrate has been inspected, gradients and elevations are correct.

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. Install geotextile fabric over subgrade according to manufacturer's instructions and in accordance with Section 310519.13 - Geotextiles for Earthwork.

3.3 AGGREGATE PLACEMENT

A. Spread aggregate over prepared substrate to total compacted thickness indicated on Drawings.

B. Level and contour surfaces to elevations, profiles, and gradients indicated.

C. Add small quantities of fine aggregate to coarse aggregate when required to assist compaction.

D. Maintain optimum moisture content of fill materials to attain specified compaction density.

E. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.4 FULL DEPTH RECLAMATION

A. Place virgin aggregate to the specified depth.

B. Use reclaiming equipment to blend the material.

C. Compact blended material to facilitate traffic.

D. Maintain blended base until construction activities resume.

3.5 REMOVE AND RELAY BLENDED MATERIAL

A. Remove and stockpile blended material when construction resumes.

B. Relay and compact blended material.

3.6 TOLERANCES

A. Section 014000 - Quality Requirements: Tolerances.

B. Maximum Variation From Flat Surface: 1/4 inch measured with 10 foot straight edge.

C. Maximum Variation From Thickness: 1/4 inch.

D. Maximum Variation From Elevation: 1/2 inch.

3.7 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Select test standards referenced in the following paragraph appropriate for Project requirements. Consult geotechnical report.

C. Gradation:

1. Collect three (3) samples for each 1,000 cubic yards of material placed.

D. Perform in place compaction tests in accordance with the Drawings.

E. Compaction Testing (Proof Roll):

1. Proof roll all aggregate bases prior to paving along all travel lanes to verify the uniformity of the underlying base throughout the roadway section and to check for the presence of localized soft or weak zones.
2. Perform proof roll under the observation of the Engineer with a fully loaded, tandem axle dump truck with a weight of approximately 25 tons, or an approved equal. Proof roll at a vehicle speed of between 1 ½ and 3 miles per hour along the aggregate base such that unrolled areas between wheel paths are not wider than 1 foot. Typical yielding should be limited to less than ½-inches for aggregate bases, provided the aggregate base does not display permanent deformation.
3. Correct areas that display excessive yielding, pumping or rutting during the proof roll.
4. Repeat proof roll procedures until accepted by the Engineer.
5. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

END OF SECTION 321123

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Asphalt materials.
2. Aggregate materials.
3. Aggregate base.
4. Asphalt paving base course, binder course, and wearing course.
5. Asphalt paving overlay for existing paving.

1.2 PRICE AND PAYMENT PROCEDURES

A. Asphalt Pavement:

1. Basis of Measurement: By tonnage (TON) or square yard (SY).
2. Basis of Payment: Includes mix design, tack coating surfaces, furnishing, placing, compacting, and quality control testing of bituminous material and aggregate.

B. Asphalt Pavement Leveling:

1. Basis of Measurement: By tonnage (TON).
2. Basis of Payment: Includes mix design, tack coating surfaces, furnishing, placing, compacting, and quality control testing of bituminous material and aggregate.

C. Asphalt Patching:

1. Basis of Measurement: By tonnage (TON) or square yard (SY).
2. Basis of Payment: Includes mix design, tack coating surfaces, furnishing, placing, compacting, and quality control testing of bituminous material and aggregate.

D. Asphalt Core Sample:

1. Bais of Measurement: By each (EA).
2. Basis of Payment: Includes all labor, materials, and equipment in order to extract one (1) cored sample, including coring operations, handling, and patching of cored hole.

1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO M320 - Standard Specification for Performance-Graded Asphalt Binder.

B. ASTM International:

1. ASTM D3549 - Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.

C. North Dakota Department of Transportation (NDDOT):

1. Standard Specifications for Road and Bridge Construction; current version.

2. Field Sampling and Testing Manual, current version.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit product information for asphalt and aggregate materials.
2. Submit mix design with laboratory test results supporting design.
3. If using a mix with RAP and a mix without RAP, submit mix designs for both mixes.

C. Reports:

1. Certified Haul Sheets.
2. Testing Reports.
3. Asphalt Plant Cutoff Reports

1.5 QUALITY ASSURANCE

A. Obtain materials from same source throughout.

B. Perform Work in accordance with North Dakota Department of Transportation Standard Specification for Road and Bridge Construction, Section 430

1.6 QUALIFICATIONS

A. Installer: Company specializing in performing work of this section with minimum five (5) years documented experience.

1.7 AMBIENT CONDITIONS

A. Section 015000 - Temporary Facilities and Controls: Ambient conditions control facilities for product storage and installation.

B. Place a subsequent lift after the previous lift has cooled to 130°F.

C. Place asphalt mixture without supplementary admixtures when ambient air or base surface temperatures are at or above the requirements in the table below:

Standard Paving Temperatures			
Compacted Thickness	Air Temp for Surface Course	Air Temp for Subsurface Course	Existing Mat
1-1/2 inches or less	45°F	40°F	40°F
More than 1-1/2 inches	40°F	35°F	40°F

D. Include a supplementary admixture such as Evotherm, AD-here LOF 65-00 EU, or an Engineer approved equal in the bituminous mixture when placing bituminous mix when temperatures are within the ranges shown in the table below. Submit admixture manufacturer's name and dosage rate to Engineer prior to use.

Paving Temperatures Using Supplementary Admixtures			
Compacted Thickness	Air Temp for Surface Course	Air Temp for Subsurface Course	Existing Mat
1-1/2 inches or less	40°F - 45°F	35°F - 40°F	35°F - 40°F
More than 1-1/2inches	35°F - 40°F	35°F or above	35°F - 40°F

E. Discharge mix from the mixer with a temperature no higher than the bituminous material manufacturer's recommendation. If there are no recommendations on maximum mix temperature, discharge mix with a maximum temperature of 300°F.

F. When the ambient temperature is 60°F or higher, place mix with a minimum laydown temperature of 230°F. When the temperature is below 60°F, place mix with a minimum laydown temperature of 250°F. Loads not meeting this requirement will be rejected and removed from the worksite.

PART 2 - PRODUCTS

2.1 ASPHALT PAVING

A. Performance and Design Criteria:

1. Provide mix that meets the requirements of Superpave mix design indicated on the bid form in accordance with Section 430 of the North Dakota Department of Transportation Standard Specification for Road and Bridge Construction.

B. Asphalt Materials:

1. Asphalt Binder: AASHTO M320; performance grade PG 58S-34 .
2. Tack Coat: In accordance with Section 401 of the North Dakota Department of Transportation Standard Specifications for Road and Bridge Construction.
3. Recycled Asphalt Pavement (RAP):

a. When indicated on the Bid Form, RAP may be incorporated into mix used for mainline pavement at a rate between 10 and 20 percent of the mix by weight.
b. Provide recycled material with a maximum particle size of 1.5 inch.
c. Introduce recycled material so that it does not come into direct contact with the burner flame. Add binder to the combined virgin aggregate and recycled material.

C. Aggregate Materials:

1. Develop a mix design that contains an aggregate gradation that conforms to the requirements in Section 430 of the North Dakota Department of Transportation Standard Specifications for Road and Bridge Construction.
2. Use the below gradation for leveling courses:

Sieve Size	% Passing by Weight
1/2”	100%
3/8”	85-100%
#4	50-80%
#10	35-65%
#30	25-45%
#100	5-20%
#200	3-10%
Maximum Shale and Soft Rock	4%
Maximum Clay	5%
Maximum Loss (L. A. Abrasion Test)	40%

D. Aggregate Base: As specified in Section 321123 - Aggregate Base Courses.

2.2 MIXES

A. Use dry material to avoid foaming. Mix uniformly.

B. Asphalt Paving Mixtures: Designed in accordance with Section 430.04 D of the current North Dakota Department of Transportation Standard Specifications for Road and Bridge Construction.

2.3 SOURCE QUALITY CONTROL

A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify utilities indicated under paving are installed with excavations and trenches backfilled and compacted.

C. Verify compacted granular base is dry and ready to support paving and imposed loads.

D. Verify gradients and elevations of base are correct.

E. Verify gutter drainage grilles and frames manhole frames and valve boxes are installed in correct position and elevation.

3.2 PREPARATION

A. Prepare base as specified in Section 321123 - Aggregate Base Courses.

3.3 REMOVALS

A. Saw cut and notch existing paving as indicated on Drawings.

B. Clean existing paving to remove foreign material, excess joint sealant and crack filler from paving surface.

C. Repair surface defects in existing paving to provide uniform surface to receive new paving.

3.4 INSTALLATION

A. Base Course: As specified in Section 321123 - Aggregate Base Courses.

B. Tack Coat:

1. Apply tack coat on asphalt and concrete surfaces at uniform rate.
   a. New Surfaces: 0.10 gal/sq yd.
   b. Existing Surfaces: 0.10 gal/sq yd.
2. Apply tack coat to contact surfaces of curbs, gutters and concrete pavement.
3. Coat surfaces of manhole, catch basin, and gate valves frames with oil to prevent bond with asphalt paving. Do not tack coat these surfaces.

C. Asphalt Paving:

1. Install Work in accordance with Section 430 of the North Dakota Department of Transportation Standard Specifications for Road and Bridge Construction
2. Place asphalt within 8 hours of applying primer or tack coat.
3. Place asphalt wearing course thickness indicated on Drawings.
   a. Maximum allowable lift: 3 inches.
   b. Minimum allowable lift: 1.5 inches
4. Compact paving by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.

5. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

D. Asphalt Paving Overlay:

1. Verify existing surface is stable.
2. Pave surface no more than 5 days after milling operations.
3. Compact overlay by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
4. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.5 TOLERANCES

A. Section 014000 - Quality Requirements: Tolerances.

B. Surface Irregularities: Maximum variation of 3/16 inch measured with 10 foot straight edge.

C. Scheduled Compacted Thickness: Within 1/4 inch.

D. Variation from Indicated Elevation: Within 1/2 inch.

3.6 FIELD QUALITY CONTROL

A. Section 017000 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

B. Contractor Quality Control (QC) responsibility as shown in section 430.02 of the North Dakota Department of Transportation Field Sampling and Testing Manual will not apply.

C. Independent Testing Firm to provide Quality Assurance (QA) testing in accordance with Table 1 below. Independent Testing Firm must provide NDDOT certified personnel to conduct all required asphalt testing. Send testing results to the Engineer within 24 hours of the sample being received.

Table 1 – Testing Frequencies

Test/Assessment	Minimum Testing Requirements
ND T 11 Materials Finer than No. 200 Sieve	1 per Lot
ND T 27 Sieve Analysis of Fine and Coarse Aggregate	1 per Lot
ND T 304 Fine Aggregate Angularity	1 per Lot

ND T 166 Bulk Specific Gravity of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens	1 per Lot
ND T 209 Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt	1 per Lot

D. A "Lot" is equal to the amount of material, in tons, placed each production day.

E. Provide Daily Cut-Off Reports for asphalt cement for each Lot. Calculate average AC content at the end of each production day and record results on SFN 9988 or a similar contractor provided form approved by the Engineer prior to paving operations beginning, Mix Bitumen Cut-Off Report. Complete SFN 9988 and submit to the Engineer the day following paving.

F. Total the recorded average asphalt contents of the Lots and divide by the number of Lots to obtain the average asphalt content for the job. Use this in the Asphalt Content Adjustment Factor in Section 430.06 C.3 a of the North Dakota Department of Transportation's Standards Specifications for Road and Bridge Construction.

G. Engineer will direct the Independent Testing Firm to obtain cores from each Lot following Table 2 below. The Engineer will mark coring locations distributed throughout the Lot. Cores will be taken no later than the following day and prior to any successive lifts being placed. Coring will be observed by both the Engineer and paving Contractor.

Table 2 – Coring Frequencies

Number of Cores	Tonnage Placed in Lot*
No cores required unless directed by the Engineer	<100
2	100-250
Take additional cores at the rate of 1 per 250 tons of asphalt placed per Lot.	>250
*Tonnage excludes asphalt use for minor patching and leveling.	

H. Engineer will record the information on SFN 10071, "Compaction Control" and will observe the coring procedure. The Engineer will take immediate possession of the cores.

I. The Independent Testing Firm will determine the density of the cores in accordance with ND T 166, "Bulk Specific Gravity of Compacted Hot Mix Asphalt Using Saturated Surface-Dry Specimens," and ND T 209, "Maximum Theoretical Density." The Engineer will determine the acceptance of the Lot based on the average of all the cores taken from that Lot.

J. The density of a Lot will be determined using the recorded average densities of the cores taken from the Lot. The recorded average densities of the cores will be totaled and divided by the number of cores within the Lot to obtain the average density of the pavement. If average density is less than the number specified on the Density Adjustment Factors Table 3 below, the Contractor may take additional cores at their own cost to better determine the areas needing replacement.

K. When Ordinary Compaction is specified, cored samples will be taken at the frequencies listed above and will be used only to determine final pavement thickness.

L. Asphalt Paving Thickness: ASTM D3549; record pavement thickness for each cored sample taken.

M. Asphalt Paving Mix Temperature: Measure temperature at time of placement.

3.7 PAYMENT ADJUSTMENTS

A. Asphalt Pavement Thickness (when paid by square yard):

1. Upon completion of paving operations, obtain cores according to Table 2.
2. Core locations will be determined and marked out by the Engineer.
3. Measure cores to the nearest 1/8”.
4. Density cores from the final lift can be used as pavement thickness cores.
    a. In this instance, obtain full depth cores and measure prior to cutting the core for pavement densities.
5. Average any deficient cores against conforming cores using the planned thickness for the conforming cores.
6. A deduct may be applied to the area of each Lot.
    a. The deduct will be the calculated percentage of the ratio between the depth of deficiency and the planned thickness of asphalt multiplied by the square yard area of asphalt in each Lot.
    b. The square yard deduction will be applied to the respective bid items for both the Base and Wear Courses quantities.
7. Contractor may provide additional cores at their expense.
8. Any pavement with more than 1/2 inch of deficiency will be removed and replaced to the proper thickness at no additional cost to the Owner.
9. There will be no additional payment for pavement thickness exceeding the specified section.

B. Asphalt Pavement Thickness (when paid by tonnage):

1. Upon completion of paving operations, obtain cores according to Table 2.
2. Core locations will be determined and marked out by the Engineer.
3. Measure cores to the nearest 1/8”.
4. Density cores from the final lift can be used as pavement thickness cores.
    a. In this instance, obtain full depth cores and measure prior to cutting the core for pavement densities.
5. When the average core thickness for each Lot exceeds the planned thickness plus 1/4 inch, a deduct will be applied for the excess thickness.

a. The deduct will be based on a density factor of 2 tons per cubic yards (111 lbs/sq-in).

6. Contractor may provide additional cores at their expense and will be incorporated into the previously determined Lot average.
   a. Locations for additional cores to be determined by the Engineer.
7. Any pavement with more than 1/2 inch of deficiency will be removed and replaced to the proper thickness at no additional cost to the Owner.

C. Aggregate Gradation, Asphalt Content, Compaction, and Bitumen:
1. Adjustment factors will be applied to the "Asphalt" bid item.
   a. The payment adjustment factor will be multiplied by the unit cost of the item and the quantity of asphalt represented by the sample.

The compaction adjustment factor will be determined using the modified table below:

Table 3 - Density Adjustment Factors	
Adjustment Factor	Average Pavement Density*
1.0	≥92.0 %
0.95	91.0 to 91.9 %
0.90	90.0 to 90.9%
Remove & Replace	<90.0 %

*All Average Pavement Density numbers are adjusted down by 1.0% when pavement is placed on aggregate base or reclaimed material.

3.8 PROTECTION

A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Immediately after placement, protect paving from mechanical injury until surface temperature is less than 120°F.

END OF SECTION 321216

SECTION 321236 - SEAL COAT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Seal coating, commonly referred to as chip seal.
2. Preparation of surfaces.
3. Placing bituminous material and aggregate, and rolling final product.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Seal Coat:

1. Basis of Measurement: By square yard (SY).
2. Basis of Payment: Includes submittal of mix design, surface cleaning, masking to protect adjacent surfaces, applying bituminous material, aggregate, blotter material, compacting and rolling, sweeping and removal of excess aggregate, and maintenance.

B. Fog Seal:

1. Basis of Measurement: By square yard (SY).
2. Basis of Payment: Includes surface cleaning, applying bituminous material, masking to protect adjacent surfaces, and maintenance.

1.3 REFERENCES

A. Asphalt Institute:

1. AI MS-19 - Basic Asphalt Emulsion Manual.

B. ASTM International:

1. ASTM D4 - Standard Test Method for Bitumen Content.
2. ASTM D6 - Standard Test Method for Loss on Heating of Oil and Asphaltic Compounds.
3. ASTM D244 - Standard Test Methods and Practices for Emulsified Asphalts.

C. North Dakota Department of Transportation (NDDOT):

1. Field Sampling and Testing Manual.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on bituminous material, and aggregates.

C. Mix Design: Submit seal coat mix design to Engineer a minimum two (2) weeks prior to beginning Work.

1. Include the following design information:
   a. Aggregate gradation.
   b. Bulk specific gravity of the aggregate.
   c. Loose unit weight of the aggregate.
   d. Asphalt type and rate of application.
   e. Aggregate rate of application.

D. Equipment: Submit list of equipment intended for use on the Work.

1.5 QUALITY ASSURANCE (QA)

A. Independent Testing Firm to provide testing in accordance with NDDOT Field Sampling and Testing Manual Section 420.02 as follows:

1. Bitumen:
   a. Under the observation of the Engineer, the Contractor will obtain a sample, which is two containers, of bitumen from each load delivered to the project following NDDOT 1, “Sampling of Bituminous Materials.” At the discretion of the Engineer, Independent Testing Firm will test the emulsified asphalt samples for sieve and viscosity only according to tests listed in AASHTO T 59, “Emulsified Asphalts.”
2. Aggregate:
   a. Obtain three (3) random samples from each Lot of cover coat material. Obtain and split aggregate samples according to ND T 2, “Sampling of Aggregate,” and ND T 248, “Reducing Samples of Aggregate to Testing Size.”
   b. Test all samples from the Lot and determine acceptance of the Lot based on the average of the tests.

B. Test Method and Frequency:

1. ND T 27, “Sieve Analysis of Fine and Coarse Aggregates”: 1 test result per Lot. Minimum of 2 tests per project.
2. ND T 11, “Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing”: 1 test result per Lot. Minimum of 2 tests per project.

C. Definition of a Lot:

1. 1,200 tons or Plan Quantity if less than 1,200 ton total.
2. If the final Lot is less than 600 tons, include it in the previous Lot.

3. If the final Lot is greater than 600 tons, it is a separate Lot.
4. Lots continue from day to day. Each day does not start a new Lot.

D. Compute the sieve analysis on SFN 9987, "Aggregate Sample Worksheet". Results are recorded on SFN 10072, "Aggregate Quality Test Summary".

1.6 ENVIRONMENTAL REQUIREMENTS

A. Section 016000 - Product Requirements: Environmental conditions affecting products on site.

B. Do not perform Work when weather conditions will not permit successful completion of the Work.

C. Begin chip seal work after May 15th and no later than September 1st, unless written approval is provided by the Engineer.

D. Do not perform Work when pavement is wet.

E. Do not begin chip seal until ambient air and pavement temperature is 60 degrees F and rising.

F. Do not apply Seal Coat on newly constructed asphalt surfaces until after the rolling has been completed and the traffic permitted on the surface for not less than seven (7) days or longer if such longer interval is required for the surface to properly cure prior to receiving the seal.

PART 2 - PRODUCTS

2.1 BITUMINOUS MATERIAL

A. Polymer modified, cationic water-based emulsified asphalt:

1. As specified in the plans: Type CRS-2P or CHFRS-2P.
2. Conforms to the requirements of AASHTO M 316.
3. Conforms to the requirements of the State of North Dakota Standard Specifications for Road and Bridge Construction, Section 818.

B. Fog Seal

1. In accordance with Section 401 of the North Dakota Department of Transportation.

2.2 AGGREGATE

A. Seal Coat aggregate:

1. Sound, durable particles of gravel, sand and stone.
2. Conforms to the requirements of the State of North Dakota Standard Specifications for Road and Bridge Construction, Section 816, Class 41M.
   a. Revise NDDOT Class 41M to limit percent passing the #200 sieve to 1 percent.
3. Wash aggregate using clean potable water prior to stockpiling on site.

2.3 EQUIPMENT

A. Heating/Spreading Equipment:

1. Self-propelled pressure distributor with adequate capacity to properly heat the bituminous materials.
2. Provide an accurate thermometer on the outside heating unit to indicate the temperature of the bituminous material in the unit in which heat is applied.
3. Provide manufacturer's recommendation for spray bar height above surface, nozzle size, and angle of spray fan with the spray axis.
4. Equipment must have an independent wheel to accurately measure speed in ft/min.
5. Provide a bitumeter and tack chart within equipment.
6. Use a digital application rate indicator.
7. The use of any equipment or methods that introduce moisture into the bituminous material, injures, or in any way changes the characteristics of the material will not be permitted.

B. Power Broom or Blower.

C. Aggregate Spreader:

1. Self-propelled.
2. Adjustable spread rate to provide the specified material quantity per area.
3. Proof of spreader calibration is required at the time of construction.

D. Compactor:

1. Pneumatic tired roller.
2. Minimum of three units required.

PART 3 - EXECUTION

3.1 PREPARATION

A. Cleaning and Protection:

1. Mechanically sweep pavement surfaces immediately prior to commencement of Work. Clean pavement surfaces of loose foreign matter. Verify surfaces are dry.
2. Protect existing improvements, overhanging trees, and plant life from heat damage by individual shielding.

3. Cover or mask manhole covers, frames and concrete pads, catch basin covers and frames, gate valve boxes, valley gutters, pavement markings, and any other adjacent surfaces to be protected with contractor building paper, roofing felt, or equivalent.
4. Route traffic to temporary detours, or confine work area to one half of the road at a time.
5. Verify forecasted weather conditions prior to beginning chip seal operation. No chip sealing should take place unless the roads are completely dry and clean. Resweep as necessary to achieve clean and dry streets.
6. Calibrate the chip spreader prior to performing the test strip.
7. Adjust and align distributor nozzles so that each nozzle is at the same angle, with the exception of the end nozzles.
8. Provide manual workforce sufficient to touch up areas that are missed by the mainline operation.

3.2 INSTALLATION

A. Bituminous Material and Aggregate:

1. Apply emulsified asphalt and cover material at the following rates:
   a. Emulsified Asphalt: 0.42 Gal/SY
   b. Cover Coat Material Cl 41M: 25 Lb./SY
2. Construct a test strip of approximately 50 feet (min.) to verify application rates. Repeat as necessary and adjust application rates depending on existing pavement condition.
   a. Adjust application rates to target 70% embedment of the seal aggregate after binder cure without bleeding or flushing.
   b. The binder should rise almost to the top of the compacted chips to ensure proper embedment after the binder cures.
3. Use contractor building paper or roofing felt as a launching pad at all starts and stops to maintain a clean and straight edge and allow application at the proper rate upon reaching the untreated surface.
4. Apply bitumen in a uniform and continuous spread. Correct skipped areas and deficiencies. Prevent lapping at transverse junctions.
5. Immediately apply aggregate while the bituminous material is tacky and before the binder breaks.
6. Uniformly apply aggregate at the designed rate as adjusted by the test strips.
7. Immediately correct bleeding and flushing of the asphalt with an approved blotter material.
8. If unexpected rainfall occurs, discontinue chip sealing immediately. Do not resume work until streets are completely dry.
9. Cul-de-sacs: Adjust application rates as needed and phase application of binder to ensure the chips are placed and rolled before the binder breaks.

B. Rolling and Compacting:

1. Roll and compact aggregate immediately after spreading for a minimum of four passes. Ensure the roller speed does not exceed 7 MPH on the initial pass.

2. Develop rolling with consecutive passes beginning at the edges and continuing towards the center.
3. Broom aggregate with approved broom drags concurrent with rolling operations until the aggregate for the seal coat is thoroughly embedded and the surface is thoroughly compacted and uniform in texture.
4. Remove protection devices or paper from castings and concrete surfaces unless fog seal is scheduled.
5. Sweep all excess and loose cover coat material with a vacuum-type sweeper, between 24 and 48 hours after the chip seal has been completed.
    a. Do not dislodge embedded aggregate.
    b. Remove all excess chips from the project site, unless otherwise specified.
    c. Do not sweep excess chips into boulevards or grassed areas.
        1) If chips are present in boulevards or grassed areas, use a handheld, gas powered sweeper capable of removing excess chips and to not damage boulevards or grassed areas.

C. Fog Seal:

1. Apply fog seal to all seal coat areas immediately following final sweeping of chip seal.
2. Protect streets from traffic to reduce tracking.
    a. Clean surfaces where tracking occurs.
3. Remove protection devices or paper from castings and concrete surfaces.

3.3 MAINTENANCE

A. Maintain the chip seal during the chip seal operation and continue maintenance for five (5) calendar days after completion of the chip seal operation. Maintenance of the chip seal may include additional:

1. Application of bitumen;
2. Application of cover coat material;
3. Rolling; and/or
4. Sweeping.

B. Do not place loose cover coat material from the shoulder onto the new sealed surface.

C. Perform a final sweeping at the end of the maintenance period.

1. Remove excess material from the roadway and shoulders.

3.4 PROTECTION OF FINISHED WORK

A. Section 017000 - Execution and Closeout Requirements: Protecting finished work.

B. Do not permit traffic over surface where bituminous material is applied until spreading, rolling and brooming is complete.

END OF SECTION 321236

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete paving for roadways.
2. Curb and Gutter.
3. Valley Gutter.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Concrete Paving:

1. Basis of Measurement: By square yard (SY).
2. Basis of Payment: Includes forms, reinforcing steel (when indicated), concrete, accessories, placing, finishing, curing, surface smoothness testing, and mix design.

B. Valley Gutter:

1. Basis of Measurement: By square yard (SY).
2. Basis of Payment: Includes forms, reinforcing, concrete, accessories, placing, finishing, curing, and mix design.

C. Curb & Gutter:

1. Basis of Measurement: By linear foot (LF).
   a. Measured along the flowline.
2. Basis of Payment: Includes forms, reinforcing, concrete, accessories, placing, finishing, curing, and mix design.

D. Curbing - Type I:

1. Basis of Measurement: By linear foot (LF).
2. Basis of Payment: Includes forms, reinforcing, concrete, accessories, placing, finishing, curing, and mix design.

E. Landscape Curb:

1. Basis of Measurement: By linear foot (LF).
2. Basis of Payment: Includes forms, reinforcing, concrete, accessories, placing, finishing, curing, and mix design.

1.3 REFERENCE STANDARDS

A. North Dakota Department of Transportation (NDDOT):

1. Standard Specifications for Road and Bridge Construction; current version.

B. American Association of State Highway and Transportation Officials:

1. AASHTO M324 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

C. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.
2. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

D. ASTM International:

1. ASTM A184 - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
2. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
3. ASTM A706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
4. ASTM A775 - Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
5. ASTM A934 - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
6. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
7. ASTM C33 - Standard Specification for Concrete Aggregates.
8. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
9. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
10. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
11. ASTM C150 - Standard Specification for Portland Cement.
12. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
13. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
14. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
15. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
16. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
17. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
18. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
19. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
20. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

21. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
22. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
23. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
24. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit data on concrete materials, joint filler, admixtures, and curing compounds.

C. Concrete Mix Design include per yard quantity of each material and the following information:

1. Cement Mill Certificate.
2. Fly Ash Mill Certificate.
3. Slag Cement Mill Certificate.
4. Aggregate Sourcing including:
    a. Gradations
    b. Physical Test Results
    c. Absorption and Specific Gravity
    d. Deleterious reaction results
5. Admixtures.

D. Hot Weather Plan:

1. In accordance with ACI 305R - Guide to Hot Weather Concrete.
2. Submit detailed procedures for the production, transportation, placement, protection, curing, and temperature monitoring during hot and/or windy weather.

E. Cold Weather Plan:

1. In accordance with ACI 306R - Guide to Cold Weather Concrete.
2. Submit detailed procedures for the production, transportation, placement, protection, curing, and temperature monitoring of concrete during cold weather.

F. Concrete Curing Plan including:

1. Certificate of Compliance .
2. Trade name of curing compound.
3. Statement that curing compound meets all requirements specified.
4. Equipment and Methods used for applying curing compound.

G. Joint sealant Certificate of Compliance including:

1. Type of backer rod.
2. Joint sealant type.

H. Reinforcement Steel, Dowel Bars, and Tie Bars Certified Mill Analysis.

I. Jointing Plan.

1.5 QUALITY ASSURANCE

A. Obtain cementitious materials from same source throughout.

B. Perform Work according to Section 550 of the North Dakota Department of Transportation Standard Specifications for Road and Bridge Construction.

1.6 QUALIFICATIONS

A. Manufacturer:

1. Company specializing in manufacturing Products specified in this section with minimum three (3) years documented experience. Certified by an approved plant certification program by the National Ready Mix Concrete Association, MNDOT or NDDOT (in the current construction season).

B. Installer:

1. Company specializing in performing work of this section with minimum five (5) years documented experience.
2. Minimum two (2) employees with a current ACI concrete flatwork technician or flatwork finisher certification.
    a. At lease one of the employees must be onsite performing quality control and guidance during all concrete forming, placement of reinforcement steel, dowel bars, and tie bars, pouring, finishing, and curing operations.

1.7 AMBIENT CONDITIONS

A. Section 015000 - Temporary Facilities and Controls: Ambient conditions control facilities for product storage and installation.

B. Do not place concrete on or against frozen ground.

C. Perform patching and/or joint sealing when the ambient and pavement temperatures are greater than 40°F.

PART 2 - PRODUCTS

2.1 AGGREGATE BASE COURSE

A. Aggregate Base Course: As specified in Section 321123.

2.2 CONCRETE

A. Form Materials:

1. Steel form material, at least 10 feet in length, profiled to suit conditions.
2. Wood form material may be used for irregular shapes and short sections.
3. Thickness equal to concrete to be placed.
4. Mortar and dirt free.
5. No variations of more than 1/8 inch.

B. Joint Materials:

1. Rubber material conforming to ASTM D 1752.

C. Expansion Joint Filler:

1. Material: Asphalt-impregnated fiberboard or felt.
2. Comply with ASTM D1751 Type 5.
3. Thickness: 3/4 inch.

D. Reinforcement:

1. Deformed and Plain Steel Bars for Concrete Reinforcement.
   a. Use deformed and plain bars that meet AASHTO M 31, Grade 40 or 60. If epoxy coated bars are specified, use bars that have been coated as specified in ASTM A 775.
2. Welded Deformed Steel Bar Mats for Concrete Reinforcement.
   a. For concrete reinforcement, use fabricated steel bar or rod mats that meet AASHTO M 54, Grade 40 or 60.

E. Finishing Tools:

1. Use finishing tools constructed of aluminum, magnesium, or wood. Steel hand finishing tools are not allowed.

F. Concrete Materials:

1. Provide concrete materials in accordance with Class AE of Section 802 of the North Dakota Department of Transportation Standard Specifications for Road and Bridge Construction.

2.3 MIXES

A. Concrete Mix:

1. Performance Criteria:
   a. Compressive Strength:
      1) 7-day: 3,000 psi.
      2) 28-day: 4,000 psi.
   b. Cement Content: 550 - 600 lb./cu yd.
   c. Maximum Water/Cement Ratio: 0.47 by weight (mass).
   d. Slump:

Slump Requirements		
Concrete Application	Min Inches	Max Inches
Formed Paving	1.0	4.0
Slip-form Paving	0.0	2.0

   e. Air Entrainment: 5 - 8 percent Target 6%.
2. Limit the following cementitious materials to maximum percentage by mass of all cementitious materials:
   a. Fly Ash: 29 percent.

2.4 ACCESSORIES

A. Curing Compound:

1. Standard Concrete:
   a. According to ASTM C 309, Type 2, Class B with 100 percent poly-alpha-methylstyrene resin.
   b. White pigmented in color.
2. Colored Concrete:
   a. According to ASTM C 309, Type 1, Class A or B.
   b. Transparent, non-yellowing.

B. Concrete Sealers:

1. Colored Pedestrian Crosswalks:
   a. Chem-Crete Pavix CCC100 by International Chem-Crete Inc.
   b. Or Approved Equal.

2.5 SOURCE QUALITY CONTROL

A. Section 014000 - Quality Requirements: Testing and Inspection Services

B. Submit proposed mix design of each class of concrete to appointed firm for review prior to commencement of Work.

C. Tests on cement, aggregates, and mixes will be performed to ensure conformance with specified requirements.

D. Test samples according to ACI 301.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify compacted subgrade aggregate base is dry and ready to support paving and imposed loads.

C. Verify manholes, catch basins, and gate valves are at the correct elevation.

D. Verify gradients and elevations of base are correct.

3.2 PREPARATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Moisten substrate to minimize absorption of water from fresh concrete.

C. Notify Engineer minimum 24 hours prior to commencement of concreting operations.

3.3 INSTALLATION

A. Base Course:

1. Aggregate Base Course: Install as specified in Section 321123.

B. Forms:

1. Place and secure forms and screeds to correct location, dimension, profile, and gradient.
2. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

C. Reinforcement:

1. Place reinforcement mid-depth of concrete thickness at dimensions as indicated on Drawings.
2. Overlap reinforcement a minimum of 20 inches and tie securely in place at all points where bars cross.
3. Place reinforcing on plastic, plastic coated, or epoxy coated bar supports to support reinforcement.

D. Placing Concrete:

1. Pour curb and gutter separate from concrete pavement.
2. Place all concrete pavement and curb and gutter by slip-form operation.
    a. Use fixed forms in irregular areas, intersections, tapers, alleys, roundabouts, areas inaccessible to slip-form equipment or other areas approved by Engineer.
3. Uniformly moisten aggregate base immediately prior to concrete placement.
4. Install transverse construction joint if concrete placement is temporarily interrupted for more than 45 minutes.
5. Protect concrete from rain damage
    a. Do not place concrete when rain conditions appear imminent.
    b. Maintain on site sufficient waterproof material to protect concrete.
    c. Do not place concrete during rain that results in standing water on fresh concrete surface.

E. Slip-Form Paving

1. Use and maintain a taut stringline for operating the automatic equipment controls.
    a. Use of Automated Machine Guidance (AMG) is not permitted.
2. Consolidation Vibrator Operation
    a. Operate internal vibrators within a frequency range of 4,000 to 8,000 vibrations per minute.
    b. Operate surface vibrators within a frequency range of 3,500 to 6,000 vibrations per minute.
    c. Reduce vibratory frequency when forward motion of the paver is reduced and stop vibrators when forward motion of the paver is stopped.
    d. Use a vibrator monitor that records at intervals of 25 feet or 5 minutes, whichever occurs first. Provide both electronic and printed records each day that state:
        1) Time
        2) Station
        3) Speed
        4) Operating frequency of individual vibrator
    e. Do not delete the data from the vibratory monitoring system until the records are in their final form and given to the Engineer. The Engineer will allow one of the records to be produced in an office. Provide the original record before takin the data into the office. Provide an electronic record that is a comma or space delimited text file, adequate for insertion into a computerized spreadsheet software package.
    f. Provide a written explanation each week that details:
        1) Vibrator setting changes
        2) Out of tolerance vibratory operations
        3) Monitoring device malfunctions

F. Slip-Form Curbing:

1. Automated Machine Guidance (AMG) operations may be an option in lieu of stringline slip-form curb and gutter paving.
2. Submit AMG operation plan containing the following:
    a. Location of project where AMG will be used
    b. Vertical and horizontal accuracies of the AMG

c. Contractor's past performance with AMG
   1) Project locations
   2) Amount of curbing installed
   3) Owner/Engineer references
d. Equipment manufacturer and type of equipment that would be used to operate the EMG system.

