



**BOXELDER SANITATION
DISTRICT**

**STANDARDS & SPECIFICATIONS
for
SANITARY SEWER PIPELINE CONSTRUCTION
AND IMPROVEMENTS**

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SECTION 01110

GENERAL PROVISIONS

PART 1 GENERAL

1.1 PURPOSE AND SCOPE

- A. The purpose of these technical specifications is to set forth the minimum standards for construction and installation of 12-inch and smaller sewer mains, sewer services and all appurtenances associated with these mains and services. Prior to construction, acceptance of Plans/Drawings by the Boxelder Sanitation District (District) is required.
- B. In the case of sanitary sewer mains larger than 12-inches the Developer or his/her representative shall consult with the District on the design, specification and implementation of the project.
- C. As with any construction standards, occasions may arise where the minimum standards are either inappropriate or cannot be justified economically. In these cases a variance to these standards shall be considered. Written requests for variance should be directed to the District.
- D. The Contractor is responsible for making themselves thoroughly familiar with the provisions and the content of the Specifications.
- E. These specifications are composed of written material specifications. The interpretation of these specifications shall be made by the District.
- F. When a conflict occurs within these specifications, an interpretation shall be made by the District.
- G. In the event that a conflict between the sewer and other utilities is identified during construction, Contractor shall contact the District and the owner of the other utility to interpret the specifications and determine if the standards of other utilities apply.

1.2 REVISIONS TO THE CONSTRUCTION STANDARDS

- A. These standards shall be periodically revised and amended.

1.3 DEFINITIONS AND TERMS

A. Definitions

Whenever the definitions, abbreviations and terms listed in this section are used in these standards they shall be defined as follows:

- 1. District – Boxelder Sanitation District**
- 2. Rules and Regulations –** The latest officially adopted District Rules and Regulations.

3. **Collector** means a pipeline eight inches (8") or more in diameter, including manholes and appurtenances, designed to collect and transmit wastewater from its sources to the wastewater treatment plant, excluding service lines.
4. **Construction Drawings** – Details and working drawings, including plan, profile, and detail sheets of proposed utility improvements, accepted by the District for construction.
5. **Consultant** – A person, partnership, or corporation duly registered as a professional engineer according the Colorado Statutes who is hired by the land owner or developer and is empowered to act as his/her agent.
6. **Contractor** – A person, partnership, or corporation duly licensed and bonded in the local jurisdiction in accordance with the requirements of the local jurisdiction.
7. **Design Engineer** –The partnership, corporation, or individual who is registered as a professional engineer, according to Colorado Statutes, and who is hired by the land owner or developer, and is empowered to act as his/her agent for the project.
8. **Developer**– The person or persons, public or private, legally responsible for construction of improvements within a specific development.
9. **District** means the Boxelder Sanitation District's General Manager, Engineer, or any agent authorized by the Boxelder Sanitation District's General Manager to represent the Boxelder Sanitation District.
10. **Domestic Wastewater Treatment Plant (Treatment Plant)** means an arrangement of devices and structures for treating, neutralizing, stabilizing, or disposing of domestic wastewater, industrial wastes, and biosolids. The term “domestic wastewater treatment plant” does not include industrial wastewater treatment plants or complexes whose primary function is the treatment of industrial wastes, notwithstanding the fact that human wastes generated incidentally to the industrial process are treated therein.
11. **Domestic Wastewater Treatment Works (Treatment Works)** means a treatment plant or facility for treating, neutralizing, stabilizing, or disposing of domestic wastewater which system or facility has a designed capacity to receive more than two thousand gallons of domestic wastewater per day.

The term “domestic wastewater treatment works” also includes appurtenances to such system or facility such as vaults, outfall sewers, interceptor sewers and pumping stations and to equipment related to such appurtenances. The term “domestic wastewater treatment works” does not include industrial wastewater treatment plants or complexes whose primary function is the treatment of industrial wastes, notwithstanding the fact that human wastes generated incidentally to the industrial process are treated therein.
12. **Engineer** – The Boxelder Sanitation District Engineer, or his/her authorized representative acting on behalf of the District.
13. **Engineer/Utility** – A term used in situations where a decision or action may be required by the District, but the request for the decision or the action must be routed through the Engineer.

14. **Acceptance** – the date that all public improvements are accepted by the District Engineer.
15. **Inspector** – The authorized representative of the District assigned to make detailed inspections for contract performances, standards and contract compliance.
16. **May** – A permissive condition. No requirement for design or application is intended.
17. **Owner** means the person or organization in legal possession of the Work.
18. **Or An Approved Equal** – as approved to being acceptable by the District.
19. **Record Drawings** - detailed drawings which have been prepared by the Design Engineer, upon completion and prior to final acceptance, and show actual construction and contain field dimensions, elevations, details, changes made to the Construction Drawings by modification, details which were not included on the Construction Drawings, and horizontal and vertical locations of underground utilities which have been impacted by the utility installation. Record Drawings are usually Construction Drawings which have been modified to contain the information listed above.
20. **Right-of-Way** – A general term denoting land, property, or interest therein, usually in a strip acquired for or devoted to a street or utility.
21. **Service Line** means pipelines designed to