G. Fixed Form Concrete:

1. Consolidate concrete using concrete finishing machine.
2. Engineer may allow hand operated vibrator.
   a. Must produce a minimum of 3600 impulses per minute.
3. Uniformly consolidate concrete with no segregations, honeycombing, or voids.
4. Check all finishing equipment with a straight edge in the presence of the Engineer.
5. All curb and gutter to be tied to existing curb and gutter with (3) No. 4 x 12" Bars.

H. Joints:

1. General:
   a. Layout joints and construction sequence per Jointing Plan
   b. Repair spalls deeper than 1/4 inch by patching with an epoxy mortar.
      1) Clean the spall area
      2) Prime the spall surface with a brush application of epoxy binder.
      3) Mix the epoxy binder as recommended by the manufacturer.
      4) Insert materials in the joint that will not bond to the epoxy to form the faces of the spall patch.
      5) Blend dry concrete sand into the mixture to give an epoxy mortar of trowelable consistency.
      6) Place and finish the epoxy mortar surface.
      7) After the epoxy mortar has cured, remove the inserts.
2. Transverse Contraction Joints:
   a. Extend joints across the entire width of the pavement through adjacent curb and gutter.
   b. Place reinforcement and/or dowel bars as indicated in the drawings.
3. Longitudinal Joints:
   a. Place reinforcement as indicated in the drawings.
      1) Replace all loose or easily rotated bars by drilling in new tie-bar.
4. Construction Joints:
   a. Construct at planned transverse or longitudinal joint locations per detail.
   b. Form by securely staking in place at right angles to the subbase and centerline of the pavement, a bulkhead of wood or metal cut to the cross-section of the pavement.
      1) Install dowels by inserting into plastic concrete or drilling.
   c. Do not incorporate grout from the paver grout box into the construction joint.
5. Expansion and Isolation Joints:
   a. Install as indicated on the Details.
   b. Extend expansion material entirely through depth and width of concrete.
   c. Use epoxy coated smooth bars unless otherwise specified.

d. Coat free end with approved lubricant and cover with an approved non-coercive metal or plastic dowel cap or sleeve.
e. Pre-punch expansion material to fit tightly around smooth bars.
f. Set top edge of expansion material flush with concrete surface.

6. Sawing:
   a. Extend saw joints through adjacent curb and gutter.
   b. Saw all joints along a true and straight line established by the contractor
   c. Saw concrete as soon as conditions permit to avoid raveling and before random cracking.
      1) Delay sawing immediately if raveling is observed.
   d. Early entry dry saw or "Soft-Cut" method only allowed with Engineer approval.
7. Uncontrolled Cracking:
   a. Remove pavement with uncontrolled cracks to the nearest planned longitudinal and transverse Joints.
   b. Submit removal and replacement plan to Engineer.
   c. Removal and replacement of concrete pavement and including any items damaged during operation are at the Contractor's expense.

I. Finishing:

1. Consolidate, level, finish, and apply cure within 45 minutes of concrete being placed on grade.
2. Use of water and evaporation retarders is not permitted. Use of items will result in non-payment, replacement, and/or repair of the wetted area as determined by the Engineer.
3. Remove forms from concrete no less than 15 hours after placing concrete.
4. Test the slab for trueness with a 10 foot straightedge immediately following floating operations.
   a. Place straightedge parallel to pavement centerline and pass over slab to reveal any high or depression points.
   b. Cut or fill high or depression points as needed with long handled float.
   c. Check area again with straightedge.
   d. Advance straightedge while maintaining 1/2 the length of the straightedge overlaps.
5. Finish all curb and gutter surfaces true to line and grade without any irregularities noticeable to the eye.
6. Replace any areas with segregation, honeycombing, and/or voids at Contractor's expense.

J. Final Surface Finish:

1. Provide texture uniform in appearance and free of rough or porous spots, irregularities, depressions, and other objectionable features.
2. Slip-formed Paving
   a. Texture surface using a seamless strip of artificial grass-type carpet, or by broom bristle sections.
      1) Provide artificial grass type carpet with:
         a) Molded polyethylene pile face
         b) Blade length of 5/8 to 1 inch
         c) Minimum weight of 70 ounces per square yard
   b. Pull textured material longitudinally along pavement in a single pass.
   c. Apply 1/16 to 1/8 inch deep striations.

d. Other texturing methods allowed with Engineer approval.

3. Formed Paving
   a. Draw broom across pavement at right angle to centerline.
   b. Overlap broom strokes by 2 inches.
   c. Wash and dry broom at frequent intervals during pave.

K. Curing and Protection

1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
2. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete, minimum 72 hours.
3. Spray all finished surfaces with curing compound.
   a. Apply curing compound uniformly at a rate not less than one gallon per 200 square feet of surface area.
   b. Apply curing compound using mechanically pressurized spray equipment.
   c. Limit handheld sprayer use to small areas.

3.4 TOLERANCES

A. Section 014000 - Quality Requirements: Tolerances.

B. Dowel Bar Placement Tolerances:

1. Alignment Placement: Within 1/8 inch on both horizontal and vertical planes.
2. Longitudinal Shift: 1/2 inch

C. Tie-Bar Placement Tolerance:

1. Longitudinal Shift: 3 inches
2. Vertical Placement: 1 inch
3. No less than 15 inches of transverse joint

D. Saw lines:

1. Maximum 1/2 inch deviation from straight line

E. Raveling:

1. Engineer will categorize the degree of raveling and determine whether a contract price adjustment to the pavement bid item or rejection of the pavement will be administered.
2. The Engineer will determine the degree of raveling by using the table below and areas of contract price adjustment by measuring the defective areas in square yards.
   a. Engineer will measure half of each adjoining panel in each direction from joint with raveling.
3. Engineer reserves the right to reject any concrete with joint raveling present.
4. The table below will be used to determine the degree of raveling.

Joint Raveling Deduct Adjustments	
Degree of Raveling	% Deduct per SY

No Raveling: 0” to 1/4”	(0%)
Light Raveling: 1/4” to 3/8”	(15%)
Moderate Raveling: 3/8” to 1/2”	(25%)
Severe Raveling: 1/2” +	Remove and Replace

F. Pop Out Tolerances:

1. A pop out is defined as a small, generally cone shaped cavity in horizontal concrete surface left after a near-surface aggregate particle has expanded and fractured. The cavity can range from 1/2 inch to a few inches in diameter.
2. The Engineer will select random test locations for determining the number of visual pop outs.
   a. Engineer will mark a square yard perimeter and visually count pop outs 1/2 inch or greater located within the perimeter.
   b. Each separate pour will be considered a lot size for price adjustment.
   c. Then number of pop outs will be counted, and the arithmetic mean will be calculated for each lot.
3. Frequency of testing:
   a. The Engineer will test three separate locations for lots less than 1000 square yards.
   b. The Engineer will test one location per 1000 square yards, or a minimum of three random locations, whichever is greater for lots greater than 1000 square yards.
4. The contract unit price for each lot will be adjusted according to the table below:

Pop Out Deduct Adjustments	
Average number of Pop Outs	Total Deduct per defined Lot Size
0-15	(0%)
16-25	(5%)
26-35	(15%)
36 or more	To be determined by Engineer

G. Curb & Gutter:

1. Maximum deviation from line and grade: 3/16 inch measured with a 10 foot straightedge.

H. Sealant:

1. Seal joints from bottom up to a height approximately 1/8 inch below flush.

I. Pavement Surface Smoothness:

1. Engineer may direct Contractor to use the 10 foot straight edge method, the profiler method, or both to determine surface smoothness.
2. Perform all pavement smoothness testing and corrective action at no additional cost.
3. Thresholds of localized roughness and smoothness are shown below.

	Methods of Measuring Localized Roughness and Smoothness			
Concrete Pavement	MRI Threshold	ALR Threshold	RSE Threshold (Excluded Areas)	10’Straight Edge Threshold

Categories				(Excluded Areas)
> 30 mph	120 in/mile	160 in/mile	0.25-inch deviation per 25 ft. segment	1/8-inch deviation
All others	140 in/mile	180 in/mile	0.25-inch deviation per 25 ft. segment	1/8-inch deviation

Definitions:
IRI - International Roughness Index
MRI - Mean Roughness Index
ALR - Areas of Localized Roughness
RSE - Rolling Straightedge

3.5 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting testing.

B. Perform field inspection and testing according to ACI 301.

C. Inspect reinforcing placement for size, spacing, location, support.

D. Testing firm will take cylinders and perform slump and air entrainment tests according to ACI 301.

E. Strength Test Samples:

1. Sampling Procedures: ASTM C172.
2. Cylinder Molding and Curing Procedures: ASTM C31, cylinder specimens, standard cured.
3. Sample concrete and make one set of four cylinders for every class of concrete placed each day. Larger paving operations may require additional testing frequencies as directed by the Engineer.
4. Make one additional cylinder during cold weather concreting, and field cure.

F. Field Testing:

1. Slump Test Method: ASTM C143.
2. Air Content Test Method: ASTM C173.
3. Temperature Test Method: ASTM C1064.
4. Measure slump and temperature for each compressive strength concrete sample.
5. Measure air content in air entrained concrete for each compressive strength concrete sample.

G. Cylinder Compressive Strength Testing:

1. Test Method: ASTM C39.

2. Test Acceptance: Average compressive strength of three consecutive tests at or above 4,000 psi.
3. Test one cylinder at 7 days.
4. Test three cylinders at 28 days.
5. Core and retest pavement if design strength is not achieved within 28 days. The number and location of the cores will be at the discretion of the Engineer. Contractor is responsible for all expenses related to coring and retesting. All concrete found to be under-strength will be removed and replaced at the contractor's expense.

H. 10-foot Straight Edge Method:

1. Furnish an approved 10 foot straight edge, depth gauge, and operator to aid Engineer in testing the pavement surface.
2. Use diamond grinding equipment to correct high or low spots of more than 1/8 inch and less than 1/4 inch in 10 feet. Ensure the deviation after grinding is less than 1/8 inch.
3. Submit a corrective action plan to Engineer that includes either grinding or removal and replacement of pavement if deviation exceeds 1/4 inch.

I. Profiler Method:

1. Inertial Profiler:
   a. Furnish an inertial profiler capable of measuring International Roughness Index (IRI) in dual wheel paths, producing a profilogram, and exporting raw profile data in an unfiltered electronic Engineering Research Division (ERD) file format.
   b. Furnish proof of current profiler calibration and certification from MnDOT, or other approved agency, prior to performing profiling operations.
   c. Furnish equipment adhering to AASHTO M 328.
   d. Operator Certification.
      1) Provide an operator trained in the operation of the Inertial Profiler and knowledgeable in the use of the required Profile Analysis Software (ProVAL).
      2) Provide operator with current MnDOT certification, or other approved agency. Provide Engineer documentation of certification.
   e. Profiler Operation.
      1) Clean and prepare the surface of pavement immediately prior to test.
      2) Profile all mainline concrete for smoothness and ALR evaluation.
      3) Report profiles in 0.1-mile segments, measured in each wheel path per lane based on Mean Roughness Index (MRI), the average IRI values from both wheel paths.
      4) Exclude areas listed below from MRI smoothness and ALR. However, provide RSE in ProVal, and/or measured by 10 foot Straight Edge to identify bumps or dips for these areas if directed by the Engineer.
         a) Intersection (PC to PC)
         b) Roundabouts (Circular Portion)
         c) Parking Lanes
         d) Turn Lanes
         e) Interchange Ramps and Loops
         f) Railroad Crossings
   f. Evaluation

1) Utilize the most current version of ProVal to calculate the MRI from the Engineering Research Division files. Send a copy of the ERD files to the Engineer upon completion of the data collection.
2) Ensure the low and high pass filters are set to zero.
3) Identify areas of localized roughness using the Smoothness Assurance Module (SAM) within the current version of Pro Val. Use the following settings.
   a) Ride Quality Index: MRI
   b) Base Length:
      Short continuous: 25 feet.
      Long continuous: 528 feet.
      Fixed Interval: 528 feet.
   c) Ride Quality Threshold:
      160 in/mile for 30 mph or greater.
      180 in/mile for less than 30 mph.
   d) Apply a 250 mm filter to the file being analyzed
   e) Calculate the localized roughness in inches per mile at the short continuous interval of 25 feet.
4) Identify areas of localized roughness using the Smoothness Assurance Module (SAM) within the current version of Pro Val. Use the following settings.
   a) Ride Quality Index: MRI
   b) Base Length:
      Short continuous: 25 feet.
      Long continuous: 528 feet.
      Fixed Interval: 528 feet.
   c) Ride Quality Threshold:
      120 in/mile for 30 mph or greater.
      140 in/mile for less than 30 mph.
   d) Apply a 250 mm filter to the file being analyzed
   e) Calculate the localized roughness in inches per mile at the long continuous interval of 528 feet.
   f) Record MRI numbers in inches per mile for each 528 foot section for each travel lane of finished pavement. If the last segment is greater than 250 feet and less than 528 feet measure as an independent segment. IF the last segment is less than 250 feet include the profile for that segment in the evaluation for the previous profile.
5) Determine Roughness in excluded pavement areas as directed by the Engineer.
6) Identify areas of roughness using the Rolling Straight Edge (RSE) within the current version of ProVal. Correct any dips and bumps in excess of 1/4 inches. Use the following settings in the RSE.
   a) Straight Edge Length: 25 feet
   b) Deviation Threshold: 1/4 inches

J. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

K. Rain Damaged Concrete:

1. Core at the direction of the Engineer and depth damage determined by petrographic examination.
    a. If depth of damage is 1/4 inch or less the concrete may be corrected by diamond grinding.
2. Engineer reserves the right to reject any rain damaged concrete.
3. Contractor is responsible for all expenses related to coring for petrographic examination, and diamond grinding.

3.6 PROTECTION

A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Immediately after placement, protect paving from premature drying, excessive hot or cold temperatures, and mechanical injury.

C. Keep newly placed concrete clean of loose aggregates, dust, and debris at all times during construction.

D. Repair any part of pavement damaged from traffic or other causes occurring prior to the acceptance of the pavement at Contractor's expense.

E. Protect pavement from spills or smears when placing colored concrete or bituminous pavement adjacent to it.

1. Clean discolored concrete at Contractor's expense.

F. Protect pavement from pedestrian and vehicular access until a compressive strength of 75% of its design strength is achieved.

END OF SECTION 321313

SECTION 321623 - SIDEWALKS, DRIVEWAYS & MEDIANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete sidewalks, driveways and medians.
2. Detectable warning panels.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Sidewalk Concrete:

1. Basis of Measurement: By square yard (SY).
2. Basis of Payment: Includes excavation, subgrade preparation, aggregate base, forms, reinforcement, concrete, accessories, placing, finishing, curing, and testing.

B. Driveway Concrete:

1. Basis of Measurement: By square yard (SY).
2. Basis of Payment: Includes excavation, subgrade preparation, aggregate base, forms, reinforcement, concrete, accessories, placing, finishing, curing, and testing.

C. Pigmented Imprinted Concrete:

1. Basis of Measurement: By square yard (SY).
2. Basis of Payment: Includes excavation, subgrade preparation, aggregate base, forms, reinforcement, concrete, coloring, accessories, placing, finishing, imprinting, curing, and testing.

D. Detectable Warning Panel:

1. Basis of Measurement: By square foot (SF).
2. Basis of Payment: Includes furnishing and installing detectable warning panel.

1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO M 148 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

B. American Concrete Institute:

1. ACI 301 - Specification for Concrete Construction

C. ASTM International:

1. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
2. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
5. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
6. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
7. ASTM C979 - Standard Specification for Pigments for Integrally Colored Concrete.
8. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
9. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

D. U.S. Access Board:

1. Public Rights-of-Way Accessibility Guidelines (PROWAG)

E. Americans with Disabilities Act of 1990:

1. The Public Right-of-Way (Title II)

F. North Dakota Department of Transportation (NDDOT):

1. Standard Specifications for Road and Bridge Construction; current version.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit required information regarding concrete materials, joint filler, admixtures, and curing compounds.
2. Mix Design:
   a. Submit concrete mix design for each concrete strength prior to commencement of Work.
   b. Submit separate mix designs if admixtures are required for hot- and cold-weather concrete Work.
   c. Identify mix ingredients and proportions, including admixtures.

C. Detectable Warning Panel Certificate of Compliance.

D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

E. Hot Weather Plan in accordance with Section 321313 - Concrete Paving.

F. Cold Weather Plan in accordance with Section 321313 - Concrete Paving.

1.5 QUALITY ASSURANCE

A. Perform Work according to Section 750 of the North Dakota Department of Transportation Standard Specifications for Road and Bridge Construction.

B. Obtain cementitious materials from same source throughout.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' experience.

C. Sidewalk Contractor: On-site employee to have ADA Construction Certification as administered by the Minnesota Department of Transportation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.8 AMBIENT CONDITIONS

A. Section 015000 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.

B. Minimum Conditions: Do not place concrete if base surface temperature is less than 40 °F, or if surface is wet or frozen.

C. Subsequent Conditions: Maintain surface temperature between 40°F and 90°F, for duration of the curing period.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 AGGREGATE SUBGRADE

A. As specified in Section 321123 - Aggregate Base Courses.

2.2 MATERIALS

A. Forms:

1. Material:
   a. Wood: Straight and free from warping, twisting, loose knots, splits, or other defects.
   b. Steel: Channel-formed sections.
2. Profile: To suit conditions.
3. Joint Filler:
   a. Material: Asphalt-impregnated fiberboard or felt.
   b. Comply with ASTM D1751 Type 5.
   c. Thickness: 3/4 inch.

B. Reinforcement:

1. Deformed Reinforcing:
   a. Steel: Comply with ASTM A615.
      1) At all curb ramps and driveway connections to curb and gutter use epoxy coated bars as specified in ASTM A775.
   b. Yield Grade: 40 ksi.
   c. Billet Bars: Deformed.
   d. Finish: Uncoated.

C. Concrete:

1. Furnish materials according to Section 802 of the North Dakota Department of Transportation Standard Specifications for Road and Bridge Construction Class AE.

D. Color Pigment:

1. Comply with ASTM C979.
2. Resistant to mineral oxides, alkalis, and fading.
3. Color: As scheduled.

E. Curing Compound:

1. Sidewalks and Driveways:
   a. Conform to the requirements of AASHTO M 148 Type 2.
   b. White pigmented in color.
2. Colored Concrete:
   a. Conform to the requirements of AASHTO M 148 Type 2.
   b. Transparent (no color).

F. Detectable Warning Panels:

1. All detectable warning panels to meet the requirements of Section 885 of the North Dakota Department of Transportation Standard Specifications for Road and Bridge Construction.
2. Materials and Colors:
   a. Ductile Iron - No Finish

2.3 SOURCE QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Testing: Comply with ACI 301.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that compacted subgrade is dry and ready to support paving and imposed loads.

C. Verify that gradients and elevations of subgrade are as indicated on Drawings.

D. Verify reinforcing placement for proper size, spacing, location, and support.

3.2 PREPARATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Moisten substrate to minimize absorption of water from fresh concrete.

C. Notify Engineer minimum 24 hours prior to commencement of concreting operations.

3.3 INSTALLATION

A. Aggregate Subgrade:

1. As specified in Section 321123 - Aggregate Base Courses.

B. Forms:

1. Place and secure forms and screeds to correct location, dimension, profile, and gradient.
2. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
3. Clean forms and coat with form oil or wet each time before concrete is placed.
4. Sidewalk ramps to be 6 inches thick for a minimum of 5 feet from existing back of curb.

C. Reinforcement:

1. Place reinforcing as indicated on Drawings.
2. Sidewalk ramps to be tied to existing curb and gutter with No. 4 x 12” epoxy coated rebar placed mid depth at 18 inches on center.

D. Placing Concrete:

1. Place all concrete using formwork unless mechanical paver is used.
2. Rough finish concrete with mechanically vibrated screed assembly.
3. Use hand vibrators next to forms to prevent voids or honeycomb surfaces.

E. Joints:

1. Sidewalk:
    a. Construct contraction joints as to divide the sidewalk into square slabs.
        1) Maximum horizontal dimension of 6 feet.
        2) Tooling of contraction joints 4 foot in length is permitted. Saw cut anything longer.
    b. Place expansion joints in sidewalk at 250-foot intervals, driveway edges, at every property corner and along existing curb abutting the sidewalk
        1) Place greased 3/8-inch smooth bar at mid-depth 6 inches in from each sidewalk edge through the expansion joint.
2. Driveway:
    a. Space transvers joints evenly between the crossing plate and the curb
        1) Do not exceed 8 foot spacing.
    b. Space driveway longitudinal joints evenly across the driveway
        1) Do not exceed 12 foot spacing
3. Medians:
    a. Construct contraction joints as to align with curb or adjacent slab joints.
        1) Tooling of contraction joints 4 foot in length is permitted. Saw cut anything longer.
    b. Place expansion joints between adjacent curb and decorative concrete median.
        1) Hot pour sealant on expansion joint.

F. Finishing:

1. Provide a light broom finish.
2. Texture Direction: Transverse to paving direction.
3. Ramps: Broom perpendicular to slope.
4. Place curing compound on exposed concrete surfaces immediately after finishing.
5. Edges and Joints:
    a. Edger Radius: 1/2 inch.
    b. Spalled Corners and Edges: Clean and fill with mortar mixture and finish.

G. Curing:

1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
2. Maintain concrete with minimal moisture loss at relatively constant temperature for period. necessary for hydration of cement and hardening of concrete.
3. Spray all finished surfaces with curing compound.
    a. Apply curing compound with mechanically pressurized sprayer.
4. Cure for 72 hours minimum.

H. Impressioned Concrete:

1. Reinforce as indicated in the Drawings.
2. Follow normal procedures for sidewalk.
    a. Do not trowel surface more than once.
3. Use roller/stamp to obtain specified pattern.
    a. Ensure pattern is accurately aligned.
    b. Ensure uniform depth of 5/16 inch.
4. Saw joints to match joints in abutting concrete or as directed by Engineer.
5. Sandblast any colored concrete from roadway and/or curb and gutter surfaces.

I. Backfilling:

1. After curing, backfill against sides of the sidewalk and driveways to the top of concrete.

J. Accessible Sidewalks:

1. Install all sidewalks and ramps in accordance with PROWAG standards.

3.4 TOLERANCES

A. Section 014000 - Quality Requirements: Requirements for tolerances.

B. Maximum Variation of Surface Flatness: 1/2 inch in 10 feet.

C. Maximum Variation from True Position: 1/2 inch.

D. Line and Grade for Forms: 1/8 inch in any 10-foot long section.

E. Raveling as specified in Section 321313 - Concrete Paving.

F. Pop Out Tolerances as specified in Section 321313 - Concrete Paving.

G. Running slope and cross slope of all sidewalks or ramps to not exceed the maximums allowed as shown on the Drawings.

3.5 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting testing.

B. Perform field inspection and testing according to ACI 301.

C. Inspect reinforcing placement for size, spacing, location, and support.

D. Testing firm will take cylinders and perform slump and air entrainment tests according to ACI 301.

E. Strength Test Samples:

1. Sampling Procedures: ASTM C172.
2. Cylinder Molding and Curing Procedures: ASTM C31, cylinder specimens, standard cured.
3. Sample concrete and make one (1) set of four (4) cylinders once per day or at the discretion of the Engineer.
4. Make one additional cylinder during cold weather concreting and field cure.

F. Field Testing:

1. Slump Test Method: ASTM C143.
2. Air Content Test Method: ASTM C173.
3. Temperature Test Method: ASTM C1064.
4. Measure slump and temperature for each compressive strength concrete sample.
5. Measure air content in air entrained concrete for each compressive strength concrete sample.

G. Cylinder Compressive Strength Testing:

1. Test Method: ASTM C39.
2. Test Acceptance: Average compressive strength of three consecutive tests at or above 4,000 psi.
3. Test one cylinder at seven (7) days.
4. Test two cylinders at 28 days.
5. Retain one cylinder for 56 days for testing if the average 28-day breaks are below 4,000 psi.

H. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

I. Rain Damaged Concrete:

1. Remove and replace all rain damaged concrete at the direction of the Engineer.
2. Contractor is responsible for all costs associated with the removal and replacement of concrete.

J. Non-compliant Sidewalks and Ramps

1. Remove and replace all sidewalks and curb ramps that do not meet the requirements shown on the Drawings.
2. Contractor is responsible for all costs associated with the removal and replacement of concrete.

3.6 PROTECTION

A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, rain and flowing water, and mechanical injury.

C. Do not permit pedestrian traffic over paving for minimum 24 hours after finishing and driveways for a minimum seven (7) days.

D. Damaged Concrete:

1. Remove and reconstruct concrete that has been damaged for entire length between scheduled joints.
2. Refinishing damaged portion is not acceptable.
3. Dispose of damaged portions.
4. Work completed at Contractor’s expense.

END OF SECTION 321623

SECTION 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Traffic lines, markings, and messages.
2. Removal of existing pavement markings.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Pavement Marking Line:

1. Basis of Measurement: By linear foot (LF).
2. Basis of Payment: Includes Epoxy, Preformed, or Temporary, as specified; preparation, cleaning, grooving, installation of pavement marking line, and testing.

B. Pavement Marking Message:

1. Basis of Measurement: By square foot (SF).
2. Basis of Payment: Includes Epoxy, Preformed, or Temporary, as specified; preparation, cleaning, grooving, installation of pavement marking message, and testing.

C. Removal of Pavement Marking:

1. Basis of Measurement: By linear foot (LF) or square foot (SF).
2. Basis of Payment: Includes removal of existing pavement marking line or messages.

1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO M247 - Standard Specification for Glass Beads Used in Pavement Markings.

B. ASTM International:

1. ASTM D1213 - Standard Test Method for Crushing Resistance of Glass Spheres
2. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

C. North Dakota Department of Transportation (NDDOT):

1. Standard Specifications for Road and Bridge Construction, current version.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit paint formulation for each type of paint.

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

D. Provide proof of employee’s manufacturer certification ID Card or Certification paper upon request.

E. Test and Evaluation Reports: Indicate source and acceptance test results according to AASHTO M247.

F. Manufacturer Instructions:

1. Submit instructions for application temperatures, eradication requirements, application rate, line thickness, type of glass beads, and bead embedment and application rate.
2. Submit detailed instructions on installation requirements, including storage and handling procedures.

G. Qualifications Statements:

1. Submit qualifications for manufacturer and applicator.
2. Submit manufacturer's approval of applicator.

1.5 QUALITY ASSURANCE

A. Perform Work according to Section 762 of the North Dakota Department of Transportation Standard Specifications for Road and Bridge Construction.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Applicator: Company specializing in performing Work of this Section with minimum three years' documented experience and provide a crew of which 50% are trained and “certified” by the manufacture.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.8 AMBIENT CONDITIONS

A. Section 015000 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.

B. Do not apply materials if surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.

C. Do not apply exterior coatings during rain or snow if relative humidity is outside range required by paint manufacturer, or if moisture content of surfaces exceeds that required by paint manufacturer.

D. Minimum Conditions: Do not apply paint if temperatures are expected to fall below 50 °F within 24 hours after application.

E. Thermoplastic Compound: Do not apply unless pavement surface temperature is minimum 40 °F and rising.

F. Maximum VOCs: Do not exceed limit required by State or Environmental Protection Agency.

1.9 WARRANTY

A. Section 017000 - Execution and Closeout Requirements: Requirements for warranties.

PART 2 - PRODUCTS

2.1 PAVEMENT MARKINGS

A. Furnish materials according to Section 880 of the North Dakota Department of Transportation Standard Specifications for Road and Bridge Construction.

2.2 APPLICATION EQUIPMENT

A. Paint Application:

1. Use a self-propelled, pneumatic or airless spraying machine with atomizing nozzles or airless nozzles capable of applying two 4 inch to 8 inch wide lines at one time. Equip the spray mechanism with quick opening and closing valves. Use equipment capable of applying the materials at the specified rate and in an even and uniform thickness with clearly defined edges.

2. Use an applicator with reservoirs equipped with agitators that keep the material in a smooth, even mixture. Equip the applicator with an automatic skip control device that applies a stripe of specified length with a linear tolerance of 3 inches. Equip the applicator with a guide boom and make the applicator capable of retracing and applying materials to traffic markings in place.

3. Use hand operated equipment to place the pavement markings and reflectorized spheres on areas not accessible to the pavement marking applicator.

B. Bead Application:

1. Equip the machine with a dispenser adjusted and synchronized with the paint applicator to distribute the glass beads uniformly on the painted lines using air pressure. Equip the bead dispenser with an automatic cutoff control, synchronized with the cutoff of the striping material.

C. Grooving Equipment:

1. Use grooving equipment that has the following characteristics:
   a. Equipped with diamond blades mounted on a self-propelled machine designed for grinding a recess into the pavement surface;
   b. Equipped with a dust collection system capable of removing and containing airborne emissions incurred during grooving operations;
   c. Use mounted diamond blades on a floating head with controls capable of providing uniform depth and alignment; and
   d. Capable of grooving a total width sufficient to install 8 inch wide pavement markings in a single pass.
2. Do not use equipment that causes strain or damage to the underlying surface of the pavement.

PART 3 - EXECUTION

3.1 PREPARATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for application preparation.

B. Do not apply paint to concrete surfaces until concrete has achieved 100% of its design strength.

C. Surface Preparation:

1. Clean and dry paved surfaces prior to painting.
2. Blow or sweep surface free of dirt, debris, oil, grease, or gasoline.
3. Spot location of final pavement markings, as specified and as indicated on Drawings.

3.2 REMOVAL METHODS FOR EXISTING MARKINGS

A. Obliterate Pavement Markings:

1. This item is used for the removal of existing markings in areas where the marking that is being removed will not be replaced with a new marking. Method of removal must be approved by Engineer before any removal can be done. Demonstrate removal method to Engineer in the field prior to commencement of Work.

B. Existing Tape and Epoxy:

1. Remove any existing tape or epoxy that is to be replaced before grooving or laying new tape in the groove. Include this cost in the price bid for preformed patterned pavement marking.

C. Tape Replaced by Epoxy:

1. Remove any existing tape that is to be replaced with epoxy prior to installing epoxy. Include the work in the price bid for epoxy pavement markings.

D. Repair pavement or surface damage caused by removal methods.

3.3 INSTALLATION

A. Grooved Pavement Markings:

1. General:
   a. For messages, groove the same area as the messages.
   b. Do not groove a rectangular area to contain the message.
   c. After grinding, blow the grooved slot clean with high pressure compressed air to remove any residual and loose material before the installation of the pavement marking.
   d. Wet-grinding, is not permitted.
2. Grooves for Preformed Patterned Pavement Marking Film:
   a. If specified in the plan, groove a recess into the pavement surface for each stripe that meets the tolerances in the table below.

Parameter	Tolerance
Depth	90 to 110 mils
Smoothness	Ridges, within the groove, to be no more than 6 mils higher than either adjacent valley
Width	Line width plus ½ inch
Length	Line length plus 3 inches per end of line
Line End Tapers	3 inches

3. If pavement marking installation does not occur within 24 hours of grinding and rain or traffic is allowed on cut areas prior to blowing, sandblast the groove, and install the pavement markings the same day the sandblasting occurs.
4. Grooves for Epoxy Paint:

a. If specified in the plans, groove a recess into the pavement surface for each stripe that meets the tolerances specified in the table below.

Parameter	**Tolerance**
Depth	45 to 55 mils
Smoothness	Ridges, within the groove, to be no more than 6 mils higher than either adjacent valley
Width	Minimum line width plus 1 inch
Length	Line length plus 3 inches per end of line
Line End Tapers	3 inches

b. After creating the groove, prepare the surface in accordance with the manufacturer's instruction.

B. Preformed Pavement Marking Film:

1. Apply materials per manufacturers recommendations.

C. Epoxy:

1. General:
   a. Apply pavement marking paint and glass beads by machine. Use hand application where machine application is not feasible.
   b. Apply the epoxy pavement marking material at a thickness of 20 mils. Calculate thickness without drop on glass beads.
   c. Apply glass beads immediately after the placement of the epoxy. Use a dispenser system that delivers at least 25 pounds of beads per gallon of epoxy material.
   d. If application rates are not within the requirements, stop the marking application until corrections are made.
   e. Do not apply material over a longitudinal joint.
   f. Do not apply markings if the wind or other conditions cause a film of dust to be deposited on the pavement surface before the material can be applied.
   g. If short term paint was applied, epoxy pavement markings may be placed directly over the short term paint.
   h. Place epoxy material after bituminous material has been in place for a minimum of 7 days.
2. Retro-reflectivity:
   a. Place epoxy pavement markings so that the initial retro-reflectivity values of the markings are at or above those shown in the Table below. The initial retro-reflectivity values are those obtained at least 2 weeks after the placement of markings.

Retro-reflectivity Values ($mcd/m^2/lux$)	
White	Yellow
275	180

3.4 PAVEMENT MARKING SCHEDULE

A. Temporary Pavement Markings:

1. Water Based Pavement Marking Paint.

B. Asphalt Streets:

1. Epoxy Pavement Marking Paint.
2. Grooved

C. Parking Lots:

1. Epoxy Pavement Marking Paint.

D. Concrete Streets:

1. Preformed Patterned Pavement Marking Film.
2. Epoxy Pavement Marking Paint.
3. Grooved.

3.5 TOLERANCES

A. Section 014000 - Quality Requirements: Requirements for tolerances.

B. Maximum Variation from Wet Film Thickness: -0/+10 mils.

C. Maximum Variation from Wet Paint Line Width: Plus or minus 1/4 inch.

D. Cycle Length Timer: Plus or minus 6 inches in a 40 foot cycle.

E. Paint Line-Length: Plus or minus 3 inches from specified length.

F. Maximum Variation from Alignment: 2 inches.

3.6 FIELD QUALITY CONTROL

A. Section 017000 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

B. Request acceptance of surface preparation and groove from the project Engineer prior to application of Markings.

C. Inspect for incorrect location, insufficient thickness, line width, coverage, retention, uncured or discolored material, and insufficient bonding.

D. A manufacturer’s representative may be requested by the project Engineer for assistance during the commencement phase of the project.

1. The representative will confer with the Contractor and project Engineer to ensure that Markings are being installed in accordance with the recommended procedure.

E. Bond Testing:

1. Bond tests may be conducted by an independent testing company to determine the suitability of new concrete pavements.
   a. As required by the Engineer or manufacturer due to bond failure without visual evidence.
   b. Markings will be applied and allowed to cure, and tested for adhesion in accordance with ASTM D4541.
   c. Bond strengths of less than 250 psi without pavements failure will result in the use of a primer prior to application of Markings.
   d. Primers will not be required on asphalt pavements.

F. Acceptance:

1. Repair lines and markings which after application and curing do not meet following criteria:
   a. Incorrect location.
   b. Insufficient thickness, width, coverage, or retention.
   c. Uncured or discolored material.
   d. Insufficient bonding.

3.7 CLEANING

A. Section 017000 - Execution and Closeout Requirements: Requirements for cleaning.

B. Collect and legally dispose of residues from painting operations.

3.8 PROTECTION

A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Protect painted pavement markings from vehicular and pedestrian traffic until paint is dry and track free.

1. Unless material is track free at end of paint application convoy, use traffic cones to protect markings from traffic until track free.
2. If vehicle crosses a marking and tracks it, or if splattering or overspray occurs, eradicate affected marking and resultant tracking and apply new markings.
3. Follow manufacturer instructions or use minimum of 30 minutes of dry time.
4. Barrier cones are satisfactory protection for materials being dried.

END OF SECTION 321723

SECTION 329000 - PLANTING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Plants, soils, turf, and landscape materials and accessories.

1.02 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Plants.

1. Basis of Measurement: per each (perennial/ornamental grass, shrub, tree, evergreen, etc.)
2. Basis of Payment: includes product, materials, labor to install plant as shown in the plans and details.

1.03 REFERENCE STANDARDS

A. American National Standards Institute (ANSI) Publications:
1. ANSI Z60.1-2014 - Nursery Stock.
2. ANSI Z133.1-2012 - Tree Care Operations-Pruning, Trimming, Repairing, Maintaining, and Removing Trees and Cutting Brush- Safety Requirements.

B. ASTM International (ASTM):
1. C33/C33M-16-Concrete Aggregates.
2. C136/C136M-14 - Sieve Analysis of Fine and Coarse Aggregates.
3. D698-12 - Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
4. D977-13e1 - Emulsified Asphalt.
5. D2028/D2028M-15 - Cutback Asphalt (Rapid-Curing Type).
6. D2103-15 - Polyethylene Film and Sheeting.

C. Hortus Third, most current edition: A Concise Dictionary of Plants Cultivated in the United States and Canada.

D. Turfgrass Producers International (TPI):
1. 2006 Guideline Specifications to Turfgrass Sodding.

E. United States Department of Agriculture (USDA):
1. Federal Seed Act-2011 - Rules and Regulations of the Secretary of Agriculture.

F. United States Environmental Protection Agency (EPA):
1. 40 CFR Part 503-1993 - Biosolids Rule.

1.04 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Manufacturer's Literature and Data:
   1. Description of each product.
      a. Soil amendments.
      b. Antidesiccant.
      c. Herbicide.
      d. Weed Control.
      e. Mulches.
      f. Boulder source location and product data.
   2. Plant list: List of local/regional suppliers for each species to be installed. Include quantities, plant dimension (height x spread) and container/root ball size. Certify in writing, confirmed orders for plants by submitting a Bill of Sale for each plant to be installed. Each plant of the same species shall be supplied by one grower only unless otherwise approved by Engineer.
      a. Requests for substitutions of plants not available in size, quantity or type specified must be made within 30 days after Contract award. Submit written evidence that a specified plant cannot be obtained and has been unobtainable since Contract award.
      b. Substitutions will only be authorized when a plant (or its alternates as specified) is not obtainable and Engineer, in consultation with District Agronomist, authorizes a change order for use of nearest equivalent or larger obtainable size or variety of plant having same essential characteristics with no adjustment of contract price.
   3. Warranty.

C. Certificates: Certify products comply with specifications.

D. Before delivery, submit notarized certificates for approval to Engineer attesting that following materials meet specified requirements:
   1. Plant Materials (Department of Agriculture certification by State Nursery Inspector from the state in which the plant material originates declaring material to be free from insects and disease).
   2. Fertilizers: Four certificates of analysis for each type of fertilizer.
   3. Lime.
   4. Gypsum.
   5. Soil Sulfur.
   6. Humates.
   7. Mycorrhizae.
   8. Peat.
   9. Seed: Include guaranteed percentages of purity, weed content and germination of seed, and net weight and date of shipment.
   10. Sod.
   11. Membranes.
   12. M-Binder.
   13. Hydro Mulching: Number of kilograms (pounds) of materials to be used per liter (gallon) of water.
   14. Mulchs.

E. Maintenance Data:
   1. Care instructions for each plant material.

1.05 QUALITY ASSURANCE

A. Installer Qualifications:

1. Regularly installs specified materials and products.
2. Installed specified products with satisfactory service on five similar installations for minimum five years.
    a. Project Experience List: Provide contact names and addresses for completed projects.
    b. A member with good standing of either the Professional Landcare Network (PLANET) the American Hort.
    c. Maintain and experienced full-time supervisor on Project site when work is in progress.
    d. Installer's shall have certification in one of the following categories from the Professional Landcare Network and submit one copy of certificate to the Engineer:
    e. Certified Landscape Technician (CLT) - Exterior, with installation specialty areas, designated CLT-Exterior.
    f. Certified Ornamental Landscape Professional designated COLP.

B. Licenses: Submit licenses to Engineer:

1. Arborist: One copy.
2. Pesticide Applicator: License in state of project, commercial.

1.06 DELIVERY

A. Deliver products in manufacturer's original sealed packaging.

B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, production run number, and manufacture date.

C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

D. Bulk Products:
1. Deliver bulk products away from buildings, utilities, pavement, and existing turf and planted areas. Maintain dry bulk product storage away from contaminants. Protect products from weather.
2. Install erosion control materials to prevent erosion or displacement of bulk products.

E. Notify Engineer of delivery schedule five days in advance, minimum. Engineer will inspect materials upon arrival. Remove unacceptable plant materials from project site immediately.

F. Protect plants during delivery to prevent damage to root balls or desiccation of leaves.

G. Protect trees during transport by covering root balls and tying branches.

H. Machine dug plants are permitted provided root balls are sized according to ANSI Z60.1 and tops are protected from damage.

I. Protect sod from drying out.

1.07 STORAGE AND HANDLING

A. Store seeds, soil amendments, fertilizers, and packaged materials in dry locations away from contaminants.

B. Keep sod moist and protect from exposure to wind and direct sunlight.

C. Store plants not installed on day of arrival at project site as follows:
   1. Shade and protect plants from wind when stored outside.
   2. Heel in bare root plants.
   3. Protect plants by covering roots with moist wood chips, shredded bark, peat moss, or similar mulching material.
   4. Keep plants moist including those in containers, by watering with fine mist spray until planted.

1.08 FIELD CONDITIONS

A. Seasons and Conditions:
   1. Perform landscape planting operations within following dates: From April 15 to June 15 for spring and from September 15 to November 1 for fall, but not before irrigation system installed, tested, and approved.

B. Perform turfgrass installation operations within following dates, but not before irrigation system installed, tested, and approved.
   1. Spring Planting: April 15 to June 15.
   2. Fall Planting: to September 15 to November 15.

C. Restrictions: Do not plant when ground is frozen, or in otherwise unsuitable condition for planting. Special conditions may exist that warrant variance in specified planting dates or conditions. Submit written request for approval to Engineer stating special conditions and proposal variance.

1.09 WARRANTY

A. Construction Warranty: 1 year.

B. Warranty including the following supplements:
   1. One Year Plant and Turfgrass Warranty: Warranty begins when Owner accepts plants and turfgrass but not before end of Landscape Plant and Turfgrass Establishment Period.
   2. Replace any dead plant material and any areas void of turfgrass immediately during warranty period and during an active growing season. One-year warranty for replaced plants and turfgrass begins on day replacement work is completed and accepted.
   3. Replacement of relocated plants, not furnished, is not required unless they die from improper handling and care. Loss due to improper handling, care, or negligence requires replacement in kind and size.
   4. Engineer and Owner will inspect replacement plants and turfgrass at end of Warranty period. Replace any dead, missing, or defective plant material and turfgrass immediately and during growing season. Warranty ends on date of this inspection provided work specified in this section is complied.
   5. Remove stakes, guys wires/straps at end of one-year warranty.

PART 2 - PRODUCTS

2.01 PRODUCTS - GENERAL

A. Provide each product from one source or manufacturer.

B. Plant and Turf Grasses: Comply with the varieties specified or shown in plant list.

C. Maintain equipment, tools and machinery on project site in sufficient quantities and capacity for proper execution of Work.

2.02 ORGANIC SOIL AMENDMENT

A. Organic Soil Amendment: Dark brown or black and capable of enhancing plant growth. Ninety-eight percent of material passes 25 mm (1 inch) screen. No admixture of refuse (i.e. noticeable inert contamination) or materials toxic to plant growth are permitted, free of all woody fibers, seeds, leaf structures, plastic, petroleum products, and toxic and non-organic matter.
   1. Acceptable Organic Soil Amendments: Peat moss, humus or peat, and commercially available combinations thereof.
   2. Acceptable Compost: Natural organic sources such as food or animal residuals, or yard trimmings.
   3. Unacceptable Sole Sources of Organic Matter: Untreated sludge from wastewater treatment plants, fresh manure, sawdust, and immature composts.

B. Minimum Material Requirements:

Test Parameter	Acceptable Ranges
Organic Matter	27 to 80 percent
pH	5.5 to 8.5
Ash	20 to 65 percent
Nitrogen	0.4 to 3.5 percent
Phosphorus	0.2 to 1.5 percent
Potassium	0.4 to 1.5 percent
C: N Ratio	25 to 30: 1
CEC	50 to 150 meq/100 g
Heavy Metals	Less than max. limits established by EPA 40 CFR Part 503
Inert Contents	Less than 1 percent by weight
Water-Holding Capacity	150 to 200 percent
Pathogen/Weed Seed Destruction	Proof of EPA minimum heating requirements

C.

C. Topsoil stripped and stockpiled on project site is acceptable provided, after testing and addition of necessary additives, meets above specification. Provide additional Organic Soil Amendment as required to complete work.

D. Provide organic soil amendment in areas with organic matter content below 4 percent that will be seeded, sodded or sprigged after grading activities are completed to create satisfactory topsoil horizon.

E. Spread and incorporate organic soil amendment into finished subgrade at depths indicated on drawings to raise soil organic content to minimum four percent and maximum six percent.

Allow for additional depth of organic soil amendment to bring all grades to required finished grades as shown on grading plans.

F. Peat: Natural product of sphagnum moss peat derived from fresh-water site conforming to Fed. Spec. Q-P-166, except as otherwise specified. Shred and granulate peat to pass 13 mm (1/2 inch) mesh screen and condition in storage piles for minimum six months after excavation.

G. Perlite: Horticulture grade.

H. Vermiculite: Horticultural grade, free of any toxic materials.

I. Organic Matter: Commercially prepared compost, composted sufficiently to be free of all woody fibers, seeds, and leaf structures, and free of toxic and nonorganic matter.

2.03 PLANTS

A. Plants: ANSI Z60.1, except as otherwise stated in this section or shown on drawings. Where drawings or specifications are in conflict with ANSI Z60.1, drawings and specification will prevail.
   1. Provide well-branched and formed planting stock, sound, vigorous, and free of disease, sunscald, windburn, abrasion, harmful insects or insect eggs with healthy, normal, and unbroken root systems.
   2. Provide single stemmed trees, with a single leader, unless otherwise indicated.
   3. Provide trees and shrubs of uniform, symmetrical growth, with straight boles or stems, free from objectionable disfigurements, and with branch spread of branches typical of variety.
   4. Provide ground cover and vine plants with number and length of runners for size, and proper age for grade of plants specified. Provide well established plants in removable containers, integral containers, or formed homogeneous soil sections.
   5. Provide plants grown under climatic conditions similar to those in project locality.

B. Minimum acceptable sizes of all plants, measured with branches in normal position, to conform to plant list and ANSI Z60.1. Larger plants with Engineer's approval, at no additional cost to the Owner. Increase ball of earth or spread of roots according to ANSI Z60.1 when larger plants are provided.

C. Do not handle plants by trunk or stem. Trees must be moved by lifting root ball, box or container.

D. Bare-root (BR) plants to have root system substantially intact, but with earth carefully removed. Cover roots with thick coating of mud by "puddling" after the plants are dug.

E. Container grown plants to have sufficient root growth to hold earth intact when removed from containers, but not be root bound.

F. When existing plants are to be relocated, ball sizes to conform to ANSI Z60.1 requirement for collected plants, with plants dug, handled, and replanted according to applicable requirements of this section.

2.04 LABELS

A. Legibly tag each plant, or group and bundles or containers of the species, variety, and size of

plant with durable, waterproof and weather-resistant label indicating correct plant name and size specified in plant list. Labels to be securely attached and not removed until acceptance by the Owner.

2.05 TOPSOIL

A. Topsoil: Provide well-graded soil of good uniform quality, natural, friable soil representative of productive soils in project vicinity. Topsoil to be free of subsoil, foreign matter, objects larger than 25 mm (1 inch) in any dimension, toxic substances, weeds and any material or substances that may be harmful to plant growth and have pH value of minimum 6.0 and maximum 7.0, and be best suited to region, climate and plant material specific to project.

B. Obtain material from stockpiles established under 310513.00 - Soils for Earthwork that meet general requirements stated above. Amend topsoil not meeting pH range specified by the addition of pH adjusters.

C. When sufficient topsoil is not available on project site to specified depth, provide additional topsoil. Minimum 10 days before topsoil delivery, notify Engineer of sources from which topsoil will be furnished. Obtain topsoil meeting general requirements stated above and comply with requirements specified in 014000.00 - Quality Requirements. Amend topsoil not meeting pH range specified by adding pH adjusters.

2.06 INORGANIC SOIL AMENDMENTS

A. Lime: Agricultural limestone, minimum 90 percent calcium and magnesium carbonates. Grind lime fineness, minimum 90 percent passes No. 8 mesh and minimum 25 percent passes No. 100 mesh. Maximum moisture, 10 percent.
   1. Dolomitic Lime: Natural, agricultural limestone (calcium and magnesium carbonate), minimum of 20 percent calcium and 11 percent magnesium and as follows:
      a. Screen Analysis: 100 percent passing through No.30 sieve; 70 percent passing through No. 100 sieve; minimum 30 percent passing through No.325 sieve. Provide lime in form of granulated, prilled, dolomitic limestone.
   2. Calcitic Lime: Natural, agricultural limestone (calcium carbonate), minimum of 36 percent calcium and as follows:
      a. Screen Analysis: minimum of 100 percent passing through No. 10 sieve; minimum of 80 percent passing through No. 100 sieve. Provide lime in form of granulated, prilled, limestone.
   3. Agricultural Gypsum: Finely ground, minimum of 90 percent calcium sulfate, or 85 percent calcium sulfate dihydrate.
   4. Sulfur: Granular, biodegradable, minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.
   5. Iron Sulfate: Granulated ferrous sulfate minimum of 20 percent iron and 10 percent sulfur.
   6. Aluminum Sulfate: Commercial grade, unadulterated.
   7. Sand: Clean washed river sand, free of calcium, chlorides and other deleterious substances.
   8. Humates: Derived from mined Gypsum and with guaranteed minimum analysis; Calcium Sulfate dihydrate (CaSO4 • 2H20) 35.00%; Calcium (Ca) 7.00%; Sulfur s 5.00%, plus Humic Acids 1.5% derived from Leonardite. Pelletized product used for ease of application.
   9. Mycorrhizae: Endomycorrhizal powder inoculum consisting of the following 4 species blend of propagules of arbuscular mycorrhizal fungi: Glomus intraradices, Glomus

mosseae, Glomus aggregatum, and Glomus etunicatum. Minimum 100,000 spores/propagules per pound. The powder particle size shall be less than 300 microns (100 percent passing the #50 screen).

2.07 PLANTING SOIL MIXTURE

A. Ornamental Plantings: Planting soil mixture composed of 3 parts topsoil and 1 part peat moss.

2.08 PLANT FERTILIZERS

A. Provide commercial grade plant fertilizer of uniform composition and complying with applicable state and federal regulations.

B. For new plant material, provide uniform free-flowing granular complete analysis fertilizer based on recommendations of soils reports, containing minimum 10 percent nitrogen, phosphoric acid and potash by weight with minimum 50 percent of nitrogen from controlled release source such as sulfur coated urea (SCU), polymer coated urea (PCU), and sulfur-coated/polymer coated urea (PCSCU).

C. For existing trees, provide a uniform free-flowing granular fertilizer bearing manufacturer's warranted statement of analysis. Granular fertilizer to contain minimum 10 percent nitrogen by weight (50 percent from controlled release source such as sulfur coated urea), 10 percent available phosphoric acid, and 10 percent potash.

2.10 MEMBRANES

A. Landscape Fabric: Woven needle-punched polypropylene weighing 113 g/sq. m (4.8 oz./sq. yd.) with 950 liter per minute flow rate per sq. m (90 gal. per minute flow rate per sq. ft.).

2.11 MULCH

A. Mulch: Free of deleterious materials and stored to prevent inclusion of foreign material.

B. Rock / Mineral Mulch for planting areas:
1. Material: Native granite river rock stone, washed.
2. Type: 25 mm (1 inch) to 65 mm (2-1/2 inches) according to ASTM C 136.
3. Color: Beige, tan, and brown shades.
4. Depth: 3-4”. no fabric is to show.
5. Submit sample to be approved by Engineer.

C. Organic Mulch: Wood based products such as chips, nuggets, or shredded hardwood:
1. Shredded Hardwood mulch shall be used in all landscape planting areas and under trees isolated from planting areas, unless specified otherwise. Material shall be natural in color and approved by Engineer. Fabric is not to be used in areas where wood mulch is specified.
2. Straw for turfgrass seedbed mulch: Stalks from oats, wheat, rye, barley, or rice free of noxious weeds, mold or other objectionable material. Straw to be air-dried and suitable for placing with blower equipment.
3. Wood cellulose fiber mulch for hydraulic application (Hydro mulch) with fertilizer: Specially prepared wood cellulose fiber, processed with no growth or germination-inhibiting factors, and dyed an appropriate color to facilitate visual metering of

application of materials. Do not apply any turfgrass seed in this type mixture. Maximum 12 percent moisture dry weight, plus or minus three percent at time of manufacture. pH range from 3.5 to 5.0. Manufacture wood cellulose fiber for application as follows:

a. After addition and agitation in slurry tanks with fertilizers, water, and other approved additives, fibers will become uniformly suspended to form a homogenous slurry.
b. When hydraulically sprayed, material will form blotter-like cover.
c. Cover allows absorption of moisture and allow rainfall or applied water to percolate to underlying soil.

2.13 STAKES AND GUYING STRAPS

A. Tree Support Stakes: Rough sawn wood, free of knots, rot, cross grain, or other defects that impair strength. Minimum 50 mm (2 inches) square by 2400 mm (8 feet) long and pointed at one end or galvanized steel pipe 32 mm (1-1/4 inches) by 3000 mm (10 feet) with cap, primed with 2 coats flat black exterior enamel.

B. Hose Chafing Guards: New or used 2-ply reinforced rubber or plastic hose, all same color.

C. Flags: White surveyor's plastic tape, 150 mm (6 inches) long, fastened to guying wires or cables.

D. Guying Straps: Fabric designed specifically to guy newly planted trees. Wire will not be permitted.

E. Turnbuckles: Galvanized or cadmium-plated steel with minimum 75 mm (3 inch) long openings fitted with screw eyes.

F. Eye Bolts: Galvanized or cadmium plated steel with 50 mm (1 inch) diameter eye and minimum 40 mm (1-1/2 inches) screw length.

G. Deadmen: 100 mm by 200 mm (4-inches by 8- inch) rectangular, or 200 mm (8 inch) diameter by 900 mm (36 inch) long sound wood.

H. Anchors: Arrow shaped or auger iron anchors, noncorrosive, sized according to manufacturer's instructions.

2.14 EDGING

A. Decorative Concrete Curbing: Extruded concrete form shall be slant style sloped to grade.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements.
3. Concrete: 28-day 3000 psi minimum.
4. Edging Size: Dimensions as shown in construction details.
5. Finish
    a. Light Broom, texture perpendicular to direction of travel.
    b. Color: Concrete gray.

2.15 WATER

A. Water: Contains no elements toxic to plant life.

2.16 ANTIDESICCANT

A. Antidesiccant: Emulsion manufactured for agricultural use to provide protective film over plant surfaces permeable enough to permit transpiration.

2.19 HERBICIDES AND OTHER PESTICIDES

A. Properly label and register pesticides with U.S. Environmental Protection Agency. Keep all pesticides in original labeled containers indicating analysis and method of use.

2.20 DECORATIVE BOULDERS

A. 3-4 foot Boulder.
   1. Locally sourced, granite fieldstone.
   2. Dimension taken at longest dimension.
   3. Color: natural, multi-colored.

B. 4-5 foot Boulder.
   1. Locally sourced, granite fieldstone.
   2. Dimension taken at longest dimension.
   3. Color: natural, multi-colored.

C. Montana Ledgestone Boulder.
   1. Montana sourced, argillite quarried stone.
   2. Dimension, 2 foot to 4 foot, taken at longest dimension.
   3. Color: natural, multi-colored, gold, brown and grey tones.

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine and verify substrate suitability for product installation.

B. Protect existing construction and completed work from damage.

C. Examine areas to receive planting for compliance with requirements and other conditions affecting performance.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Stake plant material locations and bed outlines for Engineer's approval before any plant pits or beds are dug. Engineer may make adjustments to plant material locations to meet field conditions.

F. Identify and review all underground utility locations before commencing work and exercise caution when working close to utilities. Notify Engineer of apparent conflicts with construction and utilities to plan adjustment before installation.

3.02 FINE GRADING AND ORGANIC AND INORGANIC SOIL AMENDMENT INCORPORATION

A. Obtain Engineer’s written approval of previously completed rough grading work before

incorporating organic soil amendments.

B. Immediately before dumping and spreading approved organic soil amendment, clean subgrade of stones larger than 50 mm (2 inches) and debris or rubbish and remove from project site. Before spreading organic soil amendment, rip subgrades too compact to drain water or based upon compaction tests with claw 305 mm (12 inches) deep, pulled by bulldozer 610 mm (24 inches') on center, both directions, then regrade surface.

C. Place and uniformly spread soil amendment materials humates and mycorrhizae over approved sub-grades. Apply inorganic soil amendments as recommended by soils report. Apply organic amendments to depth sufficiently greater than specified depth so after natural settlement and light rolling, specified minimum settled depth conform to lines, grades and elevations indicated on drawings. Incorporate soil amendment by disc harrowing, rototilling or other means in uniform manner. Incorporate upon organic matter deep enough to produce finished soil with organic matter content of between 4 and 6 percent. Provide additional organic soil amendment material, after in-place testing and approval, as required for organic matter content and finished grades at no additional cost to Owner.

D. Spread organic soil amendment material minimum 100 mm (4 inches) deep to finished grade at disturbed areas outside project limits.

E. Do not handle subsoil or organic soil amendment material when wet or frozen.

F. Set sufficient number of grade stakes to check finished grades. Set stakes in bottom of swales and at top of slopes. Connect contours and spot elevations with even slope.

G. After incorporating soil amendments material into subsoil, prepare by scarifying or harrowing and hand raking. Remove large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter. Remove stones over 38 mm (1-1/2 inch) diameter from amended soil bed. Amended soil also to be free of smaller stones in excessive quantities as determined by Engineer.

3.03 EXCAVATION FOR PLANTING

A. Compact whole surface with roller or by other suitable means to achieve 88 to 85 percent maximum dry density according to ASTM D698. During compaction process, fill all depressions caused by settling or rolling with additional organic soil amendment. Regrade and roll surface until presenting smooth and even finish corresponding to required grades. Acceptable finished soil grade condition for all new turfgrass areas is "fine textured and firm." Satisfactory firmness test requires surface soil not be fluffy or powdery and able to support weight of average adult person without creating visible depression.

B. Verify location of underground utilities before plant pit or bed excavation. Repair damaged utility lines. Where lawns have been established before planting, cover and protect before beginning excavations. Protect existing trees, shrubbery, and beds with barricades during project construction.

C. Remove rocks and other underground obstructions to depth necessary to permit proper planting according to Drawings. Where underground utilities, construction, or solid rock ledges are encountered, Engineer may select other locations for plant material.

D. Dig plant pits by approved method to provide vertical sides and flat bottoms. When sides of pit become glazed, scarify glazed surface.

E. Where ground cover and planting beds occur in existing turfgrass areas, remove turfgrass to depth that will ensure removal of entire root system. Prepare bed as follows:
   1. Where existing soil is to be used in place, till beds 300mm (12 inches) deep. Spread soil amendment uniformly over bed 50 mm (2 inches) deep and thoroughly incorporate into existing soil 300mm (12 inches) deep using a roto-tiller or similar equipment to obtain uniform and well pulverized soil mix. Where existing soil is compacted (former roadways, parking lots, etc.) till soil to necessary depth to support growth of new planting. Remove all sticks, stones, roots, and other objectionable materials. Bring plant beds to smooth and even surface to comply with established grades.

F. In newly grading areas where existing soil will be removed and replaced to prepare new planting beds, remove 300mm (12 inches) of existing soil and replace with topsoil. Bring plant beds to smooth and even surface to comply with established grades. Till 50 mm (2 inches) of soil amendment into topsoil as specified.

G. Form earth saucers around plants with topsoil. Provide 50 mm (2 inch) high basins for shrubs and 100 mm (4 inch) high basins for trees.

H. Treat plant saucers, shrub, and ground cover bed areas, before mulching, with approved preemergence granular ornamental herbicide. Apply herbicide at 90 kg/hectare (200 lbs./acre) before both early spring and early fall weed seed germination. Plant ground cover in areas to receive erosion control material through that material after material is in place.

3.04 SETTING PLANTS

A. Move balled and burlapped and container-grown plants only by supporting ball or container. Remove container, taking care to prevent damage to plants or root system. Set plants plumb and hold in position until sufficient soil has been firmly placed around roots or ball. Set plants with root crown 25 mm (1 inch) above surrounding grade. Plant ground cover plants after mulch is in place. Avoid contaminating mulch with planting soil.

B. Backfill balled and burlapped and container-grown plants with native soil removed from planting hole to approximately half ball depth, then tamp and water. Use native soil to backfill hole. Carefully fold back top half of burlap and remove tying materials. Completely remove all wire caging or similar material. Where plastic wrap or treated burlap is used in lieu of burlap, completely remove these materials before backfilling. Tamp and water remainder of backfill, then form earth saucers or water basins around isolated plants with topsoil.

C. Plant bare-rootstock arranging roots in natural position. Form hill or mound in center of planting hole to allow plant to sit at proper depth. Spread roots out, over, and down mound in natural position. Mound to be firm to avoid settlement of entire plant. Remove damaged roots with clean cut. Carefully work native soil in among roots. Tamp and water remainder of native soil, then form earth saucers or water basins around isolated plants with topsoil.

3.05 STAKING AND GUYING

A. Stake and guy plants as indicated on drawings and as specified.

B. Drive stakes vertically to depth of 800 to 900 mm (2-1/2 to 3 feet) into ground outside plant pit, unless otherwise shown on drawings Do not injure root ball.

C. Place deadmen minimum 450 mm (18 inches) below ground surface, unless otherwise indicated

on drawings.

D. Install iron anchors according to manufacturer's instructions.

E. Fasten flags securely to each guy strap approximately 2/3 of the distance above ground level.

F. Remove stakes and guy straps after one year.

3.07 MULCHING PLANTS AND FLOWER WATERING

A. Apply approved preemergence granular ornamental herbicide and mulch within 48 hours after planting. Apply before both early spring and early fall weed seed germination.

B. Placing Inert Rock / Mineral Material for planting beds: Place landscape fabric with edges lapped 150 to 300 mm (6 to 12 inches) to receive inert mulch material. Spread inert mulch to uniform thickness over membrane as indicated on drawings.

C. Placing Inert Rock / Mineral Material for Planting and tree areas: Spread wood-base mulch to uniform (3 to 4 inch) thickness. Rake smooth. Flush mulch with adjacent lawn, curbs and paving. Taper mulch thickness 50mm (2 inches) where planting beds meet adjacent areas.

D. Keep mulch 3” out of shrub crowns, away from tree trunks, and off buildings, sidewalks, light standards, and other structures.

3.08 PRUNING

A. Do not prune new plants unless otherwise directed by arborist and approved by the Engineer. Prune indicated existing plant material as follows:
1. Remove dead, broken and crossing branches.
2. Make cuts with sharp instruments as close as possible to branch collar. Do not make flush cuts.
3. Do not make "Headback" cuts at right angles to line of growth. Do not pole trees or remove leader.
4. Remove trimmings from project site.
5. Do not apply tree wound dressing to cuts.

B. Prune existing trees as indicated on Drawings. Perform tree pruning and cavity work by licensed arborist according to ANSI Z133.1. Remove 13 mm (1/2 inch) diameter or larger dead wood, branches interfering with or hindering healthy growth of trees, and diseased branches with clean cut made flush with branch collar. Prune trees according to their natural growth characteristics leaving trees well shaped and balanced. Use of climbing spurs is not acceptable. Remove stubs or limbs improper cuts or breaks.

3.10 FINISH GRADING

A. After ripping subgrade for topsoil/subsoil bonding, spread topsoil evenly to minimum 150 mm (6 inches) deep. Incorporate topsoil at least 50 to 75 mm (2 to 3 inches) into subsoil to avoid soil layering. Spread additional topsoil as required to meet finish grades. Do not spread topsoil when frozen or excessively wet or dry. Correct irregularities in finished surfaces to eliminate depressions. Protect finished lawn areas from damage by vehicular or pedestrian traffic. Complete lawn work only after areas are brought to finished grade.

3.15 WATERING

A. Watering: Start watering turfgrass areas immediately after installation at sufficient rate to ensure thorough wetting of soil to minimum 50 mm (2 inches) deep. Supervise watering operation to prevent run-off. Supply necessary pumps, hoses, pipelines, and sprinkling equipment. Repair all areas damaged by water operations. Keep soil surface constantly moist, not wet, until turfgrass plants are well established.

B. Deep water all trees twice each week during Plant Establishment Period, providing water penetration throughout root zone to full depth of planting pits, as verified by Engineer. Discontinue watering at first hard frost in fall and resume at ground thaw in spring.

3.17 LANDSCAPE PLANT AND TURFGRASS ESTABLISHMENT PERIOD

A. Landscape Plant and Turfgrass Establishment Period: Begins immediately after installation, with Engineer's approval, and continues through growing season sufficiently long for turfgrass and landscape plant materials to become establish and provide satisfactory to District Agronomist, Engineer, and Owner. Conditions and appearance are as follows:
   1. Turfgrass has obtained minimum of 98 percent generally weed-free surface cover.
   2. Landscape Plant Materials are fully rooted, actively growing and healthy and planting beds generally weed-free.
   3. Maintain plant and turfgrass during establishment period.
   4. Plants and turfgrass will not be accepted until completion of acceptable establishment period.
   5. During Landscape Plant and Turfgrass Establishment Period complete the following:
      a. Water plants and turfgrass to maintain moist soil surface until plants and turfgrass are well established. Quantity of applied water required to achieve and maintain these conditions determined on site by District Agronomist in consultation with Engineer.
      b. Prune plants and replace mulch as required.
      c. Replace and restore stakes, guy straps, and eroded plant saucers as required.
      d. Remove grass, weeds, and other undesired vegetation, including root growth, before they reach 75 mm (3 inches) high in plant bed and saucers. After all unwanted vegetation has been removed, apply approved preemmergence herbicides and remulch.
      e. Spray with approved insecticides and fungicides to control pests and ensure plant survival in healthy growing condition, as directed by Engineer in coordination with District Agronomist.
      f. Provide the following during turfgrass establishment:
         1) Eradicate weeds. Water, fertilize, overseed, and perform other operation necessary to promote growth of turfgrass.
         2) Mow turfgrasses as often as necessary to maintain 4” specified mowing height for each type of turfgrass before final acceptance. Begin mowing when cool season turfgrass is 100 mm (4 inches) high. For warm season turfgrasses, mow at appropriate heights for species and cultivar as directed by Engineer in consultation with District Agronomist.
      g. Replace dead, missing, or defective plant material during establishment period and an active growing season. Immediately replace each plant with one of same size and species.
      h. Replant areas void of turfgrass during an active growing season only.
      i. Sod will be evaluated for species and health thirty (30) days after laying last piece and reevaluated each 15 days during the establishment period. A satisfactory stand

of grass plants from sod operation will be living sod, uniform in color and leaf texture. Bare spots to be maximum 1250 sq. mm (2 sq. inches). Joints between sod pieces to be tight and free of weeds and other undesirable growth.

j. Seeding will be evaluated for species and health thirty (30) days after final planting and reevaluated each 15 days during the establishment period. A satisfactory stand of grass plants from seeding operation will be 98 percent coverage uniform in color and leaf texture. Bare spots to be maximum 1250 sq. mm (2 sq. inches). Reseed unsatisfactory areas within seven days during an active growing season.

k. Complete remedial measures as directed by Engineer in consultation with District Agronomist to ensure plant and turfgrass survival.

l. Repair damage caused while making plant or turfgrass replacements.

3.18 LANDSCAPE PLANT AND TURFGRASS ACCEPTANCE

A. Landscape plant and turfgrass acceptance will occur after completion of landscape plant and turfgrass establishment period. Contractor to have completed, located, and installed all plants and turfgrass according to drawings and specifications. All plants and turfgrass are expected to be living and in healthy condition at time of inspection and acceptance. Make written request two weeks before final inspection of landscape plants and turfgrass. Upon inspection, when work is found to not meet specifications, plant and turf grass establishment period will be extended at no additional cost to Owner until work has been satisfactorily completed, inspected and accepted.

B. Criteria for Acceptance of Landscape Plants:
1. Planter beds and earth mound water basins are properly mulched and free of weeds.
2. Tree support stakes, guys, and turnbuckles are in good condition.
3. Total plants on site as required by specifications and required replacements have been installed.
4. Remedial measures directed by Engineer have been completed.

C. Criteria for Acceptance of Turfgrass:
1. Sod: Living sod grass plants uniform in color and leaf texture and well rooted into soil below so that gentle pulling of turfgrass leaves by hand does not dislodge sod. Bare spots to be maximum 1250 sq. mm (2 sq. inches). Joints between sod pieces shall be tight and free from weeds and other undesirable growth.
2. Seed: Living turfgrass plants with 98 percent coverage, uniform in color and leaf texture. Bare spots to be maximum 0.05 sq. m (0.5 sq. ft.).

3.19 CLEANING

A. Remove and legally dispose of all debris, rubbish, and excess material from project site.

B. Where existing or new turfgrass areas have been damaged or scarred, restore disturbed areas to original condition.

C. In areas where planting and turfgrass work have been completed, clear the area of all debris, spoil piles, and containers.

D. Maintain minimum one paved pedestrian access route and one paved vehicular access route to each building clean at all times.

E. Clear other paved areas when work in adjacent areas are completed.

3.20 PROTECTION

A. Protect plants and turfgrass areas from traffic and construction operations. Erect barricades, as required, and place approved signs at appropriate intervals until final acceptance.

B. Remove protective materials immediately before acceptance.

C. Repair damage.

END OF SECTION 32 9000

SECTION 329219 - SEEDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Seeding.
2. Mulching.
3. Fertilizing.
4. Water for turf establishment.
5. Turf Establishment.
6. Seed Protection.
7. Maintenance.
8. Mowing.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Seeding:

1. Basis of Measurement: By square yard (SY) or acre (AC).
2. Basis of Payment: Includes all costs for labor, equipment, materials, and maintenance to complete work as specified per the following schedule:
   a. 50% when seeding is completed.
   b. 100% when seeding is established.

B. Hydraulic Mulch:

1. Basis of Measurement: By square yard (SY) or acre (AC).
2. Basis of Payment: Includes all costs for labor, equipment, and materials to complete work as specified.

C. Straw Mulch:

1. Basis of Measurement: By square yard or acre.
2. Basis of Payment: Includes all costs for labor, equipment, and materials to complete work as specified.

D. Watering:

1. Basis of Measurement: By thousand gallons (M Gal).
2. Basis of Payment: Include all costs for labor, equipment, and watering.
3. Basis of Estimate: 5.6 Gal per SY per Week, for 4 weeks.

E. Turf Establishment:

1. Basis of Measurement: By lump sum (L SUM).

2. Basis of Payment: Includes all costs for labor, equipment, and materials to complete the Work as specified.

F. Weed Control:

1. Basis of Payment: By the square yard (SY) or acre (AC).
2. Basis of Payment: Includes all costs for labor, equipment, and materials to complete the Work as specified.

1.3 DEFINITIONS

A. Weeds: Vegetative species other than specified species to be established in given area.

1.4 REFERENCE STANDARDS

A. North Dakota Department of Transportation (NDDOT):

1. Standard Specifications for Road and Bridge Construction; current version.

1.5 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data for seed mix, fertilizer, mulch, and other accessories.

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

D. Herbicide Reports - Submitted on a weekly basis.

E. Water Reports - Submitted on weekly basis.

1.6 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

1.7 QUALITY ASSURANCE

A. Provide seed mixture in containers indicating the following:

1. Percentage of seed mix,
2. Germination percentage,
3. Inert matter percentage,
4. Weed percentage,
5. Year of production,
6. Net weight, and
7. Date and location of packaging.

1.8 QUALIFICATIONS

A. Seed Supplier: Company specializing in manufacturing Products specified in this section with minimum three years' documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years' documented experience.

C. Herbicide Applicator: Individual who has been trained regarding the product and application method, and meets any federal, state, and local laws and regulations. This individual is required to hold a certified applicators license or be under the direct supervision of a certified applicator. Supervisors of qualified applicators are required to hold a certified applicators license in the State of North Dakota.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Product storage and handling requirements.

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.

1.10 MAINTENANCE SERVICE

A. Section 017000 - Execution and Closeout Requirements: Requirements for maintenance service.

B. Maintain seeded areas immediately after placement until grass is well established and exhibits vigorous growing condition.

PART 2 - PRODUCTS

2.1 SEED MIXTURE

A. Types and Descriptions:

1. Type I - Shade Mix: Used for residential applications.
2. Type II - Sunny Mix: Used for residential applications.
3. Type III: Used for ditches, legal drains, and diversions.
4. Type V: Used for athletic fields and similar applications
5. Type VI: As specified in the Drawings.

B. Application Rates:

Type	Type I	Type II	Type III	Type V
Perennial Ryegrass				
Fine-Leaf Perennial Ryegrass	30%	30%		50%

Kentucky Bluegrass	35%	60%		50%
Park Kentucky Bluegrass				
Canada Bluegrass				
Fowl Bluegrass				
Creeping Red Fescue	35%	10%		
Slender Wheatgrass				
Intermediate Wheatgrass			28%	
Smooth Brome				
Bromegrass (Lincoln)			52%	
Switchgrass				
Alfalfa				
Timothy				
White Clover				
Winter Rye				
Oats (temp)			20%	
Total Pounds Live Seed Per Acre	**200**	**200**	**125**	**200**
Analysis (N-P-K)	12-24-12	12-24-12	20-20-20	12-24-12
Total Pounds Per Acre	**150**	**150**	**100**	**150**
Application Type	Any	Any	Drilled	Any

2.2 ACCESSORIES

A. Mulch Material Type 2 (Straw Mulch):

1. Threshed stalks of native oats, wheat, barely or rye.
2. Free of weeds.
3. At least 50% by weight 10 inches or more in length.

B. Hydraulic Mulching Material:

1. Virgin wood fiber for use in hydraulic planting.
2. Cooked cellulose fiber that disperses readily in water and has no toxic effect when combined with seed.
3. Treated with a tackifier to enhance placement and adherence to soil.
4. Green in color.
5. Equilibrium air-dried moisture content of 12% plus or minus 3% at the time of manufacturing.
6. pH range of 3.5 to 5.0.
7. No sawdust or byproduct mulch.

C. Fertilizer: Commercial grade and recommended for grass/lawns.

D. Water: Clean, fresh and free of substances or matter capable of inhibiting vigorous growth of grass.

E. Herbicides:

1. Type A (Non-Selective Herbicide): Round-up, glyphosate, or approved equal.
2. Type B (Selective Herbicide): Trimec, 2,4-D, quinclorac, or approved equal.
3. Type C (Pre-Emergence Herbicide): Tenacity, mesotrione or approved equal.

F. Stakes: Softwood lumber, chisel pointed.

G. String: Inorganic fiber.

2.3 SOURCE QUALITY CONTROL

A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.

B. Testing is not required when recent tests and certificates are available for imported topsoil. Submit these test results to testing laboratory. Indicate, by test results, information necessary to determine suitability.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify prepared soil base is ready to receive the Work of this section.

3.2 PREPARATION

A. Prior to or during grading and tillage operations, ensure the ground surface is raked and clear of all stumps, brush, sticks, stones larger than ½ inch in diameter, concrete chunks, rebar, wire or other material that may hinder seeding and maintenance operations. Dispose of any accumulated waste material.

B. Repair any damage from erosion or other causes that has occurred after the completion of grading and before the application of fertilizer.

C. Remove and dispose of any weeds from areas to be seeded.

D. Cultivate or disk the seed bed to a depth of 3-inches.

E. Utilize a harrow or cultipack to ensure seed bed is firm and the seed can be placed at the proper depth.

3.3 SEEDING

A. Preparation:

1. Clear all debris, rank vegetation, and other material that is detrimental to the preparation of the seed bed.
2. Shape or blade to the cross sections in the Drawings or to such cross section that best fits the existing conditions.

3. Disk, harrow, rake, or work by some other approved method into a reasonable smooth seed bed.

B. Application:

1. Seed when the ground is open, not frozen or covered with snow, except as otherwise directed in writing by the Engineer.
2. Mechanically sow seed using approved equipment.
3. Check application rates periodically using approved methods.
4. Broadcast seeding:
   a. Only in areas where drill seeding equipment is unable to perform the work with a 20% increase to the application rate.
   b. Uniformly distribute with half the seed being sown in one direction and the other half being sown at right angles to the first half.
   c. Cover seed to an average depth of 1/4 inch by harrow or approved device.
   d. Broadcast seeding is not allowed during windy conditions.
5. Drill seeding:
   a. Utilize a force feed drill with a grass seed attachment which provides a uniform flow and depth of seed placement (1/4 to 1/2 inch), except that on slopes steeper than 3:1 or on areas too small to be seeded with a force feed drill.
   b. Seed may be sown by power sprayer, blowers, or other approved methods.
   c. Calibrate grass drills to ensure proper seeding rates.
   d. Repack soil immediately after the seed is applied to firm the soil around the seed.
6. Hydroseeding:
   a. Allowed only when specified and approved by the Engineer.
   b. Combine seed, water, and mulch and keep under constant agitation.
   c. Apply fertilizer, mulch and seeded slurry with hydraulic seeder at rate of 2,000 pounds per acre, evenly in one pass.

C. Planting Season:

1. Seed at such times in the year when the climatic conditions of temperature and moisture are most adaptable for growth and work of this nature.
2. Dormant Seeding: Seeding after October 20th when there is no chance of fall germination.

3.4 MULCHING

A. Hydro Mulch:

1. Uniformly apply to cover the entire seedbed area up to 95%.
2. Ensure mulch permits percolation of water to the underlying soils.
3. Mix specified fiber mulch with fiber-mulch manufacturer’s recommended tackifier in water using equipment specifically designed for hydro mulch application.
4. Clean all fixtures, buildings, sidewalks, and other areas that may receive unwanted mulch spray.

B. Straw Mulch:

1. Application:

a. Place mulch at a rate of 2 tons per acre.
b. Do not perform mulching operations when the sustained wind velocity is over 25 miles per hour.
c. Avoid placing excessive cover that smothers seedlings.

2. Anchoring:
   a. Punching:
      1) Immediately following application, punch mulch into the soil using a puncher.
      2) Operate the tiller parallel to the contours of the ground.
      3) Push the mulch into the soil 3 inches, with the ends of the mulch exposed above the soil surface.
   b. Tackifier:
      1) Used tackifier on areas where slopes are steeper than 3:1.
      2) Apply the tackifier at the rate recommended by the manufacturer.
      3) If no manufacturer recommendations are available, apply at a rate between 175 and 275 pounds per acre by spraying with the mulch or immediately following the mulch application.
3. Maintenance:
   a. Repair or re-mulch damaged areas.

3.5 FERTILIZING

A. Fertilizer Application:

1. Apply fertilizer mixture prior to seeding at the rate specified in the table according to seed class.
2. Adjust the fertilizer rate if the analysis is different than specified.

3.6 WATER FOR TURF ESTABLISHMENT

A. Immediately begin watering all seeded and mulched areas to provide a minimum of 1 inch depth of moisture per week, at intervals of 0.25 inches per watering and no more than 4 times per week.

B. Watering is to be completed until acceptable for Final Stabilization per ND Department of Environmental Quality Construction General Permit NDR11-000 or the more recent version.

C. Water only during morning hours to avoid excessive evaporation. Water at intervals such that the soil remains most and not overly soaked.

D. Reduce watering as necessary to account for rainfall during each week and increase watering during hot and/or windy periods.

E. Provide the Engineer weekly reports of watering operations including:

1. Dates and times; and
2. Quantity of watering or rainfall amounts to indicate minimum moisture is being obtained.

3.7 WEED CONTROL

A. Use extreme caution when applying herbicides near water, adjacent to properties with plants that might be damaged, or other landscaped areas.

B. Remedy any damage resulting from improper use of herbicides.

C. Applicator is responsible for the purchase, storage, record keeping, and disposal of Herbicides.

D. Report all herbicide application weekly to the Engineer.

E. Type A (Non-Selective Herbicide):

1. Uniformly applied at the rate labeled by the manufacturer prior to soil preparation to reduce organic materials, to areas requested and designated by the Engineer to control unwanted vegetation.

F. Type B (Selective Herbicide):

1. Uniformly applied at the rate as labeled by the manufacturer after seed germination during turf establishment to reduce broad leaf weeds to areas requested and designated by the Engineer to control unwanted vegetation.

G. Type C (Pre-Emergence Herbicide):

1. Uniformly applied at the rate labeled by the manufacturer prior to seed application.

3.8 TURF ESTABLISHMENT

A. Turf establishment by a lump sum is for establishing permanent vegetation on small areas of 2 1/2 acres or less per Contract. Such Work includes soil bed preparation, fertilizer, mulch, rolled erosion prevention products, seed and repair of erosion rills of 3 inches or greater in width or depth.

B. Unless otherwise shown on the Drawings, establish vegetation cover by seeding and mulching, and fertilizing.

C. The Engineer will accept the area after the perennial seed germinates, vegetation is at least 4 inches in height, and cover is uniform. If the seeding fails to germinate, correct, and reseed failed areas to establish turf.

3.9 MAINTENANCE

A. Seed:

1. Protection:
   a. Protect all seeded areas from traffic by placing warning signs or erecting barricades immediately after seeding is complete.

b. Repair any damage that may occur prior to final acceptance by the Engineer at no additional cost.
c. Regrade, seed, and mulch erosion damaged areas.
d. When specified control the growth of weeds by applying herbicides in accordance with the manufacturer's instructions.

2. Repair:
   a. Repair damage within the area caused by Contractor operations and within Contractor's control at no expense to the Owner.
   b. Reseed areas where the original seed has failed to grow, as directed by the Engineer.

B. Mulch:

1. Re-mulch areas where the original mulch has eroded, washed away, or blown off, and reseed areas where the original seed has failed to grow, as directed by the Engineer. Use the same seed mixture used in the original seeding.

C. Turf Maintenance:

1. Provide turf maintenance until grass is fully established and approved by the Engineer.
2. Provide lawn care and maintenance instructions to property owners to be used once grass is considered full established. All costs for labor, equipment and materials necessary to complete the work included in the price bid for "Seeding".
3. Submit a draft of instructions to Engineer for acceptance prior to issuing to effected properties. Provide written correspondence to all properties that have received newly seeded and mulched areas. Instructions can be delivered via paper copy and put on homes front doors or in available mailboxes. Instructions are to be delivered no later than the day the seeding was completed. At a minimum, include the following in the instructions:
   a. Frequency of cutting and minimum cutting height.
   b. Types, application frequency, and recommended coverage of fertilizer.
   c. Watering amounts and frequency.
   d. Any other pertinent maintenance instructions.

D. Mowing:

1. Mow seeded area when grass is 4 inches or taller.
2. Mow a minimum of 2 times before seeding is considered established.

END OF SECTION 329219

33 - UTILITIES

SECTION 330110.58 - DISINFECTION OF WATER UTILITY PIPING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Disinfection of potable water distribution and transmission system.
2. Testing and reporting of results.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT - Not Used

1.3 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA B300 - Hypochlorites.
2. AWWA C651 - Disinfecting Water Mains.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Disinfection Procedure: Submit description of procedure, including type of disinfectant and calculations indicating quantities of disinfectants required to produce specified chlorine concentration.

C. Product Data: Submit manufacturer information for proposed chemicals and treatment doses.

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

E. Certify that final water complies with disinfectant quality standards of authority having jurisdiction.

F. Test and Evaluation Reports: Indicate testing results comparative to specified requirements.

G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

H. Qualifications Statements: Submit qualifications for manufacturer and applicator.

1.5 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

B. Disinfection Report:

1. Type and form of disinfectant used.
2. Date and time of disinfectant injection start and completion.
3. Test locations.
4. Name of person collecting samples.
5. Initial and 24-hour disinfectant residuals in treated water in ppm for each outlet tested.
6. Date and time of flushing start and completion.
7. Disinfectant residual after flushing in ppm for each outlet tested.

C. Bacteriological (Bac-T) Report:

1. Date issued, project name, and testing laboratory name, address, and telephone number.
2. Time and date of water sample collection.
3. Name of person collecting samples.
4. Test locations.
5. Initial and 24-hour disinfectant residuals in ppm for each outlet tested.
6. Coliform bacteria test results for each outlet tested.
7. Submit bacteriologist's signature and authority associated with testing.

1.6 QUALITY ASSURANCE

A. Perform Work according to AWWA C651.

1.7 QUALIFICATIONS

A. All bacteriological tests must be analyzed by a state certified lab or authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 DISINFECTION CHEMICALS

A. Chemicals:

1. Hypochlorite: Comply with AWWA B300.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that all piping to be disinfected and tested has been cleaned, inspected, and pressure tested.

C. Perform scheduling and disinfecting activity with startup, water pressure testing, adjusting and balancing, and demonstration procedures, including coordination with related systems.

D. Notify Owner at least two (2) days prior to testing to ensure that the required volume of water is available.

3.2 APPLICATION

A. Provide required equipment to perform Work of this Section.

B. Introduce treatment into piping system.

C. Maintain disinfectant in system for 24 hours.

D. Flush, circulate, and clean until required disinfectant quality standard has been achieved using municipal domestic water.

E. Replace permanent system devices that were removed for disinfection.

3.3 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.

B. Disinfection, Flushing, and Sampling:

1. Disinfect pipeline installation according to AWWA C651.
2.
3. Use of liquid chlorine is not permitted.
4. Upon completion of retention period required for disinfection, flush pipeline until chlorine concentration in water leaving pipeline is no higher than that generally prevailing in existing system or is acceptable for domestic use.
5. Disposal:
    a. Legally dispose of chlorinated water.
    b. If chlorinated discharge may cause damage to environment, apply neutralizing chemical to chlorinated water to neutralize chlorine residual remaining in water.
6. After final flushing and before pipeline is connected to existing system or placed in service, certify that disinfectant level meets quality standards of authority having jurisdiction.
7. Provide sampling in accordance with the latest AWWA C651 standard with the frequency of one of the following options:
    a. Option A:
        1) Take an initial sample and then resample again after a minimum of 16 hours per 1,200 feet of new water main, plus one set from the end of the line and at least one set from each branch greater than one pipe length.
        2) All sets of samples must pass for the main to be approved for release.
    b. Options B:
        1) Let the water main sit for a minimum of 16 hours without any water use.
        2) Collect two sets of samples a minimum of 15 minutes apart while the sampling taps are left running and without flushing the main.

3) Collect two sets of samples every 1,200 feet of the new water main plus one set from the end of the line and at least one set from each branch greater than one pipe length.
4) All sets of samples must pass for the main to be approved for release.

END OF SECTION 330110.58

SECTION 330130.11 - TELEVISION INSPECTION OF SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipeline flushing and cleaning.
2. Television inspection of sewer pipelines.
3. Removal of deposits and protruding taps.
4. Audio-video recording of pipeline interior.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Televise - Main:

1. Basis of Measurement: By linear foot (LF).
2. Basis of Payment: Includes flushing and cleaning, bypass pumping, temporary flow control measures, television inspection, and audio-video recording of main.
    a. Payment will be made of the actual length of televising completed, verified, and accepted.

B. Televise - Service:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes flushing and cleaning, bypass pumping, temporary flow control measures, television inspection of service from main to the end of the installed pipe, and audio-video recording of service.

C. Deposit - Remove:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes cutting and removal of hardened deposits, attached encrustations, and attached grease that require a cutter to remove. Does not include roots.

D. Protruding Tap - Remove:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes cutting and removal of protruding taps, of any size and type, that inhibit the completion of continuous mainline televising.

E. Extensive Cleaning - CIP:

1. Basis of Measurement: By linear foot (LF).
2. Basis of Payment: Includes flushing, bypass pumping, temporary flow control measures, extensive cleaning of cast iron pipe and removal of corrosion and scaling down to parent material.
   a. Payment will be made of the actual length of cast iron pipe cleaned, verified, and accepted.

1.3 COORDINATION

A. Section 013000 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with Resident Project Representative, Owner and/or Public Works.

1.4 SCHEDULING

A. Section 013216 - Construction Progress Schedule: Requirements for scheduling.

1.5 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Portable Storage Device:

1. Submit two (2) copies of complete portable storage device, such as a USB Flash Drive or Hard Drive.
   a. Identify by Project name, street name, right-of-way property name, and manhole numbers.
2. All portable storage devices provided will become property of the Owner.

C. Inspection Logs:

1. Submit cleaning and television inspection logs for each segment of pipeline.
2. Include following minimum information:
   a. Stationing and location of lateral services, wyes, or tees.
   b. Date and clock time references.
   c. Pipe joints.
   d. Flow direction.
   e. Footage readings in feet.
   f. Screenshots of all defects (thumbnails).
   g. Infiltration/inflow defects.
   h. Cracks.
   i. Leaks.
   j. Offset joints.
   k. Other information to access condition of sewer.

D. Bypass Pumping:

1. Submit a detailed description of proposed bypass pumping system, including written description of plan addressing schedule, quantity, capacity, and location of pumping equipment.

E. Spill Response Plan:

1. Submit a detailed spill response plan outlining procedures to manage and mitigate any potential spills that may occur.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with the National Association of Sewer Service Companies (NASSCO) Pipe Condition Assessment Using CCTV, current edition standards.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for application examination.

B. Verify location of sewer pipelines to be inspected.

3.2 PREPARATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for application preparation.

B. Cleaning:

1. Notify the Owner if the Contractor believes that the integrity of the existing pipe is not adequate for the cleaning operation to take place.
2. Flush and clean pipeline to remove sludge, dirt, sand, stone, grease, and other materials to ensure clear view of interior condition.

C. Obstruction:

1. Complete a reverse setup and perform inspection of the pipeline from the other end if an obstruction is encountered that impedes inspection of the pipeline.
2. Notify the Engineer immediately for resolution if additional obstruction is encountered after the reserve setup.

D. Deposit Removal:

1. Provide substantial effort to remove all hardened deposits, attached encrustations and grease from the existing pipe.
   a. Substantial effort includes chipping, grinding, and cutting by mechanical, hydraulic or chain method.
2. Notify the Engineer immediately if the Contractor believes that removal of the deposit will cause damage to the integrity of the existing pipe.

E. Roots:

1. Remove roots as necessary to complete full inspection and televising of pipeline.

F. Protruding Tap Connection:

1. Notify Engineer of protruding tap connections that impede inspection and televising of the pipe.
2. Make record of all protruding taps to be removed both before and after removal.
3. Remove protruding tap to within one-half inch of the pipe wall.
4. Notify the Engineer if the Contractor believes that the integrity of the existing pipe is not adequate to complete removal of the protruding tap.

G. Debris:

1. Intercept flushed debris at next downstream manhole using weir or screening device.
2. Remove and dispose of debris off site.

H. Bypassing:

1. Furnish temporary bypass pumping system around Work area for time required to complete television inspection.
2. Provide standby pump of equal or greater capacity at bypass location.
3. Provide safety precautions, including barricades, lights, and flaggers as specified in Section 015000 - Temporary Facilities and Controls.

I. Flow Control:

1. Provide temporary flow control to reduce the depth of the flow as needed during televising operation.

J. Live Sewer Service Verification:

1. Televise and dye test any unknown services to determine if the service is active or inactive.
2. Inactive services are to be abandoned in-place and not reinstated.
3. Record all locations of any abandoned services.

3.3 APPLICATION

A. Closed-Circuit Television (CCTV) Camera System:

1. Use cameras specifically designed and constructed for closed-circuit sewer line inspection.
2. Use camera equipment with pan-and-tilt capability to view each lateral connection at multiple angles.
3. Produce a clear, in-focus picture of the entire periphery of the inside of the pipe for a minimum distance of six feet.
4. Use camera capable of moving both upstream and downstream with minimum 1,000 feet horizontal distance within one setup and using direct-reading cable position meter.
5. Use camera with “lateral launch’ capabilities when televising services.

3.4 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.

B. Pipeline Inspection:

1. Perform televising on PVC sewer piping after backfilling has been in place for at least 30 days, but not longer than 12 months.
2. Audio-video record sections of sewer pipeline between designated manholes.
3. Tilt camera up to view interior of manholes at the beginning and end of each segment televised.
4. Maintain accurate footage counter and display on the monitor at all times.
5. Begin footage measurements in at the interior face of the manhole wall.
6. Center camera inside pipe keeping it above the flow as reasonably possible.
7. Identify and record locations of flat grades, dips, deflected joints, open joints, broken pipe, protrusions into pipeline, and points of infiltration.
8. Locate and record service connections.
9. Record locations of pipeline defects, connection horizontal distance in feet, and direction from manholes.
10. Do not exceed depth of flow while televising of 20% of the inside pipe diameter. If the depth of flow exceeds 20% of the inside pipe diameter, provide the necessary flow control or reschedule the inspection for a time when such flow is reduced.
11. Notify the Engineer of the time and date of proposed work if nighttime work is necessary.
12. Use flow-control methods as specified for bypass pumping system to eliminate surcharging and to reduce flow.
13. Re-televise the sewer and provide a new recording of good quality, if recording are of such poor quality that the Engineer is unable to evaluate the condition of the sewer, locate sewer service connections, or verify cleaning.
14. Engineer will review inspection recordings and reports within 14 days after receiving all deliverables.
    a. Partial deliverables will not be accepted.

C. Site Cleaning:

1. Clean and restore the work areas prior to leaving the site.

D. Retrieval of Materials and Equipment:

1. Remove materials and equipment that may have become lodged in the pipe and/or sewer system from the cleaning and televising operation.

2. Repair any and all damaged items from the removal of materials and equipment.

3.5 TELEVISING SCHEDULE

A. Televise sanitary sewer mains and services in the following order, if applicable:

1. Pre-Construction:
   a. Mains:
      1) Televise existing sewer mains to be evaluated or relined with CIPP.
   b. Submit to Engineer for review and approval prior to relining.
2. Post-Construction:
   a. Mains:
      1) Televise same sewer mains and locations as pre-construction and all new sewer main installed.
   b. Services:
      1) Televise all new sewer services.
   c. Submit to Engineer for review and approval.

B. Televise storm sewer mains and laterals:

1. Post-Construction:
   a. Mains:
      1) Televise all new storm sewer mains.
   b. Laterals:
      1) Televise all new storm sewer laterals.
   c. Submit to Engineer for review and approval.

END OF SECTION 330130.11

SECTION 330130.72 - CURED-IN-PLACE PIPE LINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cleaning and flushing of existing sanitary sewers and services.
2. Taking video of existing sewers and analyzing their condition.
3. Installing an inverted, resin-impregnated tube pipe liner.
4. Reestablishing service connections.

B. Related Requirements:

1. Section 036000 - Grouting: Grout as required by this Section.
2. Section 312316 - Excavation: Excavating for utilities.
3. Section 330130.11 - Television Inspection of Sewers: TV inspection of pipeline and preparatory activities.
4. Section 330505.33 - Infiltration and Exfiltration Testing: Testing of deformed pipe liner.
5. Section 330505.41 - Air Testing: Testing of deformed pipe liner.
6. Section 330505.43 - Mandrel Testing: Testing of deformed pipe liner.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Section 012000 - Price and Payment Procedures: Contract Sum/Price modification procedures.

B. Relining Sewers:

1. Basis of Measurement: By linear foot (LF), measured center of manhole to center of manhole.
2. Basis of Payment: Includes pipe cleaning and flushing, TV inspection and videography, bypass pumping, liner installation, end seals, and reestablishment of service connections.

C. Relining Sewer Services:

1. Basis of Measurement: By linear foot (LF).
2. Basis of Payment: Includes pipe cleaning and flushing, TV inspection and videography, liner installation, and hydrophilic end seals.

1.3 REFERENCE STANDARDS

A. ASTM International:

1. ASTM D5260 - Standard Classification for Chemical Resistance of Poly(Vinyl Chloride) (PVC) Homopolymer and Copolymer Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

2. ASTM D5813 - Standard Specification for Cured-In-Place Thermosetting Resin Sewer Piping Systems.
3. ASTM F1216 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.
4. ASTM F1743 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP).
5. ASTM F2019 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP).

1.4 COORDINATION

A. Section 013000 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with users connected to system.

C. Notify home owners and businesses at least 48 hours in advance of expected disruption of sanitary service. Describe the work schedule, effects of disruption, and phone number for contacts.

D. Limit disruption of service to individual properties to one-time occurrence for maximum of eight hours.

E. Do not disrupt customer service between hours of 5:00 PM and 8:00 AM.

F. Provide and maintain temporary facilities, including piping and pumps, to meet requirements.

1.5 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit manufacturer information regarding liner material, curing chemicals, and lubricants.
2. Submit complete description of proposed wet-out procedures.

C. Shop Drawings: Indicate liner dimensions for each pipe size to be relined.

D. Samples: Submit two samples of liner material in both uncured and cured state.

E. Flash Drive:

1. Submit video recordings of piping sections as follows:
   a. Show condition of existing pipe and pipe joints and location of existing service connections after cleaning and prior to relining.
   b. Show cured liner and reestablished service connections after relining Work has been completed.

F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

G. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for liner thickness.

H. Test and Evaluation Reports: Submit reports certifying that liner material meets ASTM testing standards as specified in this Section.

I. Manufacturer Instructions:

1. Submit detailed description of liner placement and curing procedures for piping.
2. Include description of procedures for sealing liner material at manholes and reestablishing service connections.
3. Submit manufacturer's requirements for receiving, handling, and storage of materials.
4. Submit liner pipe thickness design in accordance with Appendix XI of ASTM 1216 with the following specifications:
   a. Existing pipe structural support: 0% (fully deteriorated)
   b. Minimum ovality of host pipe: 5%
   c. Height of groundwater: 100% of pipe depth
   d. Enhancement factor (K): ≤ 7.0
   e. Safety Factor: 2
   f. Flexural Modulus of elasticity reduction: 50%
   g. Final thickness: Post curing

J. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

K. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

L. Qualifications Statements:

1. Submit qualifications for manufacturer, installer, licensed professional, pipeline assessor, and inspector.
2. Submit manufacturer's approval of installer.
3. Company installing product must include references from at least 3 Cities as part of the qualification process.

1.6 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of each service connection.

1.7 QUALITY ASSURANCE

A. Perform Work according to ASTM F1216 and NASSCO standards.

B. Maintain copy of each standard affecting Work of this Section on Site.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience and 2,000,000 feet installed product.

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience in installation of liner materials and 1,000,000 feet installed product and licensed or certified by manufacturer.

C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed at Project location.

D. Pipeline Assessor:

1. Person specializing in assessing condition of sewer pipelines prior to and following relining.
2. Currently certified in Pipeline Assessment and Certification Program (PACP) of the National Association of Sewer Service Companies (NASSCO).

E. Inspector:

1. Person specializing in inspection of sewer pipeline rehabilitation.
2. Currently certified in Inspector Training and Certification Program (ITCP) of NASSCO.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.10 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Design lining material to have sufficient structural strength to support dead loads, live loads, and groundwater load imposed, assuming existing pipe cannot share loading or contribute to structural integrity of liner.

B. Design liner to least-possible thickness to minimize decreasing interior pipe diameter.

C. Design liner material to provide jointless, continuous, and structurally sound construction able to withstand imposed static, dynamic, and hydrostatic loads on a long-term basis.

D. Identify design provisions for shrinkage control to prevent future misalignment of service reconnections.

2.2 INVERTED, RESIN-IMPREGNATED TUBE PIPE LINER

A. Manufacturers:

1. Insituform Technologies USA, Inc.
   1177 Birch Lake Blvd N
   White Bear Lake, MN 55110
2. LMK Technologies
   1779 Chessie Lane
   Ottawa, IL 61350
3. National Liner, LLC
   375 Williamstowne, Suite 102
   Delafield, WI 53018
4. CIPP Corporation
   515 - 5th St
   Hudson, IA 50643
5. Liner Products
   1468 West Hospital Road
   Paoli, IA 47454
6. Substitutions: As specified in Section 016000 - Product Requirements.
7. or equal.

B. Furnish materials according to ASTM F1216 and in accordance with the National Association of Sewer Service Companies (NASSCO).

C. Description:

1. Fabric Tube:
   a. One or more layers of absorbent, non-woven felt fabric, felt/fiberglass, or fiberglass.
   b. Comply with ASTM D5813, and F1216.
   c. Capable of absorbing and carrying resins.
2. Resin:

a. Corrosion-resistant polyester or vinyl ester resin and catalyst system.
b. Comply with ASTM F1216.

3. Wet-Out Fabric Tube:
   a. Furnish uniform thickness and excess resin distribution that, when compressed at installation pressure, will meet or exceed design thickness after cure.

2.3 ACCESSORIES

A. Hydrophilic End Seal Sleeves:

1. For CIPP liner connections to manholes.
2. Hydrophilic rubber
3. Insignia End Seal or approved equal.

B. Hydrophilic Connection Hat
1. For CIPP service liner connections to sewer main.
2. Hydrophilic rubber.
3. Insignia Connection Hat or approved equal.

2.4 MIXES

A. Grout: As specified in Section 036000 - Grouting.

2.5 SOURCE QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Inspection and Testing:

1. Provide shop inspection and testing of completed assembly.
2. Chemical and Physical Testing: Test cured samples according to ASTM D5260.

C. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify location of piping to be relined.

3.2 PREPARATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Cleaning: Clean existing sewer pipes of debris, sedimentation, and mineral deposits with high-velocity cleaner, bucket and scraper, root saws, rolling or balling units, or other appropriate means.

C. Initial Video Inspection and Repair:

1. Conduct closed-circuit video inspection as specified in Section 330130.11 - Television Inspection of Sewers.
2. Determine condition of existing piping, degree of offset of joints, and locations of crushed walls and obstructions.
3. Determine sizes and locations of service entrances and connections.
4. Evaluation of pipe conditions, performed by pipeline assessor.
5. Inspection of Work, performed by an ITCP-certified inspector.
6. Clear obstructions, service piping protrusions, and other materials from bottom of existing pipe to ensure that inserted pipe liner directly contacts existing pipe wall.

D. Bypassing Sewage:

1. Set up bypassing pump system to isolate each section of piping for relining.
2. Maintain bypass pumping until lining is totally formed and service connections have been reestablished.

3.3 INSTALLATION

A. Installers:

1. Insituform Technologies USA, Inc.
   1177 Birch Lake Blvd N
   White Bear Lake, MN 55110
2. LMK Enterprises, Inc.
   1779 Chessie Lane
   Ottawa, IL 61350
3. Visu-Sewer clean & Seal, Inc.
   W230 N4855 Beltker Rd
   Pewaukee, WI 53072
4. Lametti & Sons, Inc.
   PO Box 477
   Hugo, MN 55038
5. PEC, Inc.
   3400 Centennial Dr
   Helena, MT 59601

6. Municipal Pipe Tool Co, Inc.
   515 - 5th St
   PO Box 398
   Hudson, IA 50643
7. Michels
   817 W Main St
   Brownsville, WI 53006-0128
8. Hydro-Klean
   5737 8th Ave SW
   Watertown, SD 57201
9. Veit & Company, Inc.
   14000 Veit Place
   Rogers, MN 55374
10. Substitutions: As specified in Section 016000 - Product Requirements.
11. or equal.

B. Excavate for point repairs as indicated on the Drawings and as permitted by Engineer.

C. Perform relining and reestablish service connections without need for excavation while minimizing disruptions to adjacent occupied buildings and traffic.

D. Inverted, Resin-Impregnated Tube Pipe Liner:

1. Coat inside layer of fabric tube (before inversion or pull-in, as applicable) with an impermeable, flexible membrane that will contain resin and facilitate, if applicable, vacuum impregnation and monitoring of resin saturation during resin impregnation (wet-out) procedure.
2. Prior to installation, and as recommended by manufacturer, place remote temperature gages or sensors inside host pipe to monitor temperature during cure cycle.
3. Positioning:
   a. Position wet-out tube in pipeline using method specified by manufacturer.
   b. Do not damage tube during installation.
4. Cure installed liner by using appropriate medium according to manufacturer's recommended cure schedule.
5. Allow installed pipe liner to cool according to manufacturer instructions.
6. Annular Spaces:
   a. Verify that no gap or annular space exists between finished liner and existing pipe.
   b. Grout annular space, if present, to prevent damage to or collapse of liner or service connections.
   c. Install watertight seals to host pipe at beginning and end of installed liner.

E. Service Connections:

1. Verify active services prior to relining. Use of dye may be necessary.
2. Reestablish existing sewer service connections through use of closed-circuit television camera and remote-controlled cutting device.
3. Match invert of reestablished service with previously existing invert.
4. Maintain minimum of 95 percent to maximum of 100 percent of original service connection opening.
5. Repair overcut service reinstallments greater than 100% of original opening.

6. Reestablish sewer service connection with uniform cuts free of burrs and sharp edges.
7. After reestablishing service connection, flush piping clean.

F. Sanitary Sewer Service Liner:

1. Install and cure liner in the host pipe per the manufacturer’s specification as described and submitted by the contractor.
2. Position wet-out tube in the service using the method approved by the manufacturer. Do not to damage the tube as a result of installation. Extend the liner as indicated on the plans. Provide robotic or remote controlled equipment to avoid any unnecessary excavations for access and curing operations.
3. Include hydrophilic gaskets at connections to sewer main and near the terminating end of the sanitary sewer service liner to create a water tight connection.

3.4 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.

B. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than 2 days on Site for installation, inspection, and field testing.

C. Liner Acceptance:

1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
2. If liner fails to form, remove failed liner and install new liner.
3. Conduct closed-circuit video inspection of completed relining Work, indicating no visual defects, including foreign inclusions, dry spots, pinholes, cracks, or delamination.
4. Confirm that service connections are complete and unobstructed.
5. No infiltration of groundwater is permitted.
6. Make final adjustments to liner under direction of manufacturer's representative.

D. Furnish installation certificate from manufacturer's representative attesting that liner has been properly installed and is ready for startup and testing.

END OF SECTION 330130.72

SECTION 330130.81 - MANHOLE REHABILITATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes rehabilitation of sewer utility structures:

1. Manhole Rehabilitation.

2. Manhole Scanning

A. Related Sections:

1. Section 33 01 30.62 – Manhole Grout Sealing.

1.2 MEASUREMENT AND PAYMENT

A. Sanitary Sewer Manhole – Rehabilitate

1. Basis of Measurement: By vertical foot (VF).
2. Basis of Payment: Includes cleaning and preparation of walls and bottom of manhole, sealing active leaks, application of restorative cement based liner, application of epoxy coating, performance testing and other necessary items necessary to complete the work.

B. Sanitary Sewer Manhole Invert – Rehabilitate

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes cleaning and preparation of manhole inverts and bench, applying cement based material to rehabilitate and repair all inverts and manhole bench prior to relining process, installation of interior drop connection and piping as necessary, temporary flow restriction and other necessary items to complete the work.

C. Manhole Scanning:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes post-installation video inspection and 3D measurement of manhole.

1.3 REFERENCES

A. American Concrete Institute:

1. ACI318 - Building Code Requirements for Structural Concrete.
2. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.

3. ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete.

B. ASTM International:

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A48 - Standard Specification for Gray Iron Castings.
3. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
4. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
5. ASTM A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
6. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
7. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
8. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
9. ASTM A706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
10. ASTM A767 - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
11. ASTM A775 - Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
12. ASTM A884 - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
13. ASTM A996 - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
14. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
15. ASTM C33 - Standard Specification for Concrete Aggregates.
16. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
17. ASTM C138 - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
18. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
19. ASTM C150 - Standard Specification for Portland Cement.
20. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
21. ASTM C192 - Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
22. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
23. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
24. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
25. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
26. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
27. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.

28. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
29. ASTM C857 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
30. ASTM C890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Section Precast Concrete Water and Wastewater Structures.
31. ASTM C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures.
32. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
33. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
34. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
35. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
36. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
37. ASTM C1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test prior to Backfill.
38. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
39. ASTM C1433 - Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers.
40. ASTM C1504 - Standard Specification for Manufacture of Precast Reinforced Concrete Three-Sided Structures for Culverts, Storm Drains, and Sewers.

C. National Precast Concrete Association:

1. NPCA Quality Control Manual for Precast Plants.
2. NPCA Plant Certification Program.

D. SSPC: The Society for Protective Coatings:

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings:

1. Submit shop drawings as necessary.
2. Indicate product data for rehabilitating the lift station.

C. Product Data:

1. Submit product data for all proposed restorative liner materials for rehabilitating manholes**.**

D. Design Data:

1. Submit specifications, physical properties of restorative liner materials, concrete mix designs for each different mix.

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

F. Installation Logs:

1. For each structure, provide log containing the following information.
   a. Visual inspection report indicating CSP, confirmation that leaks have been stopped, and that substrate is ready to receive liner materials per Manufacturer's instructions.
   b. Date of installation of each coating application including start time and finish time.
   c. Ambient weather data including temperature, sky condition, wind, relative humidity, and precipitation.
   d. Environmental parameters inside structure including temperature and relative humidity. Measurements to be taken at least 10 feet down in structure.
2. For each structure prior to installation of liner, submit picture of concrete substrate with CSP chip corresponding to Manufacturer's required CSP in frame. Label picture with structure name.

1.5 QUALITY ASSURANCE

A. Perform all work in accordance with industry standards and in accordance with these specifications.

1.6 QUALIFICATIONS

A. Installer: Company specializing in performing work of this Section with minimum three years' experience in installation of restorative liner materials.

B. Installers shall provide a list of previous projects completed in the last three years of equivalent nature and scope. The list shall include the owner's name, phone number and address, date of the work and approximate quantity. Include qualification and experience of key personnel.

1.7 DELIVERY, STORAGE AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

1.8 WARRANTY

A. Contractor, Installer, and Supplier warrant and guarantee to Owner that all wastewater coatings installed will be free of defects for a period of 5 years. Said warranty shall include, but is not limited to, defects related to materials, workmanship, improper or unfavorable environmental and site conditions, and premature coating failure.

B. Contractor, Installer, and Supplier agree and acknowledge that any coating defects identified during the warranty period are to be promptly repaired and may require implementation of temporary sewage handling measures, and other related work.

PART 2 - PRODUCTS

2.1 INFILTRATION CONTROL

A. Furnish fast setting materials designed to be applied in dry powder form, with no prior mixing of water, directly to active leaks under hydrostatic pressure in structures.

B. Consists of rapid setting cements, siliceous gypsum, or metallic particles.

2.2 INVERT REPAIR AND PATCHING

A. Furnish material designed to fill large voids in structure walls and to repair or reconstruct inverts where no hydrostatic pressure exists.

B. Consists of rapid setting cements, NSG aggregates, and various accelerating agents without chlorides, gypsum, or metallic particles.

C. Type I, II modified cement.

2.3 RESTORATIVE LINER MATERIAL FOR STRUCTURE WALLS AND BENCHES

A. Designed for the rehabilitation of wastewater related structures.

B. Mix with water per the manufacturer's written specifications and applied using equipment specifically designed for either low pressure spray or centrifugal spin casting application of cement mortars.

C. Capable of a placement thickness of ½" – 2" in a monolithic application.

D. Transport mortars to the construction site in the original manufacturer's bags (not less than 50 lbs. each).

E. Approved manufacturers:

1. Mainstay ML-72 Sprayable Microsilica Restorative Mortar by Madewell
2. Quadex Dynastone Mortar
3. Strong-Seal MS2A Mortar
4. MasterEmaco S 487SP (formerly SP-15 Spray Mortar) by BASF
5. PERMACAST MS-10,000 Mortar by AP/M Permaform
6. Or equal

F. Cement based, and contain microsilica, thermoplastic fibers, densifiers, polymer admixtures and other modifiers that produce a high strength, low shrinkage, and low permeability mortar without calcium aluminate cements or aggregates.

G. Physical Properties:

1. Conform to the following 28-day minimum physical properties:
   a. Compressive Strength (ASTM C109): 6000 psi
   b. Tensile Strength (ASTM C109): 575 psi
   c. Flexural Strength (ASTM C78): 985 psi
   d. Shrinkage (ASTM C157): 0.04%
   e. Uniaxial Tensile Bond Strength (ACE 503R, Appendix A): Greater than 500 psi over high strength concrete (5,000 psi compression strength concrete – bond strength governed by substrate tensile strength). Minimum acceptable bond = 150 psi.

2.4 EPOXY COATING FOR STRUCTURE WALLS AND BENCHES

A. Designed specifically for the rehabilitation of manholes and other related wastewater structures.

B. Designed to be applied to newly placed mortar immediately following the placement, by low pressure spray or centrifugal spin casting, and troweling of the mortar.

C. Approved Manufacturers:

1. Mainstay DS-5 High Build Epoxy
2. Quadex Structure Guard Epoxy
3. MasterProtect 100CR (formerly Sewer Guard HBS 100 Epoxy) by BASF
4. Raven 405 High Build Epoxy
5. COR+GARD Epoxy by AP/M Permaform
6. Or equal

D. Requirements:

1. 100% solids, 2 component, modified epoxy coating with a gloss finish.

2. Capable of application to restorative liner material immediately after the liner has been sprayed, troweled, and sponge finished, while the restorative liner is in a soft, uncured state.

E. Physical Properties:

1. Off-white capable of being applied in one or two coats.
2. Applied at a minimum uniform thickness of 50 mils.
3. Place the rotating applicator head at the level, when additional epoxy is required at any level, and commence application until that area is thickened.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.

3.2 PREPARATION

A. Cleaning and Preparation:

1. Thoroughly clean and make free of all foreign materials including dirt, grit, roots, grease, sludge and all debris or material that may be attached to the floor and walls of the structure with high pressure water blasting with a minimum pressure of 4500 psi.
2. Use an approved detergent integrally with the high-pressure cleaning water when grease and oil are present.
3. Remove all materials resulting from the cleaning of the structure prior to application of the restorative liner.
4. Remove all loose or defective brick, grout, ledges, steps, and protruding ledges to provide an even surface prior to application of cement-based coating.
5. Sealing Active Leaks:
    a. Hand apply a dry quick-setting cement based mix designed to instantly stop running water or seepage in all types of concrete and masonry structures. Apply material in accordance with manufacturer's recommendations and the following specifications:
        1) Clean area and free it of all debris per Section 3.2.A of this specification.
        2) Prepare crack or hole by chipping out loose material to a minimum depth and width of ¾".
        3) Place a generous amount of the dry quick-setting cement based material to the active leak, with a smooth fast motion, maintaining external pressure for 30 seconds, repeat until the leak has stopped.
        4) Proper application should not require any special mixing of product or special curing requirements after application.

B. Invert Repair:
1. Hand mix and apply a rapid setting, high early strength, non-shrink patching material to fill all large voids and repair inverts prior to spray lining of the structure. Temporarily restrict flow by inflatable or mechanical plugs prior to cleaning.
2. Clean area and free it of all debris per Section 3.2.A of this specification.
3. Use clean potable water for mix water and require no additives or admixtures for use with cement based patching materials.
4. Mix cement based material in a mortar tub of 5 gallon pail with water per the manufacturer's specifications. Mix in small quantities, to avoid setting prior to placement in voids or inverts.
5. Apply materials once mixed to proper consistency to the invert or void areas by hand or trowel. Take care to not apply excessive material in the channel, which could restrict flow. Smooth materials either by hand or trowel in order to facilitate flow.
6. Re-establish flows in inverts within 30 minutes of material placement.

3.3 INSTALLATION

A. Application of Restorative Structure Liner:

1. Spray apply and/or centrifugally spin cast a cement based liner to the inside of the existing structure. Apply the cement based liner materials as approved by the material manufacturer with the necessary equipment and application methods.
2. Mix material with water in accordance with the manufacturer's specifications. Once mixed to a proper consistency, pump the materials via a rotor-stator style progressive cavity pump through a hose for delivery to appropriate and/or selected application device.
3. Spray application of the cement based material:
    a. Utilize a low-velocity spray application nozzle. Commence pumping of the material and atomize the mortar by the introduction of air at the nozzle, creating a low-velocity spray pattern for material application.
    b. Spray starting at the structure invert and progressing up the wall to the corbel and exit area.
    c. Apply material to a specified uniform minimum thickness no less than 1/2". Apply material to a bench area, with care to provide a 3 to 1 slope to prevent ponding.
    d. Use low velocity spray application only to prepare severely damaged areas within the structure for application by centrifugal spin cast. Do not use low velocity spray applicator for the entire liner. Use centrifugal spin casing to provide the required density.
4. Centrifugal spin cast application of the restorative liner material:
    a. Utilize a high speed rotating applicator device. Position rotating applicator within the center of the structure at either the top of the structure chimney or the lowest elevation at the junction of the structure bench and walls.
    b. Start the high speed rotating applicator and pump material. Raise and/or lower the rotating applicator head at a controlled retrieval speed to provide a uniform material thickness on the structure walls.
    c. Make controlled multiple passes until the specified minimum thickness is achieved. Stop the applicator head if the procedure is interrupted and until flows are restored.
    d. Verify material thickness if no less than 1"at any point with a depth gauge. Place applicator head at any noncompliant level and commence application until that area achieves the specified thickness.
5. Apply material only when structure is in a damp state with no visible water dripping or running over the structure walls.
6. Use low-velocity spray nozzle and the centrifugal spin casting head in conjunction to facilitate uniform application of the mortar material to irregularities in the contour of the structure walls and bench areas.
7. Begin troweling and sponge finishing immediately following the spray application of the mortar.

B. Centrifugal Spin Cast Application of the Epoxy Coating:

1. Begin process no more than four hours following placement of the mortar and mortar is in a soft, uncured, plastic state.
2. Position the high speed rotating applicator within the center of the structure at either the top of the structure chimney, or the lowest elevation at the junction of the structure bench and walls.

3. Start the high speed rotating applicator and pump the epoxy. Raise and/or lower the rotating applicator head to provide a uniform epoxy thickness on the structure walls.
4. Use controlled multiple passes until the specified minimum thickness is attained. Stop the applicator head if the procedure is interrupted for any reason, until flows are recommenced.
5. Provide epoxy thickness of no less than a uniform 50 mils. Place the rotating applicator head at any noncompliant level and commence application until that area is thickened.
6. Cure coating once the structure cover has been replaced. Place plastic sheeting below the structure lid so that the lid does not bond to the structure and to prevent foreign objects from embedding in the fresh epoxy.

3.4 FIELD QUALITY CONTROL

A. Maintain quality and performance of the material by the following measures to be determined and specified by the Engineer.

1. Performance Testing:
   a. Visual inspection and observation by the Engineer and/or representative.
2. Post installation scan:
   a. Scan each manhole after installation or rehabilitation with IBAK Panoramo SI 4K or equal. Deliver copies of manhole scans to Engineer for review.

END OF SECTION 330130.81

SECTION 330130.86 - STRUCTURE ADJUSTMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adjusting manhole and inlet frames/castings and covers.
2. Resetting manhole frames/castings and covers.
3. Replacing manhole and inlet frames/castings and covers.
4. Adjusting valve box sections and covers.
5. Manhole chimney seals.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Manhole Cover - Adjust:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes removal of existing cover, installing cover adjustment (paving) ring insert, joint sealant, reinstalling cover, and final adjustment.

B. Manhole Casting - Adjust:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes removal of existing frame and cover, reinstalling existing frame and cover, adding or removing manhole riser rings, chimney seal, grout or joint sealant, final adjustment, backfilling, and compaction.

C. Manhole Casting - Replace:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes removal of existing frame and cover, installing new frame and cover, adjustment riser rings, chimney seal, grout or joint sealant, final adjustment, backfilling, and compaction.

D. Inlet Casting - Replace:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes removal of existing inlet frame and grate, installing new frame and grate, adjustment riser rings, chimney seal, grout or joint sealant, final adjustment, backfilling, and compaction.

E. Valve Box Cover - Adjust

1. Basis of Measurement: By each (EA).

2. Basis of Payment: Includes removal of existing cover, installing cover adjustment (paving) ring insert, joint sealant, reinstalling cover, and final adjustment.

1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO M306 - Standard Specification for Drainage, Sewer, Utility, and Related Castings.

B. ASTM International:

1. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
2. ASTM C32 - Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale).
3. ASTM C478 - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.
4. ASTM C877 - Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections.
5. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
6. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
7. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information for manhole covers and riser rings construction, features, configuration, and dimensions.

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

D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

1.5 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual grade-adjusted elevation of manholes.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.7 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANHOLE FRAMES AND COVERS

A. Manufacturers:

1. Neenah Foundry
   2121 Brooks Avenue
   Neenah, WI 54956
2. East Jordan Iron Works (EJ)
   301 Sprint St
   East Jordan, MI 49727
3. Or Approved Equal.

B. Description:

1. Material:
   a. Cast iron.
   b. Comply with ASTM A48/A48M, Class 30B.
2. Cover:
   a. Bearing Surface: Machined flat.
   b. Configuration: Removable.
   c. Solid with closed pick holes.
   d. Self-sealing gasket.
   e. Inscription: SANITARY SEWER or STORM SEWER, as applicable.

f. Security: None, unless as specified on the Drawings.

3. Frames:
   a. In asphalt pavement:
      1) Self-leveling:
         a) EJ SELFLEVEL.
         b) Or Approved Equal.
   b. In non-paved areas:
      1) Standard:
         a) Neenah R-1733.
         b) EJ 1205Z2.
         c) Or Approved Equal.
   c. In concrete pavement:
      1) Self-leveling:
         a) Neenah R-1955-1
         b) EJ 3025
         c) Or Approved Equal.

2.2 INLET FRAMES AND GRATES

A. Manufacturers:

1. Neenah Foundry
   2121 Brooks Avenue
   Neenah, WI 54956
2. East Jordan Iron Works (EJ)
   301 Sprint St
   East Jordan, MI 49727
3. Or Approved Equal.

B. Description:

1. Material:
   a. Cast iron.
   b. Comply with ASTM A48/A48M, Class 30B.
2. Grates:
   a. In grass or outside pavement:
      1) Convex grate:
         a) Neenah R-2577 with convex casting grate.
         b) East Jordan Iron Works 1205-M2 with convex casting grate.
         c) Or Approved Equal.
      2) Flat Grate:
         a) Neenah R-17333 Type C.
         b) East Jordan Iron Works 1205 Type M.
         c) Or Approved Equal.
      3) Stool:
         a) Neenah R-4342.
         b) Or Approved Equal.
   b. Within curb & gutter:

1) Highback:
   a) Neenah R-3067-C with 2" radius open curb box
   b) East Jordan Iron Works 7030-M2 with T1 back
   c) Or Approved Equal
2) Mountable:
   a) Neenah R-3067-C-C
   b) East Jordan Iron Works 7030-M2
   c) Or Approved Equal
3) Knockdown:
   a) Neenah R-3067-C-Q
   b) Or Approved Equal

2.3 COVER ADJUSTMENT RINGS

A. Manufacturers:

1. Neenah Foundry
   2121 Brooks Avenue
   Neenah, WI 54956
2. East Jordan Iron Works (EJ)
   301 Sprint St
   East Jordan, MI 49727
3. Ess Brothers & Sons, Inc.
   9350 County Road 19
   Loretto, MN 55357
4. Or Approved Equal.

B. Description:

1. Solid gray or ductile iron. Steel is not allowed.
2. Locking or non-locking to match existing frame and cover.
3. Assorted thicknesses as necessary to achieve final grade.
4. Apply EBS Super Glue adhesive, per manufacturer's recommendations.
   a. No traffic for a minimum of 8 hours after glue application.

2.4 FRAME ADJUSTMENT RISER RINGS

A. Manufacturers:

1. Cretex Concrete Products, Inc.
   6655 Wedgwood Road, Suite 130
   Maple Grove, MN 55311
2. Hancock Concrete Products Co., Inc.
   17 Atlantic Avenue
   Hancock, MN 56244
3. Ladtech, Inc
   6704 Meadowlark Court

Lino Lakes, MN 55038
4. Cretex Specialty Products
Waukesha, WI
5. Or Approved Equal

B. Description:

1. Reinforced Precast Concrete:
   a. Complete, unbroken rings.
   b. Partial or broken rings are not acceptable
2. High Density Polyethylene (HDPE)
   a. Flat or tapered, to accommodate final grade.
3. Expanded Polypropylene (EPP)
   a. Flat or tapered, to accommodate final grade.
4. Assorted thicknesses as necessary to achieve final grade.

C. Accessories:

1. TCC Materials Underground Utility Mortar.
2. High-Impact Plastic Shims.

2.5 CHIMNEY SEAL SYSTEM

A. Manufacturers:

1. Cretex Specialty Products
N16 W23390 Stone Ridge Drive, Suite A
Waukesha, WI 53188
2. Strike Products
31785 64th Avenue
Cannon Falls, MN 55009.
3. Sealing Systems Inc. - Infi-Shield with stainless steel bands
9350 County Road 19
Loretto, MN 55357.
4. Or Approved Equal.

B. Description:

1. Strike Products I&I Barrier
2. Cretex Specialty Products External Chimney Seal
3. Chimney seal system not required for Cretex Specialty Products Pro-Ring adjustment rings

2.6 VALVE BOXES

A. Manufacturers:

1. Tyler Union
11910 CR 492

Tyler, TX 75706
2. Mueller Co.
633 Chestnut Street, Suite 1200
Chattanooga, TN 37450
3. Or Approved Equal.

B. Description:

1. 12-inch Diameter Valves and Smaller:
   a. Material: Cast iron.
   b. Type: Two piece; screw.
2. Valves Larger than 12-inch Diameter:
   a. Material: Cast iron.
   b. Type: Three piece; screw.
   c. Base: Round.
3. Cover Inscription: WATER.

C. Accessories:

1. Valve Box Top
   a. In asphalt pavement:
      1) Self-leveling:
         a) EJ SELFLEVEL Valve Box Top.
         b) Or Approved Equal.

2. Valve Box Aligner
   a. Manufacturers:
      1) Adaptor, Inc.
      2151 S. 54th Street
      West Allis, WI 53219
      2) Or Approved Equal.
   b. Description: High strength plastic device designed to automatically center valve box base and to prevent it from shifting off center during backfilling.

2.7 MATERIALS

A. Bedding and Cover: Fill Type A2, as specified in Section 310516 - Aggregates for Earthwork.

B. Soil Backfill: Soil Type S1, as specified in Section 310513 - Soils for Earthwork.

2.8 SOURCE QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify and locate manholes, inlets, and valve boxes requiring adjustment.

3.2 PREPARATION

A. Existing Work:

1. Saw cut existing pavement, if necessary.
2. Excavate.
3. Clean manholes.

3.3 INSTALLATION

A. Adjustment of Manhole Covers:

1. Locate manhole casting covers to be adjusted as indicated on Drawings.
2. Remove existing cover to enable reuse.
3. Install new adjustment ring under cover.
    a. Minimum elevation 3/8 inch below final pavement/ground elevation.
    b. Maximum elevation 0 inch above final pavement/ground elevation.
    c. Do not adjust cover elevation more than 3 inches with cover adjustment rings.
4. In asphalt paving areas provide 1 inch ring under cover as part of total adjustment.
    a. Adjustment over 1 inch will require multiple rings.
    b. Not required when floating castings are installed.
5. Seal joints between frame/casting top and cover adjustment ring with sealant.
6. Reinstall existing manhole cover.

B. Adjustment of Manhole Castings:

1. Locate manhole frames/castings to be removed and reset as indicated on Drawings.
2. Remove existing manhole frame and cover to enable reuse.
3. Remove existing adjustment rings and dispose.
4. Use new frame adjustment rings to achieve elevation indicated for cover.
    a. Minimum elevation 3/8 inch below final pavement/ground elevation.
    b. Maximum elevation 0 inch above final pavement/ground elevation.
    c. Do not adjust frame/casting elevation more than 4 inches with frame adjustment rings.
5. Reinstall existing frame for manhole.
6. Seal joints between manhole top, chimney seal, and frame adjustment rings with sealant.
7. Reinstall existing manhole cover.

C. Replacement of Manhole Castings:

1. Locate manhole frames/castings to be removed and replaced as indicated on Drawings.
2. Remove existing manhole frame and cover and deliver to Owner.
3. Remove existing adjustment rings and dispose.
4. Use new frame adjustment rings to achieve elevation indicated for cover.
   a. Minimum elevation 3/8 inch below final pavement/ground elevation.
   b. Maximum elevation 0 inch above final pavement/ground elevation.
   c. Do not adjust frame/casting elevation more than 4 inches with frame adjustment rings.
5. Install new frame to grade as indicated on Drawings.
6. Seal joints between manhole top, chimney seal, and frame adjustment rings with sealant.
7. Install new manhole cover.

D. Replacement of Inlet Castings:

1. Locate inlet frames/castings to be removed and replaced as indicated on Drawings.
2. Remove existing inlet frame and grate and deliver to Owner.
3. Remove existing adjustment rings and dispose.
4. Use new frame adjustment rings to achieve elevation indicated for cover.
   a. Minimum elevation 3/8 inch below final pavement/ground elevation.
   b. Maximum elevation 0 inch above final pavement/ground elevation.
   c. Do not adjust frame/casting elevation more than 4 inches with frame adjustment rings.
5. Install new inlet frame to grade as indicated on Drawings.
6. Seal joints between inlet top, chimney seal, and frame adjustment rings with sealant.
7. Install new inlet grate.

E. Adjustment of Valve Box Covers:

1. Locate gate valve covers to be adjusted as indicated on Drawings.
2. Remove existing cover to enable reuse.
3. Install new adjustment ring/paving riser under cover.
   a. Minimum elevation 3/8 inch below final pavement/ground elevation.
   b. Maximum elevation 0 inch above final pavement/ground elevation.
   c. Do not adjust cover elevation more than 3 inches with cover adjustment rings.
4. Seal joints between gate valve top and cover adjustment ring with sealant.
5. Reinstall existing gate valve cover.

F. Chimney Seal:

1. Installation in accordance with the manufacturer’s instructions and recommendations.

3.4 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.

B. Pipe and Material Testing:

1. Compaction Testing:
   a. As specified in Section 312316.13 - Trenching and in accordance with the Drawings.
2. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

3.5 PROTECTION

A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Protect castings, frames, grates, and valve boxes from damage or displacement.

END OF SECTION 330130.86

SECTION 330505.31 - HYDROSTATIC TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hydrostatic testing of pressure piping.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT - Not Used

1.3 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Test and Evaluation Reports: Indicate results of piping tests.

PART 2 - PRODUCTS

2.1 HYDROSTATIC TESTING

A. Equipment:

1. Pressure pump.
2. Pressure hose.
3. Water meter.
4. Test connections.
5. Pressure relief valve.
6. Pressure Gage: Calibrated to 0.1 psi.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that piping is ready for testing.

C. Verify that trenches are backfilled.

D. Verify that pressure piping thrust restraints have been installed.

3.2 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.

B. Testing of Pressure Piping (PVC and DIP):

1. Test system according to AWWA C600 and following:
   a. Hydrostatically test each portion of pressure pipe, including valved section, at not less than 150 psi.
   b. Do not test at a pressure that exceeds the design pressure of the pipe.
   c. Conduct hydrostatic testing for at least two hours.
   d. Slowly fill with water portion of piping to be tested, expelling air from piping at high points.
   e. Install corporation cocks at high points.
   f. Close air vents and corporation cocks after air is expelled.
   g. Raise pressure to specified test pressure.
   h. Observe joints, fittings, and valves undergoing testing.
   i. Remove and renew cracked pipes, joints, fittings, and valves that show visible leakage.
   j. Retest.
   k. Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine leakage rate.
   l. Maintain pressure within plus or minus 5.0 psi of test pressure.
   m. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of testing.
   n. Compute maximum allowable leakage using following formula:
      1) L = SD x sqrt(P) /C.
      2) L = testing allowance, gph.
      3) S = length of pipe tested, feet.
      4) D = nominal diameter of pipe, inches.
      5) P = average test pressure during hydrostatic testing, psig.
      6) C = 148,000.

7) If pipe undergoing testing contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each pipe size.

2. If testing of piping indicates leakage greater than that allowed, locate source of leakage, make corrections, and retest until leakage is within acceptable limits.
3. Correct visible leaks regardless of quantity of leakage.

C. Testing of Pressure Piping (HDPE):

1. Testing is to be conducted after placement, trench controlled low-strength material, and backfilling have been completed.
2. Test system according to AWWA C906, ASTM F2164 and the following:
   a. Initial Expansion Phase:
      1) Slowly fill portion of piping to be tested with water, expelling air from piping at high points.
      2) Temperature of pipeline section and test water should be less than 80 degrees Fahrenheit. Consult with pipe manufacturer for technical assistance with elevated temperature pressure reduction. Allow test water and the pipeline section to equalize before applying test pressure.
      3) Pressurize test section at not less than 1.25 times the anticipated maximum sustained working pressure of the pipeline at the highest elevation of the test section and at not less than 1.5 times the sustained working pressure of the pipeline at the lowest elevation of the test section. However, do not test at a pressure that exceeds the design pressure of the pipe.
      4) Maintain test pressure for four (4) hours, adding make-up water hourly as needed to maintain maximum test pressure. Measurement of make-up water during the initial expansion phase is not required.
   b. Test Phase:
      1) After initial expansion phase is complete, maintain test pressure for three (3) hours.
      2) After the test duration is complete, any water deficiency must be replaced and measured. Add and measure the amount of make-up water required to return to the test pressure and compare this to the maximum allowance in the table below.

ALLOWANCE FOR EXPANSION UNDER TEST PRESSURE			
NOMINAL PIPE SIZE	U.S. GALLONS/100FT. OF PIPE		
	1 HOUR	2 HOURS	3 HOURS
2"	0.08	0.12	0.15
3"	0.10	0.15	0.25
4"	0.13	0.25	0.40
6"	0.30	0.60	0.90
8"	0.50	1.00	1.50
10"	0.75	1.30	2.10
12"	1.10	2.30	3.40
14"	1.40	2.80	4.20
16"	1.70	3.30	5.00
18"	2.20	4.30	6.50
20"	2.80	5.50	8.00
24"	4.50	8.90	13.30

3) Do not exceed a duration of eight (8) hours at 1.5 times the system pressure rating between the initial expansion and test phases combined.

c. Correction:
   1) If pressure test fails due to leakage, equipment failure, etc., depressurize and make repairs as needed. Allow test section to remain depressurized for a minimum of eight (8) hours before retesting.
   2) Leaks at fusion joints must be cut out and re-fused.
   3) Repair and retest as required until leakage is below the maximum allowance.

END OF SECTION 330505.31

SECTION 330505.41 - AIR TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Low-pressure air testing of gravity sewer piping.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT - Not Used

1.3 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Test and Evaluation Reports: Indicate results of piping tests.

C. Qualifications Statement: Submit qualifications for applicator.

PART 2 - PRODUCTS

2.1 AIR TESTING

A. Equipment:

1. Air compressor.
2. Air supply line.
3. Shutoff valves.
4. Pressure regulator.
5. Pressure relief valve.
6. Stopwatch.
7. Plugs.
8. Pressure Gage: Calibrated to 0.1 psi.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that piping is ready for testing.

C. Verify that trenches are backfilled.

3.2 PREPARATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for preparation.

B. Plugs:

1. Plug outlets, wye branches, and laterals.
2. Brace plugs to resist test pressures.

3.3 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.

B. Low-Pressure Air Testing:

1. Test each reach of gravity sewer piping between manholes.
2. Introduce air pressure slowly to approximately 4 psig.
3. Determine ground water elevation above spring line of piping.
4. For every foot of ground water above spring line of piping, increase starting air test pressure by 0.43 psi.
5. Do not increase pressure above 10 psig.
6. Allow pressure to stabilize for at least five minutes.
7. Adjust pressure to 3.5 psig or to increased test pressure as determined above when ground water is present.
8. Do not make allowance for laterals.
9. Minimum Testing Duration:

Pipe Diameter, in.	Minimum time, min:s	Length for Minimum Time, ft	Time for Longer Length,s	Specification time for Length (L) shown, min:s							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	0.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:59	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46
42	39:48	57	41.883 L	69:48	104:42	139:37	174:30	209:24	244:19	279:13	314:07
48	45:34	50	54.705 L	91:10	136:45	182:21	227:55	273:31	319:06	364:42	410:17
54	51:02	44	69.236 L	115:24	173:05	230:47	288:29	346:11	403:53	461:34	519:16
60	56:40	40	85.476 L	142:28	213:41	284:55	356:09	427:23	498:37	569:50	641:04

10. Record drop in pressure during testing period.
11. If air pressure drops more than 1.0 psi during testing period, piping has failed.
12. If 1.0-psi air pressure drop has not occurred during testing period, piping is acceptable; discontinue testing.
13. If piping fails, test reach of piping in incremental stages until leaks are isolated, repair leaks, and retest entire reach between manholes.
14. If unsatisfactory testing results are achieved, make necessary repairs and retest until result meets criteria.
15. Repair visible leaks regardless of quantity of leakage.

END OF SECTION 330505.41

SECTION 330505.43 - MANDREL TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Deflection testing of plastic/flexible sewer piping.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT - Not Used

1.3 REFERENCE STANDARDS

A. ASTM International:

1. ASTM D2122 - Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Submit following items prior to start of testing:

1. Testing procedures.
2. List of test equipment.
3. Testing sequence schedule.
4. Provisions for disposal of flushing and test water.
5. Certification of test gage calibration.
6. Deflection mandrel drawings and calculations.

C. Test and Evaluation Reports: Indicate results of piping tests.

PART 2 - PRODUCTS

2.1 DEFLECTION TESTING

A. Equipment:

1. "Go, No Go" mandrel.
2. Pull/retrieval ropes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that piping is ready for testing.

C. Verify that trenches are backfilled.

3.2 PREPARATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for preparation.

B. Plugs:

1. Plug outlets, wye branches, and laterals.
2. Brace plugs to resist test pressures.

3.3 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.

B. Deflection Testing of Plastic/Flexible Sewer Piping:

1. Test all plastic and flexible pipe 8 inches in diameter or larger.
2. Perform vertical ring deflection testing on PVC and ABS sewer piping after backfilling has been in place for at least 30 days, but not longer than 12 months.
3. Allowable maximum deflection for installed plastic sewer pipe is no greater than five percent of original vertical internal diameter.
4. Perform deflection testing using "Go, No Go" mandrel.
5. Mandrel Diameter:
   a. Not less than 95 percent of base or average ID of pipe.
   b. Pipe Diameter: Comply with ASTM D2122.
6. Perform testing without mechanical pulling devices.
7. Locate, excavate, replace, and retest piping that exceeds allowable deflection.

END OF SECTION 330505.43

SECTION 330507 - TRENCHLESS INSTALLATION OF UTILITY PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Casing and carrier pipe.
2. Excavation for approach trenches and pits.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Casing Pipe - <size> - Jack & Bore:

1. Basis of Measurement: By linear foot (LF).
2. Basis of Payment: Includes excavation, shoring, casing pipe, jacking and boring, welding, casing spacers, grout, link seals, end seals, clamps, accessories, backfill, and testing.
    a. No additional compensation for upsizing of casing pipe for alternative piping materials or pipe restraints.

B. Casing Pipe - <size> - Open Cut:

1. Basis of Measurement: By linear foot (LF).
2. Basis of Payment: Includes open cut trench excavation, shoring, casing pipe, welding, casing spacers, grout, link seals, end seals, clamps, accessories, bedding and cover, backfill, and testing.
    a. No additional compensation for upsizing of casing pipe for alternative piping materials or pipe restraints.

1.3 REFERENCE STANDARDS

A. American Railway Engineering and Maintenance-of-Way Association:

1. AREMA - Manual for Railway Engineering.

B. American Welding Society:

1. AWS D1.1/D1.1M - Structural Welding Code - Steel.

C. ASTM International:

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded, and Seamless.

3. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3).
4. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

D. National Utility Contractors Association:

1. NUCA - Guide to Pipe Jacking and Microtunneling Design.

1.4 COORDINATION

A. Section 013000 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with applicable State, County, railroad, and utilities within construction area.

C. As specified in Section 014126.00 - Permit Requirements.

1.5 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information regarding tunnel liner plate, showing sizes, shapes, methods of attachment, connection details, and details of grout holes.

C. Shop Drawings:

1. Submit description of proposed construction plan, dewatering plan, and plan to establish and maintain vertical and horizontal alignments.

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

E. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS qualification within previous 12 months.

F. Submit written report results of visual check of entire length of casing prior to installation of carrier to verify that there are no voids or defective joints.

G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

H. Qualifications Statements:

1. Submit qualifications for installer and licensed professional.
2. Welders: Qualify procedures and personnel according to AWS D1.1/D1.1M.

1.6 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of casing, carrier pipe, and invert elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

A. Perform Work according to AREMA and NUCA standards and guidelines.

B. Obtain occupancy permit when boring, jacking, or tunneling under or within rights-of-way of state and municipal highways and railroads.

C. Maintain one (1) copy of each standard affecting Work of this Section on Site.

1.8 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

B. Welders: AWS qualified within previous 12 months for employed weld types.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

1.10 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 CASING PIPE

A. Steel Casing Pipe:

1. Comply with ASTM A53/A53M.
2. Minimum Yield Strength: 35,000 psi.
3. Minimum Wall Thickness:
    a. Roadway Crossings: Comply with standard steel pipe sizing per ANSI B36.10.
    b. Railroad Crossings: Comply with the following table:

Nominal Diameter (Inches)	Min Thickness for Coated (Inches)	Min Thickness for Non Coated (Inches)
14 and Under	0.188	0.188
16	0.219	0.281
18	0.250	0.312
20 and 22	0.281	0.344
24	0.312	0.375
26	0.344	0.406
28	0.375	0.438
30	0.406	0.469
32	0.438	0.500
34 and 36	0.469	0.531
38, 40 and 42	0.500	0.563
44 and 46	0.531	0.594
48	0.563	0.625
50	0.594	0.656
52	0.625	0.688
54	0.656	0.719
56 and 58	0.688	0.750
60	0.719	0.781
62	0.750	0.813
64	0.718	0.844
66 and 68	0.813	0.875
70	0.844	0.906
72	0.875	0.938

4. Welded Joints:
   a. Comply with AWS D1.1/D1.1M.
   b. Full circumference.
5. Finishes:
   a. Surface Preparation for Internal/External Coatings:
      1) Prepared per the coating manufacturer's instructions prior to coating. This includes but is not limited to, the following steps. This must be done for both the interior and the exterior of the pipe.
         a) Solvent clean per SSPC-SP1
         b) Blast per SSPC-SP10
         c) Clean all blasting debris.
         d) Visually inspect per SSPC-VIS-1-89.
   b. Internal/External Coating Requirements:
      1) In accordance with AWWA C222-08
      2) Coating per the coating manufacturer's instructions
      3) Coating thickness: 25 to 45 mils.
      4) Free of runs, orange peel, lumps, blisters, cracks, and debris when visually inspected.
      5) Coating cutback length to be 4-6 inches on both ends of the pipe to allow for welding.
      6) Over-coating of the pipe is not permitted.
      7) Repair weld joint areas after welding is complete.
   c. Internal/External Coating Material:

1) Shop applied coating: LifeLast DuraShield 210 (or equivalent that meets AWWA C222-08 requirements).
2) For repairs and weld areas: LifeLast DuraShield 210 (or equivalent that meets AWWA C222-08 requirements – must be compatible with shop applied coating).

B. Performance and Design Criteria:

1. Casing Pipe:
   a. Leakproof.
   b. Cathodically protected if required as part of the utility permit.
2. Loading:
   a. Highways:
      1) Earth cover.
      2) H-20 live loading, according to AASHTO HB-17.
      3) Impact loading according to AASHTO HB-17 plus 50 percent.
   b. Railways:
      1) Earth cover.
      2) Comply with AREMA - Manual for Railway Engineering.
      3) Impact loading according to AREMA guidelines plus 50 percent.
3. Bracing, Backstops, and Jacks: Of sufficient rating for continuous jacking without stopping except to add pipe sections, and to minimize tendency of ground material to freeze around casing pipe.

2.2 CARRIER PIPE

A. Piping:

1. Water Distribution Piping:
   a. Restrained joint pipe as specified in Section 331413 - Public Water Utility Distribution Piping.
2. Gravity Sanitary Sewer:
   a. Restrained joint pipe as specified in Section 333111 - Public Sanitary Sewerage Gravity Piping.
3. Sanitary Force Main:
   a. Restrained joint pipe as specified in Section 333123 - Sanitary Sewerage Force Main Piping.

2.3 ACCESSORIES

A. Steel and Plastic Supports and Insulators (spacers):

1. Bands: 14-gage stainless steel.
2. Flange Bolts: 5/16-inch stainless steel.
3. Liner: Heavy-duty PVC.
4. Skids: Polyethylene or phenolic.

B. Steel Strapping: Comply with ASTM A36/A36M.

C. End Seals:

1. Material: Neoprene
2. Types:
   a. Wrap-around with adhesive strip
   b. Seamless (pull-on)
3. Bands: Stainless steel

2.4 MATERIALS

A. Bedding and Cover: Fill Type A2, as specified in Section 310516 - Aggregates for Earthwork.

B. Soil Backfill: Soil Type S1, as specified in Section 310513 - Soils for Earthwork.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that connection, sizes, locations, and invert elevations are as indicated on Drawings.

3.2 PREPARATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation preparation.

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

C. Existing Utilities:

1. Locate and identify utilities indicated to remain and protect from damage.
2. Establish minimum separation

D. Establish elevations of casing as shown on the Drawings.

3.3 INSTALLATION

A. Excavation:

1. Excavate pipe trench as specified in Section 312316.13 - Trenching.
2. Excavate to lines and grades as indicated on Drawings.
3. Dewater excavations to maintain dry conditions and to preserve final grades at bottom of excavation.
4. Provide sheeting and shoring as specified in Section 312316.13 - Trenching.

5. Ensure that casing entrance faces as near perpendicular in alignment as conditions permit.
6. Establish vertical entrance face at least 1 foot above top of casing.

B. Bedding:

1. Place bedding material at trench bottom.
2. Level materials in continuous layers in accordance with the Earthwork and Material Testing Schedule in the Drawings.
3. Compact to percent of maximum density in accordance with the Earthwork and Material Testing Schedule in the Drawings.

C. Casing Pipe:

1. Boring:
   a. Push pipe into ground with boring auger rotating within pipe to remove soil.
   b. Do not advance cutting head ahead of casing pipe, except for distance necessary to permit cutting teeth to maintain clearance for pipe.
   c. Arrange machine bore and cutting head to be removable from within pipe.
   d. Arrange face of cutting head to provide barrier to free flow of soft material.
   e. If unstable soil is encountered during boring, retract cutting head into casing to permit balance between pushing pressure and ratio of pipe advancement to quantity of soil.
   f. Grout to fill voids if voids develop greater than OD of pipe by approximately 1 inch.
   g. If boring is obstructed, relocate jack or tunnel as directed by Engineer.
   h. If boring is abandoned, fully grout hole as approved by the Engineer.
2. Jacking:
   a. Construct adequate thrust wall normal to proposed line of thrust.
   b. Impart thrust load to pipe through suitable thrust ring sufficiently rigid to ensure uniform distribution of thrust load on full pipe circumference.

D. Carrier Pipe:

1. Clean, inspect, and handle pipe as specified in Section 331413 - Public Water Utility Distribution Piping, Section 333111 - Public Sanitary Sewerage Gravity Piping, and Section 333123 - Sanitary Sewerage Force Main Piping.
2. Placement:
   a. Prevent damage to pipe joints as carrier pipe is placed in casing.
3. Supports:
   a. Gravity Pipe:
      1) Support pipeline within casing such that no external loads are transmitted to carrier pipe.
   b. Pressure Pipe:
      1) Fused Joints: Supports are not required.
      2) External or integral bell restraints: Support pipeline within casing such that no external loads are transmitted to carrier pipe.
4. Install casing end seals per manufacturers recommendations.

E. Backfilling:

1. Backfill around sides and to top of pipe with cover fill, tamp in place, and compact.

2. Place and compact material immediately adjacent to pipes to avoid damage to pipe and prevent pipe misalignment.
3. Maintain optimum moisture content of bedding material as required to attain specified compaction density.

F. Pressure Grouting:
   a. Pressure grout the annular space between casing pipe and surround earth if required as part of the utility permit.

3.4 TOLERANCES

A. Section 014000 - Quality Requirements: Requirements for tolerances.

B. Excavation: Do not overcut excavation by more than 1 inch greater than OD of casing pipe.

C. Casing Pipe alignment prior to installation of carrier pipe:

1. Vertical: Plus or minus 1 inch
2. Horizontal: Plus or minus 3 inches

D. Pipe Bells: Minimum 1 inch clearance to interior of casing pipe.

3.5 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.

B. Pipe and Material Testing:

1. Compaction Testing:
   a. As specified in Section 312316.13 - Trenching and in accordance with the Drawings.
2. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

3.6 CLEANING

A. Section 017000 - Execution and Closeout Requirements: Requirements for cleaning.

B. Remove temporary facilities for casing installation and jacking operations.

END OF SECTION 330507

SECTION 330507.13 - UTILITY DIRECTIONAL DRILLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Horizontal directional drilling.
2. Piping.
3. Drilling fluid system.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Directional Drilling:

1. Basis of Measurement: By linear foot (LF).

Basis of Payment: Includes existing utility potholing, excavation, drilling trench, shoring, drilling, pipe, fittings, accessories, trace wire, thrust restraints, bedding, cover, backfill, compaction, and testing.

1.3 REFERENCE STANDARDS

A. ASTM International:

1. ASTM F1962 - Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings.

B. North American Society for Trenchless Technology:

1. NASTT - Horizontal Directional Drilling Good Practices Guidelines.

C. Plastics Pipe Institute:

1. PPI TR-46 - Guidelines for Use of Mini-Horizontal Directional Drilling for Placement of High Density Polyethylene Pipe.

1.4 COORDINATION

A. Section 013000 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with governing jurisdiction and utilities within construction area.

1.5 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Identify source of water used for drilling.
2. Submit copy of approvals and permits for use of water source.

C. Shop Drawings:

1. Submit technical data for equipment, method of installation, and proposed sequence of construction.
2. Include information pertaining to pits, dewatering, method of spoils removal, and equipment size, capacity, and capabilities, including installing pipe on radius, type of drill bit, drilling fluid, method of monitoring line and grade, detection of surface movement, name plate data for drilling equipment, and mobile spoils removal unit.

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

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

F. Qualifications Statement: Submit qualifications for driller.

1.6 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents:

1. Record actual locations of pipe and invert elevations.
2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
3. Record actual depth of pipe at 25-foot intervals.
4. Record actual horizontal location of installed pipe.
5. Show depth and location of abandoned bores.
6. Record depth and location of drill bits and drill stems not removed from bore.

1.7 QUALITY ASSURANCE

A. Perform Work according to following:

1. NASST - Horizontal Directional Drilling Good Practices Guidelines.
2. ASTM F1962.
3. PPI TR-46.

1.8 QUALIFICATIONS

A. Driller: Company specializing in performing Work of this Section with minimum three years' documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

1.10 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 HORIZONTAL DIRECTIONAL DRILLING

A. Performance and Design Criteria:

1. Drilling Steering System: Remote with continuous electronic monitoring of boring depth and location.
2. Directional Change Capability: Do not exceed maximum allowable curvature or bending radius as recommended by manufacturer.
3. Ratio of Reaming Diameter to Pipe OD:
   a. Nominal Pipe Diameter of 6 Inches and Smaller: Maximum of 1.5.
   b. Nominal Pipe Diameter Larger than 6 Inches: Submit recommended ratio and reaming procedures for review by Engineer.

B. Piping:

1. Water Distribution Piping: Restrained joint pipe as specified in Section 331413 - Public Water Utility Distribution Piping.

2. Water Service Lines: Polyethylene (PE) pipe as specified in Section 331416 - Site Water Service Utility Laterals.

3. Gravity Sanitary Sewer: Restrained joint pipe as specified in Section 333111 - Public Sanitary Sewerage Gravity Piping.

4. Sanitary Force Main: Restrained joint pipe as specified in Section 333123 - Sanitary Sewerage Force Main Piping.

C. Installation Requirements:

1. Consider classifications and ratings given as minimums.
2. Increase minimum pipe thicknesses if required by pull-in forces or other installation forces if such forces exceed supplier's recommended guidelines.
3. All drilled piping to provide fused or restrained joints.
4. All connections from drilled pipe to trenched pipe to be restrained.

D. Trace Wire: As specified in Section 330597 - Identification and Signage for Utilities.

2.2 MATERIALS

A. Bedding and Cover: Fill Type A2, as specified in Section 310516 - Aggregates for Earthwork.

B. Soil Backfill: Soil Type S1, as specified in Section 310513 - Soils for Earthwork.

C. Water Source: Portable.

D. Drilling Fluid: Liquid bentonite clay slurry; totally inert with no environmental risk.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that connections to existing piping system, pipe sizes, locations, and invert centerline elevations are according to Drawings.

3.2 PREPARATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Local Utility:

1. Call local utility line information service not less than two working days before performing Work.
2. Request underground utilities to be located and marked within and surrounding construction areas.

C. Maintain access to existing facilities indicated to remain; modify pipe installation indicated on Drawings to maintain access to existing facilities.

D. Locate and identify utilities indicated to remain and protect from damage.

1. Verify adequate separation from existing utility pipes (sanitary sewer mains, sewer services, storms sewer) is maintained to prevent damage during installation.

2. Contractor may adjust depths accordingly after requesting approval from Engineer.

E. Identify required lines, levels, contours, and data locations.

3.3 INSTALLATION

A. Dewatering:

1. Intercept and divert surface drainage, precipitation, and ground water away from excavation using dikes, curb walls, ditches, pipes, sumps, or other approved means.
2. Develop and maintain substantially dry subgrade during drilling and pipe installation.

B. Excavation:

1. Excavate subsoil as specified in Section 312316.13 - Trenching.
2. Excavate approach trenches and pits as Site conditions require; minimize number of access pits.
3. Provide sump areas to contain drilling fluids.
4. Install excavation supports as specified in Section 312316.13 - Trenching.
5. Restore areas after completion of drilling and carrier pipe installation.

C. Drilling:

1. Drill pilot bore with vertical and horizontal alignment as indicated on Drawings.
2. Surveying:
   a. Survey entire drill path and mark entry and exit locations with stakes.
   b. If a magnetic guidance system is used, survey drill path for surface geomagnetic variations or anomalies.
3. Guiding:
   a. Guide drill remotely from ground surface to maintain alignment by monitoring signals transmitted from drill bit.
   b. Monitor depth, pitch, and position.
   c. Adjust drill head orientation to maintain correct alignment.
4. Drilling Fluid:
   a. Inject drilling fluid into bore to stabilize hole, remove cuttings, and lubricate drill bit and pipe.
   b. Continuously monitor drilling fluid pumping rate, pressure, viscosity, and density while drilling pilot bore, back reaming, and installing pipe to ensure adequate removal of soil cuttings and stabilization of bore.
   c. Provide relief holes when required to relieve excess pressure.
   d. Minimize heaving during pullback.
5. Verification of Accuracy:
   a. Calibrate and verify electronic monitor accuracy during first 50 feet of bore in presence of Engineer before proceeding with other drilling.
   b. Excavate minimum of four test pits spaced along first 50 feet of bore to verify required accuracy.
   c. If required accuracy is not met, adjust equipment or provide new equipment capable of meeting required accuracy.
6. After completing pilot bore, remove drill bit.

D. Drilling Obstructions:

1. Notify Engineer if obstructions are encountered during drilling.
2. Do not proceed around obstruction without approval from Engineer.
3. For conditions requiring more than 3 feet of deviation in horizontal alignment, submit revised Shop Drawings to Engineer for approval before resuming Work.

E. Piping:

1. Maintain 10 feet of horizontal separation between water main and sewer piping.
2. Install reamer and pipe pulling head; select reamer with minimum bore diameter required for pipe installation.
3. Attach pipe to pipe pulling head and pull reamer and pipe to entry pit along pilot bore.
4. Inject drilling fluid through reamer to stabilize bore and lubricate pipe.
5. Install piping with horizontal and vertical alignment as shown on Drawings.
6. Protect and support pipe being pulled into bore such that pipe moves freely and is not damaged during installation.
7. Do not exceed pipe manufacturer's recommended pullback forces.
8. Trace Wire as specified in Section 330597 - Identification and Signage for Utilities:
    a. Install trace wire continuous with each bore.
    b. Splice trace wire only at intermediate bore pits.
    c. Tape or insulate trace wire to prevent corrosion and maintain integrity of pipe detection.
    d. Terminate trace wire for each pipe run at structures along pipe system.
    e. Provide extra length of trace wire at each structure such that trace wire can be pulled 3 feet out top of structure for connection to detection equipment.
    f. Test trace wire for continuity for each bore before acceptance.
9. Provide sufficient length of pipe to extend past termination point to allow connection to other pipe sections.
10. Allow minimum of 24 hours for stabilization after installing pipe before making connections to pipe.
11. Mark location and depth of bore with spray paint on paved surfaces and on wooden stakes on non-paved surfaces at 25 foot intervals.

F. Slurry Removal and Disposal:

1. Contain excess drilling fluids at entry and exit points until recycled or removed from Site; provide recovery system to remove drilling spoils from access pits.
2. Drilling Spoils:
    a. Remove, transport, and legally dispose of drilling spoils.
    b. Do not discharge drilling spoils in sanitary sewers, storm sewers, or other drainage systems.
    c. When drilling in suspected contaminated soil, test drilling fluid for contamination before disposal.
3. If drilling fluid leaks to surface, immediately contain leak and barricade area from vehicular and pedestrian travel before resuming drilling operations.
4. Complete cleanup of drilling fluid at end of each working day.

G. Backfilling:

1. Install backfill as specified in Section 312316.13 - Trenching.

H. Restoration:

1. Repair any damage caused to the surface (concrete, asphalt, ditch bottoms, etc.) due to ground heaving during drilling operations and installation.

3.4 TOLERANCES

A. Section 014000 - Quality Requirements: Requirements for tolerances.

B. Maximum Variation from Horizontal Position: 12 inches.

C. Maximum Variation from Vertical Elevations: 3 inches.

1. Maintain minimum depth specified or as shown on the Drawings.

D. Minimum Horizontal and Vertical Clearance from Other Utilities: 24 inches or as required to prevent damage, whichever is greater.

E. Deviation:

1. If pipe installation deviates beyond specified tolerances, abandon bore, remove installed pipe, rebore, and reinstall pipe in correct alignment.
2. Fill abandoned bores greater than 3 inches in diameter with grout or flowable fill material.

3.5 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.

B. Certify that equipment for drilling has been properly set up and is ready for drilling.

C. Pipe and Material Testing:

1. Pressure Testing:
   a. As specified in Section 330505.31 - Hydrostatic Testing or 330505.41 - Air Testing.
2. Deflection Testing:
   a. As specified in Section 330505.43 - Mandrel Testing.
3. Televising:
   a. As specified in Section 330130.11 - Televising Inspection of Sewer.
4. Compaction Testing:
   a. As specified in Section 312316.13 - Trenching and in accordance with the Earthwork and Material Testing Schedule in the Drawings.
5. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

3.6 CLEANING

A. Section 017000 - Execution and Closeout Requirements: Requirements for cleaning.

B. Upon completion of drilling and pipe installation, remove drilling spoils, debris, and unacceptable material from approach trenches and pits.

C. Clean up excess slurry from ground.

D. Restore approach trenches and pits to original condition.

END OF SECTION 330507.13

SECTION 330509.33 - THRUST RESTRAINT FOR UTILITY PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanical Joint Restraint.
2. Concrete Thrust Blocking.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT - Not Used

1.3 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA C110 - Ductile Iron and Gray Iron Fittings.
2. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

B. ASME International:

1. ASME B1.1 - Unified Inch Screw Threads, UN and UNR Thread Form.

C. ASTM International:

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
5. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
6. ASTM A536 - Standard Specification for Ductile Iron Castings.
7. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
8. ASTM A588/A588M - Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi Minimum Yield Point, with Atmospheric Corrosion Resistance.
9. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
10. ASTM E8 - Tension Testing of Metallic Materials.
11. ASTM F436 - Standard Specification for Hardened Steel Washers.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

1.5 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of joint restraints.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

1.7 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MECHANICAL JOINT RESTRAINTS

A. Manufacturer:

1. Megalug by EBBA Iron, Inc.,
2. One-Lok by Sigma,
3. Or Approved Equal.

B. Tees, Caps, and Couplings:

1. Manufacturer:
   a. Romac Industries, Inc.
      1) Tee: Alpha Tee
      2) Cap: Alpha EC
      3) Coupling: Alpha
   b. Or Approved Equal.

C. Bends and Valves:

1. Manufacturer:
   a. Megalug by EBBA Iron, Inc.
   b. ONE-LOK by Sigma

c. Or Approved Equal.

D. Design:

1. Consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ASNI/AWWA C110/A21.10 for nominal pipe sizes 3 inch through 36 inch.
2. Include a minimum safety factor of 2:1 in all sizes for rating for water pressure.

E. Material:

1. Cast from grades 65-45-12 ductile iron material in accordance with ASTM A536 for gland body, wedges and wedge actuating components.

F. Coating:

1. Consist of a minimum of two coats of liquid thermoset epoxy coating with heat cure to follow each coat.
2. Surface pretreated with a phosphate wash, rinse and sealer before drying.
3. Electrostatically applied and heat cured.
4. Polyester based power to provide corrosion, impact and UV resistance.

G. Approvals:

1. Listed by Underwriters Laboratories in the 4 inch through 12 inch sizes.
2. Factory Mutual Approved in the 4 inch through 12 inch sizes.
3. Meet or exceed the requirements of ASTM F1674 of the latest revision for Mechanical Joint Restraints, 4 inch through 24 inch.

2.2 CONCRETE THRUST BLOCKS

A. Compressive Strength: 4000 psi at 28 days.

B. Required Bearing Area: As indicated on Drawings.

2.3 MATERIALS

A. Steel:

1. High-Strength Low-Alloy Steel: Comply with ASTM A588/A588M, heat treated.
2. High-Strength Low-Alloy Steel: Comply with ASTM A588/A588M.
3. Carbon Steel: Comply with ASTM A36/A36M.

2.4 FINISHES

A. Zinc Plating:

1. Factory applied.

2. Comply with ASTM B633.

B. Galvanizing:

1. Factory Applied.
2. Comply with ASTM A153/A153M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that pipe and fittings are ready to receive Work.

C. Field measure and verify conditions for installation of Work.

3.2 PREPARATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Clean surfaces of pipe and fittings that are to receive tied joint restraint systems.

3.3 INSTALLATION

A. According to AWWA C600.

B. Install joint restraint system such that joints are mechanically locked together to prevent joint separation.

C. Install concrete thrust blocks according to the Drawings.

D. Install mechanical joint restraint by conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly. Ensure proper actuation of the gripping wedges with torque limiting twist off nuts.

3.4 TOLERANCES

A. Section 014000 - Quality Requirements: Requirements for tolerances.

B. In accordance with manufacturer’s recommendations and instructions.

END OF SECTION 330509.33

SECTION 330561 - PRECAST CONCRETE STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manholes for sanitary sewer and storm sewer collection systems.
2. Catch Basins and Inlets for storm sewer collection systems.
3. Modular precast concrete manholes and structures with tongue-and-groove joints and masonry transition to cover frame, covers, anchorage, and accessories.
4. Vertical adjustment of existing manholes and structures.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Sanitary Sewer Manhole:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, aggregate base, monolithic concrete base, concrete structure sections, adjusting rings, frame and cover, chimney seal, interior coatings, forming and sealing of pipe inlets and outlets, trace wire, backfill, compaction, testing, and final adjustment.

B. Sanitary Sewer Manhole - Internal Drop:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, aggregate base, monolithic concrete base, concrete structure sections, interior drop and piping, adjusting rings, frame and cover, chimney seal, interior coatings, forming and sealing of pipe inlets and outlets, trace wire, backfill, compaction, testing, and final adjustment.

C. Sanitary Sewer Manhole - External Drop:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, aggregate base, monolithic concrete base with precast exterior drop elbow, concrete structure sections, exterior drop piping and accessories, adjusting rings, frame and cover, chimney seal, interior coatings, forming and sealing of pipe inlets and outlets, trace wire, backfill, compaction, testing, and final adjustment.

D. Storm Sewer Manhole:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, aggregate base, concrete base, concrete structure sections, manhole cover slab, adjusting rings, frame and cover, grouting,

chimney seal, forming and sealing of pipe inlets and outlets, backfill, compaction, testing, and final adjustment.

E. Storm Sewer Inlets and Catch Basins:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, aggregate base, single-inlet concrete base, concrete structure sections, adjusting rings, frame and grate, grouting, forming and sealing of pipe inlets and outlets, backfill, compaction, testing, and final adjustment.

F. Storm Sewer Catch Basin - PVC:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, aggregate base, plastic catch basin assembly, adjusting rings, frame and grate, backfill, compaction, testing, and final adjustment.

G. Storm Sewer Control/Outfall Structure:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, aggregate base, concrete base, concrete structure, cover slab, frame and hatch, weir walls (when indicated), slide/flap gates (when indicated), forming and sealing of pipe inlets and outlets, backfill, and compaction.

H. Manhole Structure - Adjust:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, removal of existing frame and cover, adding or removing concrete structure sections and/or saw cutting concrete structure sections, joint sealant, reinstalling existing frame and cover, riser rings, chimney seal, backfill, compaction, testing, and final adjustment.

1.3 REFERENCE STANDARDS

A. American Association of State Highway Transportation Officials:

1. AASHTO M306 - Standard Specification for Drainage, Sewer, Utility, and Related Castings.

B. ASTM International:

1. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM C361 - Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.
4. ASTM C478 - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.

5. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
6. ASTM D648 - Test Method for Deflection Temperature of Plastics Under Flexural Load in Edgewise Position.
7. ASTM D2584 - Test Method for Ignition Loss of Cured Reinforced Resins.
8. ASTM C877 - Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections.
9. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
10. ASTM C923 - Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
11. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
12. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
13. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

1.4 COORDINATION

A. Section 013000 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with connection to municipal sewer utility service and trenching.

1.5 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information for manhole covers, component construction, features, configuration, and dimensions.

C. Shop Drawings:

1. Indicate structure locations and elevations.
2. Indicate sizes and elevations of piping, and penetrations.

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

E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

1.6 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of manholes and connections, and record invert elevations.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Handling: Comply with precast concrete manufacturer instructions and ASTM C913 for unloading and moving precast manholes and drainage structures.

D. Storage:

1. Store materials according to manufacturer instructions.
2. Store precast concrete manholes and drainage structures to prevent damage to Owner's property or other public or private property.
3. Repair property damaged from materials storage.

PART 2 - PRODUCTS

2.1 CONCRETE MANHOLES, INLETS, AND CATCH BASINS

A. Manufacturers:

1. Rinker Materials
   19500 State Highway 249, Suite 540
   Houston, TX 77070
2. Oldcastle Infrastructure
   17 Atlantic Avenue
   Hancock, MN 562444
3. Or Approved Equal.

B. Manhole and Inlet Sections:

1. Materials:
   a. Reinforced Precast Concrete: Comply with ASTM C478.
   b. Gaskets: Comply with ASTM C923.
2. Joints:
   a. Comply with ASTM C913.
   b. Maximum Leakage: 0.025 gal. per hour per foot of joint at 3 feet of head.
3. Top Section:
   a. Sanitary: Eccentric Cone or as indicated on the Drawings.
   b. Storm: Eccentric Cone, Flat Top, or as indicated on the Drawings.

4. Base:
    a. Sanitary: Monolithic precast with shaped flow channels and bench.
    b. Storm: Precast base with cast-in-place inverts.
5. Shape: Cylindrical, rectangular, or as shown on the Drawings.
6. Dimensions: As indicated on the Drawings.

C. Structure Joint Gaskets:

1. Comply with ASTM C361.
2. Material: Rubber.

2.2 PLASTIC CATCH BASINS

A. Manufacturer:

1. Advanced Drainage Systems, Inc.
   3130 Verona Ave
   Buford, GA 30518
2. Or Approved Equal.

B. Catch Basins

1. Description: Nyloplast.
2. Material: PVC.
3. Size: As indicated on the Drawings.
4. Frame & Grate/Cover: Integral to match catch basin O.D.

2.3 ACCESSORIES

A. Manhole Frames and Covers: As specified in Section 330130.86 - Structure Adjustment.

B. Inlet Frames and Grates: As specified in Section 330130.86 - Structure Adjustment.

C. Frame Adjustment Riser Rings: As specified in Section 330130.86 - Structure Adjustment.

D. Cover Adjustmnet Rings: As specified in Section 330130.86 - Structure Adjustment.

E. Chimney Seal System: As specified in Section 330130.86 - Structure Adjustment.

F. Flexible Pipe Boot For Manhole Pipe Entrances:

1. Manufacturers:
    a. Press-Seal Gasket Corporation
       2424 W State Blvd.
       Fort Wayne, IN 46808
    b. Or Approved Equal.
2. Description:
    a. Comply with ASTM C923

b. Series 300 stainless steel clamps.
c. Series 304 stainless steel hardware.

G. Strap Anchors:

1. Shape: Bent steel.
2. Finish: Stainless

H. Joint Sealant:

1. Internal: Comply with ASTM C361 or C443.
2. External:
   a. Comply with ASTM C877, Type III.
   b. Infi-Shield Gator Wrap or Approved Equal.

2.4 Fasteners: Comply with ASTM F593; stainless steel.

2.5 FINISHES

A. Interior Manhole Coatings:

1. Only required in sanitary sewer manholes or as indicated on the Drawings.
2. Application: Two (2) coats.
3. Type:
   a. Bitumastic 300M by Carboline,
   b. Hi-Build Tnemec-Tar by Tnemec,
   c. Or Approved Equal.

2.6 GROUTING

A. Portland Cement Grout:

1. Portland Cement: Comply with ASTM C150, Type I and II
2. Water: Potable, no impurities
3. Fine Aggregate: Washed natural sand, comply with ASTM C33
4. Strength: 3,000 psi.
   a. Minimum 2,000 psi prior to second day exposure to elements.

B. Non-shrink Cementitious Grout:

1. Description:
   a. Pre-mixed and ready-for-use formulation requiring only addition of water.
   b. Non-shrink, non-corrosive, nonmetallic, non-gas forming, and no chlorides.
2. Performance and Design Criteria:
   a. Certified to maintain initial placement volume or expand after set, and to meet following minimum properties when tested according to CRD-C621 for Type D non-shrink grout:

3. Setting Time:
   a. Initial: Approximately 2 hours.
   b. Final: Approximately 3 hours.
   c. Comply with ASTM C191.
4. Maximum Expansion: 0.10 to 0.40 percent.
5. Compressive Strength:
   a. One-Day: 4,000 psi.
   b. Seven-Day: 7,000 psi.
   c. 28-Day: 10,000 to 10,800 psi.
   d. Comply with CRD-C621

2.7 MATERIALS

A. Structure Base: Fill Type A6, as specified in Section 310516 - Aggregates for Earthwork.

B. Bedding and Cover: Fill Type A2, as specified in Section 310516 - Aggregates for Earthwork.

C. Soil Backfill: Soil Type S1, as specified in Section 310513 - Soils for Earthwork.

2.8 SOURCE QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that items provided by other Sections of Work are properly sized and located.

C. Verify that built-in items are in proper location and are ready for roughing into Work.

D. Verify that excavation base is ready to receive Work and excavations and that dimensions and elevations are as indicated on Drawings.

3.2 PREPARATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Prepare and implement temporary bypass pumping plan on Work involving live sewers. Submit to Engineer for approval.

C. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers as indicated on Drawings to indicate its intended use.

D. Coordinate placement of inlet and outlet pipe or duct sleeves as required by other Sections.

E. Do not install manholes and structures where Site conditions induce loads exceeding structural capacity of manholes or structures.

F. Inspect precast concrete manholes and structures immediately prior to placement in excavation to verify that they are internally clean and free from damage; remove and replace damaged units.

3.3 INSTALLATION

A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface structures or utilities in immediate or adjacent areas.

B. Correct over-excavation under structures with Coarse Aggregate Type A6.

C. Remove large stones or other hard matter impeding consistent backfilling or compaction.

D. Protect manhole from damage or displacement while backfilling operation is in progress.

E. Excavation:

1. As specified in Section 312316.13 - Trenching and in indicated locations and depths.
2. Provide clearance around sidewalls of manhole or structure for construction operations.
3. If ground water is encountered, prevent accumulation of water in excavations; place manhole or structure in dry trench.
4. Where possibility exists of watertight manhole or structure becoming buoyant in flooded excavation, anchor manhole or structure to avoid flotation as approved by Engineer.

F. Precast Concrete Structures:

1. Lift precast components at lifting points designated by manufacturer.
2. When lowering manholes into excavations and joining pipe to units, take precautions to ensure that interior of pipeline and structure remains clean.
3. Assembly:
    a. Assemble multi-section manholes and structures by lowering each section into excavation.
    b. Install rubber gasket joints between precast sections according to manufacturer recommendations.
    c. Lower, set level, and firmly position base section before placing additional sections.
4. Remove foreign materials from joint surfaces and verify that sealing materials are placed properly.
5. Maintain alignment between sections by using guide devices affixed to lower section.

6. Joint sealing materials may be installed on Site or at manufacturer's plant.
7. Verify that installed structures meet required alignment and grade.
8. Pipe connections that are concreted shall be allowed to cure for a minimum of 8 hours prior to backfilling, unless approved by the Engineer. At no time shall backfilling occur before concrete has fully set. Grouted connections that show evidence of backfilling prior to concrete grout setting shall be reset.
9. Grout manhole step holes (storm and sanitary).

G. Adjusting Rings, Riser Rings, Frame, and Covers:

1. As specified in Section 330130.86 - Structure Adjustment.

H. Vertical Adjustment of Existing Manholes and Structures:

1. As specified in Section 330130.86 - Structure Adjustment .

3.4 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.

B. Structure and Material Testing:

1. Leakage Testing:
   a. Maximum Leakage: 0.025 gal. per hour per foot of joint at 3 feet of head.
2. Compaction Testing:
   a. As specified in Section 312316.13 - Trenching and in accordance with the Drawings.
3. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

END OF SECTION 330561

SECTION 330597 - IDENTIFICATION AND SIGNAGE FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Trace wire systems for utilities.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT - Not Used

1.3 REFERENCES

A. ASTM International:

1. ASTM B910/B910M: Standard Specifications for Annealed Copper-Clad Steel Wire.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer catalog information for each specified product.

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

D. Qualifications Statement: Submit qualifications for manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of products installed.

1.6 QUALITY ASSURANCE

A. Trace Wire:

1. Verify all installed trace wire is operational using Owner’s locating equipment or project provided locator.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years' documented experience approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in undamaged, unopened container, bearing manufacturer's original labels. Inspect for damage.

C. Protect materials from damage by storing in a secure location.

1.9 COORDINATION

A. Section 013000 - Administrative Requirements: Requirements for coordination

B. Furnish testing schedule for products requiring Owner testing.

PART 2 - PRODUCTS

2.1 TRACE WIRE

A. Manufacturers:
1. Copperhead Industries, LLC
   PO Box 1081
   Monticello, MN 55362
2. Kris-Tech Wire
   80 Otis Street
   Rome, NY 13441
3. Or Approved Equal.

B. Trace wire for direct bury applications:

1. High-strength copper clad steel (CCS) wire.
2. 450-lb minimum rated break strength.
3. 30 mil HDPE insulation.

C. Trace wire for directional drilling applications:

1. Extra high-strength copper clad steel (CCS) wire.
2. 1150-lb minimum rated break strength.

3. 45 mil HDPE insulation.

D. Trace wire for pipe bursting:

1. 3/16” high-strength stranded copper clad steel (CCS) wire.
2. 4700-lb minimum rated break strength.
3. 50 mil HDPE insulation.

E. Insulation color coded to marked utility according to the American Public Works Association (APWA) uniform color standards.

2.2 SPLICE CONNECTORS

A. Manufacturers:

1. Copperhead Industries, LLC
   PO Box 1081
   Monticello, MN 55362
2. Kris-Tech Wire
   80 Otis Street
   Rome, NY 13441
3. Or Approved Equal.

B. Connectors:

1. Sealant-filled.
2. Designed for direct bury installation in damp, wet, or submersible locations.

2.3 TERMINAL BOXES

A. Manufacturers:

1. Copperhead Industries, LLC
   PO Box 1081
   Monticello, MN 55362
2. Rhino Marking & Protection Systems
   10740 Lyndale Avenue South, Suite 16W
   Bloomington, MN 55420
3. Or Approved Equal.

B. Flush mount terminal boxes:

1. Minimum 12” long, 2-1/2” diameter ABS shaft.
2. Flared shaft bottom.
3. Encapsulated magnet or made of ferrous material.
4. Variable size wire terminal blocks beneath lid.
5. Integral direct connection terminal to allow connection of locator without removing the lid.
6. 2 terminals with jumper.

7. Locking cover with pentagonal nut.
8. Lid stamped with utility type and color coded to marked utility according to the American Public Works Association (APWA) uniform color standards.
9. Include 2” cast-iron collar when within concrete driveways or sidewalks.
10. Include 5” cast-iron collar when within roadways.

C. Above grade terminal boxes for hydrants:

1. PVC terminal box with 1” diameter conduit connection.
   a. Glue conduit to terminal box
2. 2 terminals with removable jumper.
3. Minimum 12” flexible liquid-tight, UV resistant, electrical conduit.
4. Color coded to marked utility according to the American Public Works Association (APWA) uniform color standards.

D. Above grade terminal boxes for pipelines:

1. Triangular shaped thermoplastic UV stabilized terminal box.
2. 2 internal terminals with removable jumper.
3. 72” length with 24” bury depth.
4. Warning decal describing marked utility.
5. Color coded to marked utility according to the American Public Works Association (APWA) uniform color standards.

2.4 GROUND ROD

A. Manufacturers:

1. Copperhead Industries, LLC
   PO Box 1081
   Monticello, MN 55362
2. Or Approved Equal.

B. Drive-in type magnesium ground rod.

1. Minimum 1.5-lb magnesium.
2. Minimum 20 feet of factory installed copper clad steel wire.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Trace Wire:

1. Install trace wire in such a manner that allows proper access for connection of line tracing equipment, and successful signal reception of 512Hz frequency without distortion or loss of signal.

2. Install trace wire system as a continuous single wire.
3. Attach trace wire to utility pipes and services at 10 foot intervals using tape or plastic zip ties installed all the way around the utility pipe.
    a. Allow for 1 to 3 inches of slack between the pipe and trace wire at connections to branch lines and service lines.
4. Install mainline pipe trace wire continuously on the south or east side of utility pipes below the spring line, running around or through valves, manholes, or other structures as shown on Drawings.
5. Make all connections between individual trace wires with approved waterproof splice connectors only.
6. Repair immediately any damage occurring during installation of the trace wire using an approved waterproof method.
7. Connect the new and existing trace wires using approved splice connectors where existing trace wire is encountered on an existing utility to be tied into or extended.
8. Leave a 3 foot pigtail of trace wire lay horizontally beyond the pipe where trace wire is to be terminated at a mainline dead end/stub.
    a. Terminate the line by installing an approved splice connector with magnesium ground rod.
9. Install branching mainline, service line, or hydrant lead trace wire as a single continuous wire between the mainline wire and a terminal box as shown in the details.
    a. Connect to the mainline wire with an approved waterproof splice connector without cutting the mainline trace wire.
10. Install trace wire for boring, directional drilling, and pipe bursting applications as one single continuous wire.
11. Install ground rod whenever the line is terminated.
12. Install ground rod vertically and penetrating undisturbed soil.
    a. Ground rods not driven into undisturbed soil will be considered defective work.
13. At dead ends, connect the ground rod leader wire to the trace wire and trim the ground rod leader wire to length.
14. At terminal boxes, connect the ground rod leader wire directly to one of the terminals.
    a. Do not connect the ground rod leader wire directly to the trace wire.

B. Flush-mount terminal boxes:

1. Install flush-mount terminal boxes at finished ground elevations as shown on the Drawings or as directed by the Engineer.
2. Provide 3 feet of extra trace wire in the flush mount terminal box to allow for connection of line tracing equipment.
3. Connect trace wire to flush-mount terminal box cap according to manufacturer’s instructions.

C. Above grade terminal boxes:

1. Install above grade terminal boxes as shown in the drawings and details, or as directed by the Engineer.
2. Provide 12 inches of extra trace wire in the terminal box to allow for connection of line tracing equipment.
3. Connect trace wire to the terminal post according to manufacturer’s instructions.

3.2 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements

B. Prohibited products and methods:

1. Uninsulated trace wire or insulated trace wire using any insulation other than HDPE.
2. Twist on wire nuts or other unapproved connectors.
3. Tape or spray on waterproofing.
4. Any installation involving multiple instances of wire twisted together or in close proximity to one another.
5. Connecting the trace wire to any conductive utilities.
6. Looping, coiling, or kinking the trace wire.
7. Using any other HDPE jacket color than specified by the American Public Works Association (APWA) uniform color standards.
8. Leaving excess trace wire in the trench.
9. Use of connectors in boring, directional drilling, and pipe bursting applications.

C. Post-installation test:

1. Locate all new trace wire installations at 512Hz frequency using either Owner’s provided locator equipment or Contractor’s personal locator.
2. Post-installation testing is to be witnessed by the Contractor, Engineer, or Engineer’s Representative, and Owner as applicable, prior to acceptance of ownership.
3. Perform this verification upon completion of rough grading and again prior to final acceptance of the project.
4. Continuity testing in lieu of line tracing will not be accepted.

END OF SECTION 330597

SECTION 331413 - PUBLIC WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Water main pipe and fittings.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Water Main:

1. Basis of Measurement: By linear foot (LF).
2. Basis of Payment: Includes excavation, hand trimming, pipe, fittings, couplings, thrust restraints, bedding and cover, insulation, trace wire, backfill, compaction, disinfection, and hydrostatic testing.

B. Water Main - Connect to Existing:

1. Basis of Measurements: By each (EA).
2. Basis of Payment: Includes excavating, hand trimming, cleaning and preparing existing pipe, installing couplings, materials, accessories, bedding and cover, backfill, compaction, and disinfection.

1.3 REFERENCE STANDARDS

A. ASTM International:

1. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3).
2. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
3. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
4. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
5. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

B. American Water Works Association:

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings.

4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
6. AWWA C153 - Ductile-Iron Compact Fittings.
7. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances.
8. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.
9. AWWA C606 - Grooved and Shouldered Joints.
10. 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.

C. NSF International:

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.

1.4 COORDINATION

A. Section 013000 - Administrative Requirements: Requirements for coordination.

1.5 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information regarding pipe materials, pipe fittings, and taps.

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

D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

E. Qualifications Statements: Submit qualifications for manufacturer and installer.

1.6 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

A. Perform work in accordance with Ten State Standards.

B. Materials in Contact with Potable Water: Certified according to NSF 60 and 61 and NSF 372. A product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify such products.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience in installation of liner materials.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Storage:

1. Store materials according to manufacturer instructions.
2. Block individual and stockpiled pipe lengths to prevent moving.
3. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.
4. Store PE and PVC materials out of sunlight.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.10 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 WATER MAIN PIPING

A. Ductile-Iron Pipe (DIP):

1. Pipe:
   a. Comply with AWWA C151.
   b. Class 53
2. Material:
   a. Ductile iron
3. Joints:
   a. Type: Mechanical joints.
   b. Comply with AWWA C111.
4. Bituminous Outside Coating:
   a. Comply with AWWA C151.
5. Pipe Mortar Lining:
   a. Comply with AWWA C104.
   b. Thickness: Double.
6. PE Encasement:
   a. Comply with AWWA C105.

B. Polyvinyl Chloride (PVC) Pipe:

1. Pipe:
   a. Comply with AWWA C900
   b. Class: 235.
2. Material:
   a. Cell classification: 12454
3. Joints:
   a. Comply with ASTM D3139 and F477.
   b. Seals: PVC flexible elastomeric.
   c. Solvent-cement couplings are not permitted.

2.2 WATER MAIN PIPING - RESTRAINED JOINTS

A. Polyvinyl Chloride (PVC) Pipe:

1. Pipe:
   a. Comply with AWWA C900.
   b. Class 235.
2. Material:
   a. Comply with ASTM D1784.
   b. Cell Classification: 12454-C.
3. Joints:
   a. Butt Fusion.
   b. Coupled or integral bell, restrained joint (Certa-Lok® RJ/RJIB).
   c. Mechanically locking bell-and-spigot, restrained joint (TerraBrute® CR).

B. High-Density Polyethylene (HDPE) Pipe:

1. Pipe:
   a. Comply with AWWA C906 and ASTM D3350
   b. DR 11 for 200 psig pressure rating.
2. Material:

a. Comply with ASTM D3350 and PE 4710.
b. Cell Classification: 445574-C

3. Joints:
   a. Comply with ASTM D2657.
   b. Butt fusion.
4. End Connection:
   a. Mechanical Joint Restraint Adapter
   b. Provide stainless steel reinforcement rings and all mechanical joint locations.
   c. Restrain all unrestrained joints and fittings in-line with pipe after the End Connection to protect against pullout or disjoining.
5. Fittings:
   a. Comply with AWWA C906, ASTM D2657, and ASTM D3350.
   b. Style: Molded.
6. Upsize pipe diameter one nominal size larger than shown on the Drawings for a PVC equivalent.

2.3 FITTINGS AND COUPLINGS

A. Non-Restrained Fittings:

1. Material:
   a. Ductile-iron
   b. Comply with AWWA C110.
2. Description:
   a. Compatible with PVC and DIP.
3. Compact Fittings:
   a. Comply with AWWA C153.
4. Coating and Lining:
   a. Bituminous Coating: Comply with AWWA C110.
   b. Cement-Mortar Lining: Comply with AWWA C1O4; double thickness
5. Joints:
   a. Type: Mechanical joints.
   b. Comply with AWWA C111.
6. Jackets: PE; comply with AWWA C105.

B. Restrained Fittings:

1. As specified in Section 330509.33 - Thrust Restraint for Utility Piping.

C. Non-Restrained Couplings:

1. Manufacturers:
   a. Macro HP by Romac Industries, Inc.
      1) Sizes: 2” to 12”
   b. Hymax2 by Krausz USA
      1) Sizes: 4” to 12”
   c. Hymax HLD by Krausz USA
      1) Sizes: Greater than 12”
   d. Or Approved Equal.

2. Description:
   a. Two bolt wide-range coupling
   b. Compatible with PVC, DIP, and ACP.
   c. Fusion bonded epoxy coating
   d. Grade C Steel or Ductile Iron
   e. Stainless steel bolts, nuts, and washers

D. Restrained Couplings and Fittings:

1. As specified in Section 330509.33 - Thrust Restraint for Utility Piping.

2.4 MATERIALS

A. Bedding and Cover: Fill Type A2, as specified in Section 310516 - Aggregates for Earthwork.

B. Soil Backfill: Soil Type S1, as specified in Section 310513 - Soils for Earthwork.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that existing utility water main size, location, and invert are as indicated on Drawings.

3.2 PREPARATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Pipe Cutting:

1. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, and remove burrs.
2. Use only equipment specifically designed for pipe cutting; use of chisels or hand saws is not permitted.
3. Grind edges smooth with beveled end for push-on connections.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare pipe connections to equipment with flanges or unions.

3.3 INSTALLATION

A. Excavation:

1. Excavate pipe trench as specified in Section 312316.13 - Trenching.
2. Hand trim for accurate placement of pipe to elevations as indicated on Drawings.
3. Dewater excavations to maintain dry conditions and to preserve final grades at bottom of excavation.
4. Provide sheeting and shoring as specified in Section 312316.13 - Trenching.

B. Bedding:

1. Place bedding material at trench bottom.
2. Level materials in continuous layers in accordance with the Drawings.
3. Compact to percent of maximum density in accordance with the Drawings.

C. Piping:

1. Comply with AWWA C600 and C605.
2. Handle and assemble pipe according to manufacturer instructions and as indicated on Drawings.
3. Steel Rods, Bolts, Lugs, and Brackets: Coat buried steel before backfilling.
4. Maintain 10 feet of horizontal separation between water main and sewer piping.
5. Maintain a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer.
6. Ductile-Iron Piping and Fittings: Comply with AWWA C600.
7. Grooved and Shouldered Pipe Joints: Comply with AWWA C606.
8. Field Welding Materials: Comply with AWWA C206.
9. Flanged Joints: Do not use in underground installations except within structures.
10. Route pipe in straight line, and re-lay pipe that is out of alignment or grade.
11. High Points:
    a. Install pipe with no high points.
    b. If unforeseen field conditions arise that necessitate high points, install air-release valves as directed by Engineer.
12. Bearing:
    a. Maintain bearing along entire length of pipe.
    b. Excavate bell holes to permit proper joint installation.
    c. Do not lay pipe in wet or frozen trench.
13. Prevent foreign material from entering pipe during placement.
14. Allow for expansion and contraction without stressing pipe or joints.
15. Close pipe openings with watertight plugs during Work stoppages.
16. Install access fittings to permit disinfection of water system.
17. Cover:
    a. Establish elevations of buried piping with not less than 7.5 feet of cover.
    b. Measure depth of cover from final surface grade to top of pipe barrel.
18. Trace Wire: As specified in Section 330597 - Identification and Signage for Utilities.

D. Valves and Hydrants: As specified in Section 331419 - Valves and Hydrants for Water Utility Service.

E. PE Encasement:

1. Encase buried iron and piping in PE to prevent contact with surrounding backfill material.
2. Comply with AWWA C105.

3. Terminate encasement 3 to 6 inches above ground where pipe is exposed.

F. Thrust Restraints: As specified in Section 330509.33 - Thrust Restraint for Utility Piping.

G. Service Connections: As specified in Section 331417 - Site Water Service Utility Laterals.

H. Backfilling:

1. Backfill around sides and to top of pipe with cover fill, tamp in place, and compact.
2. Place and compact material immediately adjacent to pipes to avoid damage to pipe and prevent pipe misalignment.
3. Maintain optimum moisture content of bedding material to attain required compaction density.

I. Disinfection of Potable Water Piping Systems: As specified in Section 330110.58 - Disinfection of Water Utility Piping Systems.

3.4 TOLERANCES

A. Section 014000 - Quality Requirements: Requirements for tolerances.

B. Install pipe to indicated elevation within tolerance of 5/8 inch.

3.5 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.

B. Pipe and Material Testing:

1. Pressure Testing:
   a. As specified in Section 330505.31 - Hydrostatic Testing.
2. Compaction Testing:
   a. As specified in Section 312316.13 - Trenching and in accordance with the Earthwork and Material Testing Schedule in the Drawings.
3. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

3.6 PROTECTION

A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION 331413

SECTION 331417 - SITE WATER SERVICE UTILITY LATERALS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Water service lines and fittings.
2. Corporation stops.
3. Curb stops and boxes.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Water Service Line:

1. Basis of Measurement: By linear foot (LF).
2. Basis of Payment: Includes excavation, hand trimming, pipe, fittings, couplings, blocking, bedding and cover, insulation, trace wire, connection to existing service line, backfill and compaction, disinfection, and hydrostatic testing.

B. Corporation Stop & Saddle:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, connection to water main, service saddle, corporation stop, fittings, and accessories.

C. Curb Stop & Box:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, removal of existing curb stop and box, curb stop, curb box and cover, fittings, accessories, blocking, bedding and cover, trace wire, connection to existing service line, backfill and compaction, and final adjustment of curb box.

1.3 REFERENCE STANDARDS

A. ASTM International:

1. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
2. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
3. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3).
4. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

B. American Welding Society:

1. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding.

C. American Water Works Association:

1. AWWA C800 - Underground Service Line Valves and Fittings.
2. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm), for Water Service.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information regarding pipe materials, pipe fittings, corporation stop assemblies, curb stop assemblies, meters, service saddles, and accessories.

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

D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

F. Qualifications Statement: Submit qualifications for manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of piping mains, curb stops, connections, thrust restraints, pressure-pipe centerline elevations, and gravity-pipe invert elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with Ten State Standards.

B. Materials in Contact with Potable Water: Certified according to NSF 60 and 61 and NSF 372. A product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify such products.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Storage:

1. Store materials according to manufacturer instructions.
2. Block individual and stockpiled pipe lengths to prevent moving.
3. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.
4. Store PE and PVC materials out of sunlight.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 WATER PIPING AND FITTINGS

A. Copper Tubing:

1. Comply with ASTM B88.
2. Type: K, annealed.
3. Fittings:
   a. Cast copper; ASME B16.18
   b. Wrought copper; ASME B16.22.
4. Joints: Compression.

B. Polyethylene (PE) Pipe:

1. Comply with AWWA C901, ASTM D2239, SIDR **7**, PE4710
2. Fittings:
   a. Type: Molded.
   b. Comply with AWWA C901.
3. Joints: Compression.

C. PEXa Pipe:

1. Comply with AWWA C904, ASTM F876, SDR 9, and CSA B137.5.Type: Molded.
   a. Certified to NSF/ANSI Standards 14 and 61 (NSF-pw-g) for potable water applications.Joints: Compression.
   b. Certified to PPI TR-3 Category 3306 for long-term hydrostatic strength, chlorine and UV resistance.

c. Co-extruded UV Shield made from UV-resistant high-density polyethylene, color Blue.
d. Minimum recommended UV exposure time of one (1) year when tested in accordance with ASTM F2657.
e. Pressure-rated for continuous use at 200 psi @ 73.4 °F based on a 0.63 design factor.
f. Approved by manufacturer for use with manual plastic pipe squeeze-off tools for temporary stoppage of flow.

2. Fittings:
   a. Type: Molded.
   b. Comply with AWWA C904, and be recommended for use by the fitting manufacturer for CTS SDR 9 PEXa pipe.
3. Joints: Compression.
   a. Compression fittings shall be used for all water services 2 inches in diameter or smaller (copper and PEX). Compression fittings shall be Mueller 110 Compression, Ford Quick Joint, A.Y. McDonald McQuik, or approved equal.

Underground fittings and insert-stiffeners used with PEX pipe must comply with the material and performance requirements of ANSI/AWWA C800 and must be recommended for use by the fitting manufacturer for CTS SDR9 PEX pipe per the ANSI/AWWA C904 standard. Insert-stiffeners shall be stainless steel.

2.2 CORPORATION STOP ASSEMBLIES

A. Manufacturers:
1. A.Y. McDonald Mfg. Co.
   PO Box 508
   Dubuque, IA 52004
2. Ford Meter Box Company, Inc.
   775 Manchester Avenue
   Wabash, Indiana 46992
3. Or Approved Equal.

B. Corporation Stops:

1. Comply with ASTM B62.
2. Body: Brass or red brass alloy.
3. Inlet End: Threaded for tapping according to AWWA C800.
4. Outlet End: Suitable for service pipe specified.
5. Copper Services: ¾” and 1”
   a. Flared or compression style plug corporations
      1) A.Y. McDonald 4701 and 4701-22 series,
      2) Ford F600 and F1000 series,
      3) Or Approved Equal.
6. Copper Services: 1 ½” and 2”
   a. Ball corporation style either flared or compression
      1) McDonald 4704B and 4704B-22 Series,
      2) Ford FB700 and FB1100 series,
      3) Or Approved Equal.

7. Polyethylene Services: ¾" and 1"
   a. Compression style
      1) McDonald 4701-33 series,
      2) Ford F1001 series,
      3) Or Approved Equal.
   b. Use of the proper size of insert stiffeners is required for compression corporations for polyethylene.
8. Polyethylene Services: 1 ½" and 2"
   a. Compression ball type
      1) McDonald 4704B-33,
      2) Ford BF1101 series,
      3) Or Approved Equal.
   b. Use of the proper size of insert stiffeners is required for compression corporations for polyethylene.

C. Service Saddles:

1. Description:
   a. Double strap, gasketed, full width sleeve with integral tapped outlet.
2. Material:
   a. Stainless steel.
3. PVC & DIP mains:
   a. Ford FS313,
   b. PowerSeal 3412AS,
   c. Romac 306,
   d. Or Approved Equal.
4. HDPE mains:
   a. Fused service saddle;
   b. Ford FSP313,
   c. PowerSeal 3412AS-PE,
   d. Romac 306-H,
   e. Or Approved Equal.

2.3 CURB STOP ASSEMBLIES

A. Manufacturers:

1. A.Y. McDonald Mfg. Co.
   PO Box 508
   Dubuque, IA 52004
2. Ford Meter Box Company, Inc.
   775 Manchester Avenue
   Wabash, Indiana 46992
3. Or Approve Equal.

B. Curb Stops:

1. Body: Brass or red brass alloy.
2. Comply with ASTM B62.

3. Valve Type: Ball.
4. Sealing: Positive pressure.
5. Curb stops for copper services:
    a. Flared or compression
    b. McDonald 6104 and 6104-22 series,
    c. Ford B22 or B44 series,
    d. Or Approved Equal.
6. Curb stops for polyethylene services:
    a. McDonald 6104-33,
    b. Ford B66 series,
    c. Or Approved Equal.
    d. Use of proper size of insert stiffeners is required for compression joints for polyethylene.
7. Stationary Operating Rod (Valve Stem Extension):
    a. Material: Carbon Steel, Grade 1010, ASTM A510
    b. Coating: Black Dip
    c. Length: Needed to achieve elevation 24 to 30 inches below bottom of box cover.
    d. Centering plate
    e. Provide one (1) rod key: 22 inch.

C. Curb Boxes and Covers:

1. Body: Cast iron.
2. Type: Extension.
3. Base: Minneapolis.
4. Cover:
    a. Plug: Pentagonal.
    b. Inscription: WATER

2.4 CASTINGS

A. Manufacturers

1. AY McDonald: Model 74M1A
2. Ford Meter Box Company: Meter Box Cover – A1 Style

2.5 MATERIALS

A. Bedding and Cover: Fill Type A2, as specified in Section 310516 - Aggregates for Earthwork.

B. Soil Backfill: Soil Type S1, as specified in Section 310513 - Soils for Earthwork.

2.6 ACCESSORIES

A. Tracer Wire: As specified in Section 330597 - Identification and Signage for Utilities.

B. Thrust Restraints: As specified in Section 330509.33 - Thrust Restraint for Utility Piping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that building service connections and municipal utility water main sizes, locations, and inverts are as indicated on Drawings.

3.2 PREPARATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Pipe Cutting:

1. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, and remove burrs.
2. Use only equipment specifically designed for pipe cutting; use of chisels or hand saws is not permitted.
3. Grind edges smooth with beveled end for push-on connections.

C. Remove scale and dirt from inside and outside of piping before assembly.

D. Prepare pipe connections to equipment with flanges or unions.

3.3 INSTALLATION

A. Excavation:

1. Excavate pipe trench as specified in Section 312316.13 - Trenching.
2. Hand trim for accurate placement of pipe to elevations as indicated on Drawings.
3. Dewater excavations to maintain dry conditions and to preserve final grades at bottom of excavation.
4. Provide sheeting and shoring as specified in Section 312316.13 - Trenching.

B. Corporation Stop Assemblies:

1. Make connection for each different kind of water main, using suitable materials, equipment, and methods as approved by Engineer.
2. Provide service clamps for mains constructed of materials other than cast iron or ductile iron.
3. Location:
   a. Screw corporation stops directly into tapped and threaded iron main at 10- and 2-o'clock positions along main's circumference.
   b. Locate and stagger corporation stops at least 12 inches apart longitudinally.
4. Plastic Pipe Mains:

a. Provide full support for service clamp for full circumference of pipe, with minimum 2-inch width of bearing area.
b. Exercise care against crushing or causing other damage to mains at time of tapping or installation of service clamp or corporation stop.

5. Use seals or other devices such that no leaks are present in mains at points of tapping.
6. Do not backfill and cover service connections until installation has been approved by Engineer.

C. Bedding:

1. Place bedding material at trench bottom.
2. Level materials in continuous layers in accordance with the Drawings.
3. Compact to percent of maximum density in accordance with the Drawings.

D. Pipe and Fittings:

1. Comply with AWWA C800.
2. Handle and assemble pipe according to manufacturer instructions and as indicated on Drawings.
3. Maintain 10 feet of horizontal separation between water main and sewer piping.
4. Maintain a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer.
5. Allow for expansion and contraction without stressing pipe or joints.
6. Install access fittings to permit disinfection of water system.
7. Prevent foreign material from entering pipe during placement.
8. Cover:
   a. Establish elevations of buried piping with not less than 7.5 feet of cover.
   b. Measure depth of cover from final surface grade to top of service line piping.
9. Trace Wire: As specified in Section 330597 - Identification and Signage for Utilities.

E. Curb Stop Assemblies:

1. Set curb stops on solid bearing.
2. Boxes:
   a. Center and plumb curb boxes over curb stops.
   b. Set box cover flush with finished grade.

F. Service Connections:

1. Install water service as indicated on the Drawings.

G. Backfilling:

1. Backfill around sides and to top of pipe with cover fill, tamp in place, and compact.
2. Place and compact material immediately adjacent to pipes to avoid damage to pipe and prevent pipe misalignment.
3. Maintain optimum moisture content of bedding material to attain required compaction density.

H. Castings

1. Install castings as indicated on the Drawings and where curb stop boxes are located within pavement.

I. Disinfection of Potable Water Piping Systems: As specified in Section 330110.58 - Disinfection of Water Utility Piping Systems.

3.4 TOLERANCES

A. Section 014000 - Quality Requirements: Requirements for tolerances.

B. Install pipe to indicated elevation to within tolerance of 5/8 inch.

3.5 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.

B. Pipe and Material Testing:

1. Pressure Testing:
   a. As specified in Section 330505.31 - Hydrostatic Testing.
2. Compaction Testing:
   a. As specified in Section 312316.13 - Trenching and in accordance with the Drawings.
3. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

3.6 PROTECTION

A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION 331417

SECTION 331419 - VALVES AND HYDRANTS FOR WATER UTILITY SERVICE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gate valves and valve boxes.
2. Fire hydrants.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Hydrant - 6”:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, hydrant, bedding, thrust blocking, drainage aggregate, geosynthetics, trace wire, accessories, flag marker, backfill, compaction, and testing.

B. Yard Hydrant:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, yard hydrant, bedding, thrust blocking, drainage aggregate, geosynthetics, trace wire, accessories, backfill, compaction, and testing.

C. Hydrant - Extension:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes removal of hydrant from standpipe, installation of barrel extension, re-installation of hydrant, trace wire, accessories, backfill, compaction, and testing.

D. Hydrant - Remove & Reinstall:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, removal of existing hydrant in its entirety, re-installation of hydrant, bedding, thrust blocking, drainage aggregate, geosynthetics, trace wire, accessories, backfill, compaction, and testing.

E. Gate Valve & Box:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, gate valve, valve box and cover, thrust blocking, trace wire, accessories, bedding, backfill, compaction, and final adjustment.

F. Gate Valve Box - Replace:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, removal of existing valve box, new valve box sections, cover, backfill, compaction, and final adjustment.

G. Tapping Sleeve & Valve:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, tapping sleeve, gate valve, tapping of existing main, valve box and cover, thrust blocking, trace wire, accessories, bedding, backfill, compaction, and final adjustment.

1.3 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA C502 - Dry-Barrel Fire Hydrants.
2. AWWA C515 - Resilient-Seated Gate Valves for Water Supply Service.
3. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.

B. National Fire Protection Association:

1. NFPA 291 - Recommended Practice for Fire Flow Testing and Marking of Hydrants.

C. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP-60 - Connecting Flange Joints between Tapping Sleeves and Tapping Valves.

D. NSF International:

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.

1.4 COORDINATION

A. Section 013000 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with installation of water mains.

1.5 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information regarding component materials, fittings, assembly and parts diagram, and accessories.

1.6 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of valves and hydrants.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for maintenance materials.

1.8 QUALITY ASSURANCE

A. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.

B. Cast manufacturer's name, pressure rating, and year of fabrication into valve body.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Delivery:

1. Seal valve and hydrant ends to prevent entry of foreign matter.
2. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.11 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 RESILIENT-WEDGE GATE VALVES

A. Manufacturer:
1. American Cast Iron Pipe Company (American Flow Control & Waterous)

B. Description:
1. Valves 2”-66” shall be resilient wedge type rated for 250 psi cold water working pressure. All cast ferrous components shall be ductile iron. This includes but is not limited to Stuffing Box, Valve Body, Valve Bonnet and Wrench nut /Operating nut.
2. Valves 3”-16” shall be in full compliance with AWWA C-515. The words "DI' or "Ductile Iron" shall be cast on the valve or stamped on a permanently attached corrosion resistant metal. All cast ferrous parts of the valve shall be made of ductile iron ASTM A536, minimum 65,000 psi tensile strength.
3. Valves 3”-12” shall be furnished with a stem seal (Debris Seal) above the stuffing box O-rings. This seal shall also be capable of sealing against internal or external pressure equal to the valve’s rated working pressure.
4. Valves shall have a label or tag, exhibiting a barcode that when scanned by a Trimble mobile device or approved smartphone and necessary software application, the device associates high accuracy GPS coordinates, photos, product description and specifications with the valve or hydrant asset. The application shall provide interoperability with existing ESRI® ArcGIS, computerized maintenance management systems (CMMS), or enterprise resource planning databases
5. MJ connecting pipe bolt holes must have anti-rotation lugs to aid in installation
6. Valves stems shall be full diameter from thrust collar to wrench nut, without any reduced area that allows premature failure. Stems with fracture grooves will not be accepted.
7. Wedge nut shall be held in place on three sides. Valves with wedge nuts held in place by less than three side will not be accepted.
8. The wedge shall be symmetrical and seal equally well with the flow in both direction and have wedge covers on both wedge guides made of Delrin.
9. Seal between bonnet and body shall be a flat gasket with integral O-ring, allowing bolting to pass through. Standard O-rings or standard flat gaskets without integral O-rings will not be accepted.
10. Valves 2"-66" shall be NSF Standard 61 certified.
11. Valve shall have factory installed 304 stainless steel exterior bolting. All bolting on valves 4” and larger must be at least 5/8" diameter. Metric bolts, Allen head, and socket head cap screws will not be accepted.
12. Operating nuts on non-geared valves shall be made of ductile iron and shall have four flats at stem connection to assure even torque input to the stem.
13. Stem shall be sealed by three pressure sealing O-rings.

14. Valve shall have thrust washers located with one above and one below the thrust collar to assure trouble-free operation of the valve.
15. All internal and external surfaces of the valve body and bonnet shall be epoxy coated, complying with ANSI/AWWA C550.
16. 4”-12” Valve inlet shall be restrained for use with ductile iron, cast iron, HDPE and PVC materials. Inlet shall incorporate a stab-fit design using a single Type 304 stainless steel fastener and heat-treated ductile iron grippers. The joint shall work with pressure to achieve joint restraint. All valves inlets shall be the Romac ALPHA design, as furnished by AMERICAN Flow Control.
17. MJ shall be allowed as an alternative to be used at contractor’s discretion.

2.2 TAPPING SLEEVES AND VALVES

A. Tapping Sleeve:

1. Manufacturers:
   a. Romac Industries, Inc.
   b. Powerseal.
   c. Ford.
   d. Or Approved Equal.
2. Description:
   a. Material: Stainless Steel.

B. Tapping Valve:

1. Description:
   a. AWWA C509. Resilient-seated gate vales with non-rising stem.
   b. Inlet flanges, conforming to ANSI B16.1, Class 125 and MSS SP-60.
   c. Mechanical joint outlets conforming to AWWA C111.
   d. Mark manufacturer’s name and pressure rating on valve body.

2.3 FIRE HYDRANTS

A. Manufacturers:
1. American Cast Iron Pipe Company (American Flow Control & Waterous)

B. Description:
1. Fire hydrants shall meet or exceed ANSI/AWWA C502, latest revision. Rated working pressure shall be 250 psi.
2. The nozzle section, caps, upper/lower standpipes and hydrant base shall be ductile iron.
3. Nozzles shall be mechanically attached by retaining collars. Pinned, threaded-in, screwed in or nozzles using set screws will not be allowed.
4. Nozzles shall be two 2 ½ size and 4 pumper
5. Nozzle section will be designed for easy 360 degree rotation by the loosening of no more than four bolts.
6. All external bolting must be Standard and a nut and bold design. Metric, Allen bolts, or threaded castings in place of nuts will not be accepted.
7. Hydrant shall measure 30” inches from ground line to center of nozzle. (22” upper barrel)

8. External bolting below grade shall be stainless steel bolting that meets the requirements of ASTM F 593 Standard Specification for Stainless Steel Bolts, Type 304, Alloy Group 1, CW condition and ASTM F 594 Standard Specification for Stainless Steel Nuts, Type 304, Alloy Group 1, CW condition.
9. Hydrant shall be open Left
10. External surfaces above grade shall be coated with two-part epoxy primer and a two-part high-gloss urethane topcoat. Color RED
11. 4.5" nozzle must be facing roadway
12. Above grade painted area of Hydrant shall be protected from damage during installation.
13. Valve or hydrant shall be supplied with a label or tag from the manufacture exhibiting a barcode that when scanned by a Trimble mobile device or approved smartphone and necessary software application, the device associates high accuracy GPS coordinates, photos, product description and specifications with the valve or hydrant asset. The application shall provide interoperability with existing ESRI® ArcGIS, computerized maintenance management systems (CMMS), or enterprise resource planning databases.
14. Hydrant must have an internal travel stop nut located in the top-housing. Hydrant must have a double oil reservoir so that operating threads are oil lubricated and will be O-ring sealed from water, moisture and foreign matter.
15. Hydrant must have a traffic flange design allowing for quick and economical repair of damage resulting from a vehicle's impact. The rod coupling must be two half sleeves bolted on by two stainless steel studs and four brass lock nuts. Pins, standard nuts and bolts not allowed.
16. The seat diameter shall be 5 1⁄4", opening against the pressure and closing with the pressure. Hydrant must be designed so that removal of all working parts can be accomplished without excavating. The lower valve washer must be fusion-bonded epoxy coated. The bronze seat must be threaded into mating threads of bronze for easy field repair.
17. The draining system of the hydrant shall be bronze and be positively activated by the main operating rod. Hydrant to be furnished with a sliding bronze drain valve. Sliding drain valves made of *rubber, plastic or leather* will not be allowed.
18. Connection shall be MJ or Restrained push-on joint that use water pressure to achieve restraint (AFC Alpha)
19. Hydrant model must have at least 50 years of service history and maintained complete interchangeability of internal parts.
20. Coating System Performance Requirements for Exterior Surfaces above Grade
    a. Hydrants shall be coated to meet the minimum coating requirement of the latest edition of AWWA/ANSI C502.
    b. Primer: Primer shall be used on all surfaces and shall be cross-linked two-part liquid epoxy. Epoxy primer shall be applied using an electrostatic spray process.
    c. Topcoat: Surfaces shall be top coated with high-gloss two-part liquid urethane that uses an aliphatic isocyanate catalyst to produce a cross-linked cure. Topcoat shall be applied using an electrostatic spray process.
    d. The hydrant base shall be coated with fusion-bonded epoxy on interior and exterior surfaces using materials and coating application procedures that meet or exceed the requirements of the latest edition of ANSI/AWWA C550 *Standard for Protective Epoxy Interior Coatings for Valves and Hydrants*
21. See attached Submittal Sheet and Product Acceptance Notice for additional specifications.

C. Hydrant Marker: E-Z Fold Down Aluminum Hydrant Marker or equal.

2.4 YARD HYDRANTS

A. Manufacturers:

1. Woodford Manufacturing Company, LLC
   2121 Waynoka Rd.
   Colorado Springs, CO 80915
2. Or Approved Equal.

B. Description:

1. For use with potable water.
2. Backflow protection with diverter spout.
3. Automatic draining.
4. Frost-free/freezeless.

C. Design Criteria:

1. Bury Depth: 7 feet
2. Inlet: 1” NPT Female
3. Pressure:
   a. Minimum: 20 psi
   b. Maximum: 100 psi

2.5 VALVE BOXES

A. Manufacturers:

1. Tyler Union
   11910 CR 492
   Tyler, TX 75706
2. Mueller Co.
   633 Chestnut Street, Suite 1200
   Chattanooga, TN 37450
3. Star Pipe Products
4. Or Approved Equal.

B. Description:

1. 12-inch Diameter Valves and Smaller:
   a. Material: Cast iron.
   b. Type: Two piece; screw.
2. Valves Larger than 12-inch Diameter:
   a. Material: Cast iron.
   b. Type: Three piece; screw.
   c. Base: Round.
3. Cover Inscription: WATER.

C. Accessories:

1. Thrust Restraints: As specified in Section 330509.33 - Thrust Restraint for Utility Piping.
2. Valve Box Aligner
   a. Manufacturers:
      1) Adaptor, Inc.
         2151 S. 54th Street
         West Allis, WI 53219
      2) Or Approved Equal.
   b. Description: High strength plastic device designed to automatically center valve box base and to prevent it from shifting off center during backfilling.
3. Stationary Operating Rod (Valve Stem Extension)
   a. Description:
      1) Carbon or Stainless Steel, Type 304, ASTM A484
      2) Centering plate
   b. Length: Needed to achieve elevation 6 inches to 12 inches below bottom of valve box cover.
   c. Provide one (1) rod key: 22 inch.

2.6 MATERIALS

A. Bedding and Cover: Fill Type A2, as specified in Section 310516 - Aggregates for Earthwork.

B. Soil Backfill: Soil Type S1, as specified in Section 310513 - Soils for Earthwork.

2.7 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Determine exact location and size of valves from Drawings.

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

D. Verify that elevations of existing facilities prior to excavation and installation of valves and hydrants are as indicated on Drawings.

3.2 PREPARATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Locate, identify, and protect from damage utilities to remain.

C. Do not interrupt existing utilities without permission and without making arrangements to provide temporary utility services.

1. Notify Engineer not less than two days in advance of proposed utility interruption.
2. Do not proceed without written permission from Engineer.

3.3 INSTALLATION

A. Perform trench excavation, backfilling, and compaction as specified in Section 312316.13 - Trenching.

B. Install valves and hydrants in conjunction with pipe laying.

C. Provide buried valves with valve boxes installed flush with finished grade.

D. Provide support blocking and drainage gravel while installing fire hydrants.

1. Do not block drain hole.

E. Orientation:

1. Set valves and hydrants plumb.
2. Set fire hydrants with pumper nozzle facing roadway.
3. Set fire hydrants with centerline of pumper nozzle 30 inches above finished grade and with safety flange not more than 6 inches nor less than 2 inches above grade.

F. After main-line pressure testing, flush fire hydrants and check for proper drainage.

G. Disinfection of Water Piping System: Flush and disinfect valves and hydrants with water mains as specified in Section 330110.58 - Disinfection of Water Utility Piping Systems.

H. Tapping Sleeves and Valves: As indicated on Shop Drawings and according to manufacturer instructions.

3.4 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.

B. Pipe and Material Testing:

1. Pressure Testing:
   a. As specified in Section 330505.31 - Hydrostatic Testing.

2. Compaction Testing:
   a. As specified in Section 312316.13 - Trenching and in accordance with the Earthwork and Material Testing Schedule in the Drawings.
3. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

3.5 PROTECTION

A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Protect valves, hydrant, and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION 331419

AMERICAN Flow Control®
5-1/4" WATEROUS PACER® FIRE HYDRANT
SUBMITTAL SHEET

City Specfication: Kindred		**Customer PO:**	**Quantity:**
Style:	☒ Contemporary	☐ Classic	
Type:	☒ Traffic (Model WB67-250)	☐ Non-Traffic (Model W67-250)	
Direction to Open:	☒ Left (C.C.W.)	☐ Right (C.W.)	

Operating Nuts	**Operating Nut**		**Nozzle Cap Nuts**	
	☐ Non-Weathershield ☒ Weathershield		☐ Rocker Lug for Spanner Wrench or ☒ Same as Operating Nut	
	Nominal Size: 1 1/2	Shape: Pentagon	Nominal Size:	Shape:
	Waterous No. (If Known) 5		Waterous No. (If Known)	

Nozzles	**Nozzle Configuration (Check One)**	**Pumper Nozzle**	**Hose or IHG Valve Nozzle**
	☒ DDP (Two Hose, One Pumper) ☐ DDD (Three Hose) ☐ DD (Two Hose) ☐ PP (Two Pumpers) ☐ GGP (Two IHG Valves One Pumper) ☐ GG (Two IHG Valves)	Storz: ☐ 4 in. ☐ 5 in. Nat'l Std. ☒ Yes ☐ No	Nat'l Std: ☒ Yes ☐ No
		Size: 4 Pitch Dia: O.D. x T.P.I.	Size: 2.5 Pitch Dia: O.D. x T.P.I.
		Waterous Template (If Known):	Waterous Template (If Known):

Nozzle Cap Chains: ☒ Yes ☐ No	**Bury Depth:** (Depth of Trench)
Upper Standpipe Length: ☐ 10" ☐ 16" ☒ 22" ☐ 28" ☐ 34"	

Bottom (Base) Connection: (Check One)

☐ 6" Flanged ☑ 6" MJ ☐ 6" TYTON® ☐ 6" Plain End with Integral MJ Gland

☐ 6" Flanged Vertical Entry ☐ 4" MJ ☒ 6" ALPHA™ ☐ 6" ALPHA™ XL

Paint Color: Red					
UL Listed	☐ Yes	☒ No	FM Approved	☐ Yes	☒ No
Other Requirements: (List)					

Notes:

1. Meets or exceeds requirements of AWWA C502, latest revision.
2. 250 psig rated working pressure.
3. May be furnished in configurations that are UL Listed and Approved by FM Approvals.
4. Certified to NSF/ANSI Standard 61 and NSF/ANSI 372.
5. TYTON® is a registered trademark of United States Pipe and Foundry Co., LLC.
6. ALPHA™ is a trademark of Romac Industries, Inc. (U.S. Patent 8,894,100)

AMERICAN
THE RIGHT WAY

AMERICAN Flow Control Product Acceptance Notice

Date Accepted: 05-03-2022
Utility/Water System: Utility
City: City of Kindred State: North Dakota

Product	Description	Approved	Open Direction	Color	Nozzles (DDP: PP; DD)	Trench	ALPHA	Special Requirements
Hydrant:	5-1/4" WB67 (Classic Pacer)	X	Left	Red	DDP	TBD	Optional	Waterous Only
		Approved	Open Direction	End Connection	2" Op Nut	Bevel/Spur Gear	ALPHA	
Resilient Wedge Gate Valve:	Series 2500 (Sizes 2" - 12")	X	Left	MJ	X		Optional	AFC Only
	Series 2500 (Sizes 14" - 66")	X	Left	MJ		If spec		

Approval Authorized by: Rich Schock
Title: Public Works Superintendent

SECTION 333111 - PUBLIC SANITARY SEWERAGE GRAVITY PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sanitary sewer piping.
2. Sanitary services (laterals) and connections.
3. Connection to existing manholes.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Sanitary Sewer Main:

1. Basis of Measurement: By linear foot (LF).
2. Basis of Payment: Includes excavation, hand trimming, pipe, fittings, couplings, trace wire, connection to main or existing pipe, bedding and cover, backfill, compaction, and testing.

B. Sanitary Sewer Service:

1. Basis of Measurement: By linear foot (LF).
2. Basis of Payment: Includes excavation, hand trimming, removal of existing pipe, service pipe, fittings, couplings, trace wire, connection to existing service, bedding and cover, backfill, compaction, and testing.

C. Sanitary Sewer Service Connection:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, in-line service wye, fittings, couplings, connection to existing sewer service or cap when indicated, bedding and cover, backfill, compaction, and testing.

D. Sanitary Sewer Cleanout:

1. Basis of Measurements: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, pipe, fittings, couplings, trace wire, bedding and cover, backfill, compaction, testing, casting, cover, and final adjustment.

E. Sanitary Sewer - Connect to Existing Manhole:

1. Basis of Measurements: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, drilling and coring, watertight seal, accessories, grouting, backfilling, and compaction.

1.3 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings.
4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C150 - Thickness Design of Ductile-Iron Pipe.
6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
7. AWWA C153 - Ductile-Iron Compact Fittings.

B. ASTM International:

1. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
2. ASTM C1173 - Standard Specification for Flexible Transition Couplings for Underground Piping Systems.
3. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3).
4. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
5. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
6. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
7. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
8. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
9. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
10. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
11. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
12. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
13. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
14. ASTM F1336 - Standard Specification for Poly(Vinyl Chloride) (PVC) Gasketed Sewer Fittings.

1.4 COORDINATION

A. Section 013000 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with municipal utilities department.

1.5 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

1.6 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record invert elevations and actual locations of pipe runs, connections, manholes, and cleanouts.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Storage:

1. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Block individual and stockpiled pipe lengths to prevent moving.
3. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 SANITARY SEWER PIPING

A. Polyvinyl Chloride (PVC) Pipe:

1. Material:
   a. PVC; Comply with ASTM D3034
2. Type:
   a. Main:
      1) Less than 18 foot depth: SDR-35 or as indicated on the Drawings.
      2) Greater than 18 foot depth: SDR-26 or as indicated on the Drawings.
   b. Services:
      1) SDR-26 or as indicated on the Drawings.
3. Inside Nominal Diameter: As indicated on the Drawings.
4. End Connections:
   a. Bell-and-spigot style
   b. Rubber-ring-sealed gasket joint.
5. Fittings:
   a. Material:
      1) PVC; Comply with ASTM D3034 and F1336.
   b. Joints:
      1) Elastomeric gaskets.
      2) Comply with ASTM F477.

2.2 SANITARY SEWER PIPING - RESTRAINED JOINT

A. Polyvinyl Chloride (PVC) Pipe:

1. Material:
   a. PVC; Comply with AWWA C900
   b. Minimum DR-25.
2. Inside Nominal Diameter: As indicated on the Drawings.
3. Joints:
   a. Butt Fusion.
   b. Coupled or integral bell, restrained joint (Certa-Flo® RJ/RJIB).
4. For use in conditions requiring restrained joints.

2.3 ACCESSORIES

A. Flexible Couplings:

1. Description: Comply with ASTM C1173
2. Material: Resilient, chemical-resistant, elastomeric PVC.
3. Gasket:
   a. One piece molded-in bushing gasket.
4. Clamps:

a. Attachment with two (2) series-300 stainless steel clamps, screws, and housings.

5. Shear Ring:
   a. Minimum 0.012 inch thick.
   b. 300 series stainless steel.
6. Dissimilar Sizes:
   a. Use “step-down” or Approved Equal.

B. Trace Wire: As specified in Section 330597 - Identification and Signage for Utilities.

2.4 MANHOLES

A. As specified in Section 330561 - Precast Concrete Structures.

2.5 MATERIALS

A. Bedding and Cover: Fill Type A2, as specified in Section 310516 - Aggregates for Earthwork.

B. Soil Backfill: Soil Type S1, as specified in Section 310513 - Soils for Earthwork.

2.6 SOURCE QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that trench cut is ready to receive Work of this Section.

C. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Correct over-excavation with fine aggregate.

C. Remove large stones or other hard materials that could damage pipe or impede consistent backfilling or compaction.

D. Protect and support existing sewer lines, utilities, and appurtenances.

E. Utilities:

1. Maintain profiles of utilities.
2. Coordinate with other utilities to eliminate interference.
3. Notify Engineer if crossing conflicts occur.

3.3 INSTALLATION

A. Excavation:

1. Excavate pipe trench as specified in Section 312316.13 - Trenching.
2. Excavate to lines and grades as indicated on Drawings.
3. Dewater excavations to maintain dry conditions and to preserve final grades at bottom of excavation.
4. Provide sheeting and shoring as specified in Section 312316.13 - Trenching.

B. Bedding:

1. Place bedding material at trench bottom.
2. Level materials in continuous layers in accordance with the Drawings.
3. Compact to percent of maximum density in accordance with the Drawings.

C. Piping:

1. Install pipe, fittings, and accessories according to ASTM D2321, and seal joints watertight.
2. Maintain 10 feet of horizontal separation between water main and sewer piping.
3. Maintain a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer.
4. Lay pipe to slope gradients as indicated on Drawings.
5. Begin at downstream end of system and progress upstream.
6. Bedding: As indicated on Drawings.
7. Lay bell-and-spigot pipe with bells upstream.
8. Cap open ends of piping during periods of work stoppage.
9. Backfill and compact as specified in Section 312316.13 - Trenching.
10. Do not displace or damage pipe when compacting.
11. Connect pipe to existing sewer system or at manhole.
12. Trace Wire: As specified in Section 330597 - Identification and Signage for Utilities.

D. Wye Branches:

1. Install concurrent with pipe-laying operations, install wye branches at locations indicated on Drawings.
2. Use fittings of same material and joint type as sewer main.
3. Maintain minimum 5-foot separation distance between wye connection and manhole unless otherwise shown on the Drawings.

E. Sanitary Services:

1. Construct services from wye branch to terminal point as indicated on drawings.

2. Where depth of main pipeline warrants, construct riser-type service from wye branch.
3. Maintain 5 feet minimum separation between sewer services.
4. Install watertight plug, braced to withstand pipeline test pressure thrust, at termination of service.
5. Temporary Marker:
    a. Install temporary marker stake extending from end of service to 2 feet above finished grade.
    b. Paint top 12 inches of stake with fluorescent orange or green paint.

F. Manholes: As specified in Section 330561 - Precast Concrete Structures.

G. Connections to Existing Manholes:

1. Drilling:
    a. Core drill existing manhole and provide a clean opening.
    b. Use of pneumatic hammers, chipping guns, sledge hammers, and saws are not permitted.
    c. Recoat exposed concrete needing repair after drilling operations when interior coating is present.
2. Sealing:
    a. Link-Seal or equal connections.
    b. Watertight neoprene gasket and seal with non-shrink grout as specified in Section 330561 - Precast Concrete Structures.

H. Backfilling:

1. Backfill around sides and to top of pipe with cover fill, tamp in place, and compact.
2. Place and compact material immediately adjacent to pipes to avoid damage to pipe and prevent pipe misalignment.
3. Maintain optimum moisture content of bedding material as required to attain specified compaction density.

3.4 TOLERANCES

A. Section 014000 - Quality Requirements: Requirements for tolerances.

B. Maximum Variation from Indicated Slope: 1/8 inch in 10 feet.

3.5 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.

B. Request inspection by Engineer prior to and immediately after placing bedding.

C. Pipe and Material Testing:

1. Pressure Testing:
    a. As specified in Section 330505.31 - Hydrostatic Testing or 330505.41 - Air Testing.

2. Deflection Testing:
   a. As specified in Section 330505.43 - Mandrel Testing.
3. Televising:
   a. As specified in Section 330130.11 - Televising Inspection of Sewer.
4. Compaction Testing:
   a. As specified in Section 312316.13 - Trenching and in accordance with the Drawings.
5. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

3.6 PROTECTION

A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION 333111

SECTION 333123 - SANITARY SEWERAGE FORCE MAIN PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Force main pipe and fittings.
2. Gate valves and valve boxes.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Sanitary Sewer Force Main:

1. Basis of Measurement: By linear foot (LF).
2. Basis of Payment: Includes excavation, hand trimming, pipe, fittings, couplings, thrust restraints, bedding and cover, insulation, trace wire, backfill, compaction, and pressure testing.

B. Sanitary Sewer Force Main - Connect to Existing:

1. Basis of Measurements: By each (EA).
2. Basis of Payment: Includes excavating, hand trimming, cleaning and preparing existing pipe, installing couplings, materials, accessories, bedding and cover, backfill, and compaction.

C. Gate Valve & Box:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, gate valve, valve box and cover, trace wire, utility marker, accessories, bedding, backfill, compaction, and final adjustment.

D. Tapping Sleeve & Valve:

1. Basis of Measurement: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, tapping sleeve, gate valve, tapping of existing main, valve box and cover, trace wire, accessories, bedding, backfill, compaction, and final adjustment.

1.3 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.

2. AWWA C110 - Ductile-Iron and Gray-Iron Fittings.
3. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
5. AWWA C515 - Resilient-Seated Gate Valves for Water Supply Service.
6. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.
7. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.
8. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 63 In., For Water Distribution and Transmission.

B. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP-60 - Connecting Flange Joints between Tapping Sleeves and Tapping Valves.

C. ASTM International:

1. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3).
2. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
3. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
4. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
5. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
6. ASTM D3350 - Standard Specification for Polyethylene Plastic Pipe and Fittings Material.
7. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
8. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

1.4 COORDINATION

A. Section 013000 - Administrative Requirements: Requirements for coordination.

1.5 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information indicating pipe material used, pipe accessories, valves, restrained joint details and materials.

C. Shop Drawings:

1. Indicate piping piece numbers and locations.
2. Indicate restrained joint locations.

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

E. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for restrained joints, including establishing lengths of restrained joint piping required.

F. Manufacturer Instructions: Submit special procedures required to install specified products.

G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

H. Qualifications Statement: Submit qualifications for manufacturer, installer, and licensed professional.

1.6 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record invert elevations and actual locations of pipe runs and connections.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

A. Perform work in accordance with Ten State Standards.

B. Cast manufacturer's name, pressure rating, and year of fabrication into valve body.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience.

C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed at Project location.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Storage:

1. Store materials according to manufacturer instructions.
2. Do not place materials on private property without written permission of property owner.
3. Do not stack pipe higher than recommended by pipe manufacturer.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Store gaskets for mechanical and push-on joints in cool and dry location, out of direct sunlight, and not in contact with petroleum products.
3. Provide additional protection according to manufacturer instructions.

1.10 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 FORCE MAIN PIPING

A. Ductile-Iron Pipe (DIP):

1. Material:
   a. Ductile iron
   b. Comply with AWWA C151.
2. Pipe Class:
   a. Comply with AWWA C151.
   b. Class 54.
3. Joints:
   a. Type: Mechanical joints.
   b. Comply with AWWA C111.
4. Bituminous Outside Coating:
   a. Comply with AWWA C151.
5. Pipe Mortar Lining:
   a. Comply with AWWA C104.
   b. Thickness: Double.
6. PE Encasement:
   a. Comply with AWWA C105.

B. Polyvinyl Chloride (PVC) Pipe:

1. Material:
   a. Comply with AWWA C900
   b. Class 165.
2. Joints:
   a. Comply with ASTM D3139 and F477.
   b. Seals: PVC flexible elastomeric.
   c. Solvent-cement couplings are not permitted.

2.2 FORCE MAIN PIPING - RESTRAINED JOINTS

A. Fusible-Polyvinyl Chloride (FPVC) Pipe:

1. Pipe:
   a. Comply with AWWA C900.
   b. Class 165.
2. Material:
   a. Comply with ASTM D1784.
   b. Cell Classification: 12454-C.
3. Joints:
   a. Butt Fusion.
   b. Coupled or integral bell, restrained joint (Certa-Lok® RJ/RJIB).
   c. Mechanically locking bell-and-spigot, restrained joint (TerraBrute® CR).

B. High-Density Polyethylene (HDPE) Pipe:

1. Pipe:
   a. Comply with AWWA C906 and ASTM D3350
   b. DR 13.5 for 160 psig pressure rating
2. Material:
   a. Comply with ASTM D3350 and PE 4710.
   b. Cell Classification: 445574-C
3. Joints:
   a. Comply with ASTM D2657.
   b. Butt fusion.
4. End Connection:
   a. Mechanical Joint Restraint Adapter
   b. Provide stainless steel reinforcement rings and all mechanical joint locations.
   c. Restrain all unrestrained joints and fittings in-line with pipe after the End Connection to protect against pullout or disjoining.
5. Fittings:
   a. Comply with AWWA C906, ASTM D2657, and ASTM D3350.
   b. Style: Molded.
6. Upsize pipe diameter one nominal size larger than shown on the Drawings for a PVC equivalent.

2.3 VALVES

A. Resilient-Wedge Gate Valves:

1. Manufacturers:
   a. American Cast Iron Pipe Company (American Flow Control & Waterous)
      1501 31st Ave. North
      Birmingham, AL 35202
   b. Clow Valve Company
      902 South Second St.
      Oskaloosa IA 52577
   c. Mueller Co.
      633 Chestnut Street
      Suite 1200
      Chattanooga TN 37450
   d. Or Approved Equal.
2. Description:
   a. Comply with AWWA C515.
   b. Body: Ductile iron.
   c. Seats: Resilient.
   d. Stem:
      1) Type: Non-rising.
      2) Material: Bronze.
   e. Operation:
      1) Square operating nut.
      2) Opening Direction: Counterclockwise.
3. End Connections: Mechanical joint.
4. Coatings:
   a. Comply with AWWA C550.
   b. Interior and exterior.
5. Pressure Rating:
   a. 12-inch Diameter and Smaller: 200 psig.
   b. 16-inch Diameter and Larger: 150 psig.
6. Exterior Bolts and Nuts: Type 304 Stainless Steel.

2.4 VALVE BOXES

A. Manufacturers:

1. Tyler Union
   11910 CR 492
   Tyler, TX 75706
2. Mueller Co.
   633 Chestnut Street, Suite 1200
   Chattanooga, TN 37450
3. Star Pipe Products
4. Or Approved Equal.

B. Description:

1. 12-inch Diameter Valves and Smaller:
   a. Material: Cast iron.
   b. Type: Two piece; screw.
2. Valves Larger than 12-inch Diameter:
   a. Material: Cast iron.
   b. Type: Three piece; screw.
   c. Base: Round.
3. Lid Inscription: SEWER.

C. Accessories:

1. Valve Box Aligner
   a. Manufacturers:
      1) Adaptor, Inc.
         2151 S. 54th Street
         West Allis, WI 53219
      2) Or Approved Equal.
   b. Description: High strength plastic device designed to automatically center valve box base and to prevent it from shifting off center during backfilling.
2. Stationary Operating Rod (Valve Stem Extension)
   a. Description:
      1) Carbon or Stainless Steel, Type 304, ASTM A484
      2) Centering plate
   b. Length: Needed to achieve elevation 6 inches to 12 inches below bottom of valve box cover.
   c. Provide one (1) rod key: 22 inch.

2.5 TAPPING SLEEVES AND VALVES

A. Tapping Sleeves:

1. Manufacturers:
   a. Romac Industries, Inc.
   b. Powerseal.
   c. Ford.
   d. Or Approved Equal.
2. Description:
   a. Material: Stainless Steel.

B. Tapping Valves:

1. Description:
   a. AWWA C509. Resilient-seated gate vales with non-rising stem.
   b. Inlet flanges, conforming to ANSI B16.1, Class 125 and MSS SP-60.
   c. Mechanical joint outlets conforming to AWWA C111.
   d. Mark manufacturer’s name and pressure rating on valve body.

2.6 FITTINGS AND COUPLINGSS

A. Non-Restrained Fittings:

1. Material:
   a. Ductile-iron.
   b. Comply with AWWA C110.
2. Description:
   a. Compatible with PVC and DIP.
3. Compact Fittings:
4. Comply with AWWA C153.
   a. Coating and Lining:
   b. Bituminous Coating: Comply with AWWA C110.
   c. Cement-Mortar Lining: Comply with AWWA C1O4; double thickness
5. Joints:
   a. Type: Mechanical joints.
   b. Comply with AWWA C111.
6. Jackets: PE; comply with AWWA C105.

B. Restrained Fittings:

1. As specified in Section 330509.33 - Thrust Restraint for Utility Piping.

C. Non-Restrained Couplings:

1. Manufacturers:
   a. Macro by Romac Industries, Inc.
      1) Sizes: 2” to 12”
   b. Hymax2 by Kraisz USA
      1) Sizes: 4” to 12”
   c. Hymax HLD by Krausz USA
      1) Sizes: Greater than 12”
   d. Or Approved Equal.
2. Description
   a. Two bolt extended range coupling
   b. Compatible with PVC, DIP, ACP, HDPE
   c. Fusion bonded epoxy coating
   d. Grade C Steel or Ductile Iron
   e. Stainless steel bolts, nuts, and washers

D. Restrained Couplings and Fittings:

1. As specified in Section 330509.33 - Thrust Restraint for Utility Piping.

2.7 MATERIALS

A. Bedding and Cover: Fill Type A2, as specified in Section 310516 - Aggregates for Earthwork.

B. Soil Backfill: Soil Type S1, as specified in Section 310513 - Soils for Earthwork.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Correct over-excavation with coarse aggregate.

C. Remove large stones or other hard matter capable of damaging pipe or of impeding consistent backfilling or compaction.

3.3 INSTALLATION

A. Excavation:

1. Excavate pipe trench as specified in Section 312316.13 - Trenching.
2. Hand trim for accurate placement of pipe to elevations as indicated on Drawings.
3. Dewater excavations to maintain dry conditions and to preserve final grades at bottom of excavation.
4. Provide sheeting and shoring as specified in Section 312316.13 - Trenching.

B. Bedding:

1. Place bedding material at trench bottom.
2. Level materials in continuous layers in accordance with the Drawings.
3. Compact to percent of maximum density in accordance with the Drawings.

C. Piping:

1. Comply with AWWA C600 and C605.
2. Handle and assemble pipe according to manufacturer instructions and as indicated on Drawings.
3. Steel Rods, Bolts, Lugs, and Brackets: Coat buried steel before backfilling.
4. Maintain 10 feet of horizontal separation between water main and sewer piping.
5. Maintain a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer.

6. Ductile-Iron Piping and Fittings: Comply with AWWA C600.
7. Grooved and Shouldered Pipe Joints: Comply with AWWA C606.
8. Field Welding Materials: Comply with AWWA C206.
9. Flanged Joints: Do not use in underground installations except within structures.
10. Route pipe in straight line, and re-lay pipe that is out of alignment or grade.
11. High Points:
    a. Install pipe with no high points.
    b. If unforeseen field conditions arise that necessitate high points, install air-release valves as directed by Engineer.
12. Bearing:
    a. Maintain bearing along entire length of pipe.
    b. Excavate bell holes to permit proper joint installation.
    c. Do not lay pipe in wet or frozen trench.
13. Prevent foreign material from entering pipe during placement.
14. Allow for expansion and contraction without stressing pipe or joints.
15. Close pipe openings with watertight plugs during Work stoppages.
16. Cover:
    a. Establish elevations of buried piping with not less than 7.5 feet of cover.
    b. Measure depth of cover from final surface grade to top of pipe barrel.
17. Tracer Wire: As specified in Section 330597 - Identification and Signage for Utilities.

D. Valves:

1. Install valves in conjunction with pipe laying.
2. Orientation: Set valves plumb.

E. Tapping Sleeves and Valves: As indicated on Shop Drawings and according to manufacturer instructions.

F. Thrust Restraints:

1. Provide pressure pipeline with restrained joints or concrete thrust blocking at pumps, bends, tees, and changes in direction.
2. As specified in Section 330509.33 - Thrust Restraint for Utility Piping.

G. PE Encasement:

1. Encase buried iron and piping in PE to prevent contact with surrounding backfill material.
2. Comply with AWWA C105.
3. Terminate encasement 3 to 6 inches above ground where pipe is exposed.

H. Backfilling:

1. Backfill around sides and to top of pipe with cover fill, tamp in place, and compact.
2. Place and compact material immediately adjacent to pipes to avoid damage to pipe and prevent pipe misalignment.
3. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 TOLERANCES

A. Section 014000 - Quality Requirements: Requirements for tolerances.

B. Install pipe to indicated elevation within tolerance of 5/8 inch.

3.5 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.

B. Pipe and Material Testing:

1. Pressure Testing:
   a. As specified in Section 330505.31 - Hydrostatic Testing.
2. Compaction Testing:
   a. As specified in Section 312316.13 - Trenching and in accordance with the Drawings.
3. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

3.6 PROTECTION

A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION 333123

SECTION 334213.13 - PUBLIC STORM SEWER GRAVITY PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Storm piping and culverts.
2. Edgedrains.
3. End Sections.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Storm Sewer:

1. Basis of Measurement: By linear foot (LF).
   a. Measured from center of structure to structure or to tip of end sections.
2. Basis of Payment: Includes excavation, hand trimming, storm pipe, accessories, end sections, bedding and cover, backfill, compaction, and testing.

B. Storm Culvert:

1. Basis of Measurement: By linear foot (LF).
   a. Measured from tip of end section to tip of opposite end section.
2. Basis of Payment: Includes excavation, hand trimming, storm culvert, accessories, end sections, trash racks, bedding and cover, backfill, compaction, and testing.

C. Storm Sewer - 4” - Perforated Edgedrain:

1. Basis of Measurement: By linear foot (LF).
2. Basis of Payment: Includes excavation, hand trimming, drainage aggregate, perforated pipe, geosynthetics, accessories, connection to structures, compaction, and testing.

D. Storm Sewer - Connect to Existing Structure:

1. Basis of Measurements: By each (EA).
2. Basis of Payment: Includes excavation, hand trimming, drilling and coring, watertight seal, accessories, grouting, backfilling, and compaction.

1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO M198 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
2. AASHTO M294 - Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter.
3. AASHTO M330 - Standard Specification for Polypropylene Pipe, 300 to 1500 mm (12 to 60 in.) Diameter

B. ASTM International:

1. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.
3. ASTM D2444 - Standard Practice for Determination of the impact resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).
4. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
5. ASTM D3350 - Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.
6. ASTM D 4976 - Standard Specification for Polyethylene Plastics Molding and extrusion Materials.
7. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
8. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for joining Pipe.
9. ASTM F2306 - Standard Specification for 12 to 60 in. Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications.
10. ASTM F2881 - Standard Specification for 12 to 60in. [300 to 1500 mm] Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications.

1.4 COORDINATION

A. Section 013000 - Administrative Requirements: Requirements for coordination.

1.5 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information regarding pipe, fittings, and accessories.

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

D. Shop Drawings:

1. Indicate structure locations and elevations.
2. Indicate sizes and elevations of piping and penetrations.

1.6 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Storage:

1. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.
2. Store UV-sensitive materials out of direct sunlight.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Block individual and stockpiled pipe lengths to prevent moving.
3. Cradle pipe to prevent point stress.
4. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 STORM PIPE

A. Reinforced Concrete Pipe (RCP):

1. Comply with ASTM C76 Latest addition
   a. Sizes 12” - 18” Class V
   b. Sizes 21” - 36” Class III
   c. Sizes 42” and larger Class II
2. Furnish pipe in four to eight foot lengths.
3. Reinforcement: Mesh.
4. End Joints: Tongue and Groove.
   a. Supply weather butyl rubber gaskets in flexible rope form meeting or exceeding the requirements of Federal Specification SS-S-210 A and AASHTO M198.

B. High-Density Polyethylene (HDPE) Pipe.

1. Material:
   a. Pipe material comply with the following for their respective diameters
      1) ASTM F2306.
      2) AASHTO M294.
2. Description:
   a. Pipe 12-60 inches in diameter
      1) Smooth interior .
      2) Annular exterior corrugations.
      3) Meet or exceed ASTM F2306 and AASHTO M294.
3. Joints:
   a. Gasketed integral bell and spigot joint meeting the requirements of AASHTO M294 and ASTM F2306 for respective diameters.
   b. Watertight according to ASTM D3212.
   c. Ensure gasket complies with ASTM F477.

C. Polypropylene (PP) Pipe.

1. Material:
   a. Pipe material comply with the following for their respective diameters
      1) ASTM F2881, Section 5
      2) AASHTO MP-21-11, Section 6.1
      3) AASHTO M330
2. Description:
   a. Pipe 12-60 inches in diameter
      1) Smooth interior
      2) Annular exterior corrugations
      3) Meet or exceed ASTM F2881 and AASHTO M330
3. Joints:
   a. Gasketed integral bell and spigot joint meeting the requirements of AASHTO M330 and ASTM F2881 for respective diameters.
   b. Watertight according to ASTM D3212.
   c. Ensure gasket complies with ASTM F477.

D. Corrugated Steel Pipe (CSP):

1. Pipe 12-30 inches in diameter
2. Corrugation: 2 2/3” X ½” corrugation or as specified on the plans.
3. Gauge: 16 gauge steel;

4. Corrugated Steel Pipe: ASTM A760, galvanized:
   a. Helical lock seam.
   b. Shape: As indicated on the Drawings.
   c. Tapered Ends: Same material as pipe, machine cut, for joining to pipe end.
   d. Coupling Bands: Galvanized steel, 0.052 inches thick by 24 inches wide; connected with two galvanized steel bolts.
   e. Gaskets: none required.

E. Perforated-Polyvinyl Chloride (PVC) Pipe - Edgedrain

1. Pipe:
   a. Comply with ASTM D3034
   b. SDR-35
2. Material: Comply with ASTM D1784
3. Size: 4 inch.
4. Joints: Solvent-welded
5. Perforations:
   a. ¼ inch diameter
   b. Arranged in rows parallel to the axis of the pipe.
   c. Spaced 3 inch center to center
   d. Four (4) rows of perforations
   e. 48 perforations per row (for 12.5’ laying lengths)

2.2 ACCESSORIES

A. Trash Racks: Include size and type as shown in the Details on the Drawings on the upstream side of all culvert end sections.

2.3 MATERIALS

A. Bedding and Cover: Fill Type A2, as specified in Section 310516 - Aggregates for Earthwork.

B. Soil Backfill: Soil Type S1, as specified in Section 310513 - Soils for Earthwork.

C. Drainage Aggregate: Type A4, as specified in Section 310516 - Aggregates for Earthwork.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that trench cut is ready to receive Work.

C. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Correct over-excavation with fine aggregate.

C. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.

3.3 INSTALLATION

A. Excavation:

1. Excavate pipe trench as specified in Section 312316.13 - Trenching.
2. Hand trim for accurate placement of pipe to elevations as indicated on Drawings.
3. Dewater excavations to maintain dry conditions and to preserve final grades at bottom of excavation.
4. Provide sheeting and shoring as specified in Section 312316.13 - Trenching.

B. Bedding:

1. Place bedding material at trench bottom.
2. Level materials in continuous layers in accordance with the Drawings.
3. Compact to percent of maximum density in accordance with the Drawings.

C. Flexible Pipe:

1. Flexible pipe will only be allowed within grassed area or where the pipe is located outside of the roadway, unless otherwise stated in the Drawings or approved by the Engineer.
2. Wipe both ends clean and place sufficient lubricant on gasket and spigot end before the pipe is fully pushed into the bell.
3. Bevel field cut spigot ends when required.
4. Lay pipe upgrade with the spigot end pointing in the direction of flow.
5. Ensure that pipe remains in correct position and to required slope.
6. Ensure spigot is properly seated within bell end.

D. Rigid Pipe:

1. Handle and lay pipe in accordance with ASTM C1479.
2. If using butyl gaskets, install per manufacturer’s instructions.
3. Use Popits to fill pick holes when applicable.
4. Place the pipe in contact with the shaped bedding throughout its full length.
5. Place bell or groove ends of rigid pipe upstream.

E. End Sections:

1. The pipe lengths shown on the Drawings include both the pipe length and the end section(s) length.

2. The actual pipe length to be installed is to be determined by reducing the length of the end sections(s) from the pipe length shown on the Drawings and the following equation:
   a. Actual Pipe Length = Pipe Length (Drawing) - End Section(s) Length
3. Install trash racks when indicated on the Drawings and in accordance with the Details.
4. Rigid Pipe: Tie the last four (4) pipe joints including the end section at all outfalls.

F. Connections to Manholes, Inlets, and Catch Basins:

1. Flexible Pipe: Connect to structure utilizing a rubber boot.
2. Rigid Pipe: Connect pipe by cutting the opening and grouting in the connecting pipe.

G. Backfilling:

1. Backfill around sides and to top of pipe with cover fill, tamp in place, and compact.
2. Place and compact material immediately adjacent to pipes to avoid damage to pipe and prevent pipe misalignment.
3. Maintain optimum moisture content of bedding material to attain required compaction density.

H. Edgedrain (Drain tile):

1. Install edgedrain in accordance with the details in the Drawings.
2. Excavate or cut-in edgedrain trench to specified depth.
3. Place drainage aggregate to receive edgedrain pipe.
4. Install pipe on drainage aggregate with penetrations facing down.
5. Cover and encase edgedrain in it’s entirety with drainage aggregate.
6. Place geosynthetic material.

3.4 TOLERANCES

A. Section 014000 - Quality Requirements: Requirements for tolerances.

B. Maximum Variation from Indicated Slope: 1/8 inch in 10 feet.

C. Maximum Variation from Intended Elevation of Pipe Invert: 1/2 inch.

D. Maximum Offset of Pipe from Indicated Alignment: 1 inch.

3.5 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.

B. Request inspection by Engineer prior to and immediately after placing bedding.

C. Pipe and Material Testing:

1. Pressure Testing:
   a. As specified in Section 330505.31 - Hydrostatic Testing or 330505.41 - Air Testing.

2. Deflection Testing:
   a. As specified in Section 330505.43 - Mandrel Testing.
3. Televising:
   a. As specified in Section 330130.11 - Televising Inspection of Sewer.
4. Compaction Testing:
   a. As specified in Section 312316.13 - Trenching and in accordance with the Drawings.
5. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

3.6 PROTECTION

A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting installed construction.

B. Protect pipe and bedding from damage or displacement until backfilling operation is in progress.

END OF SECTION 334213.13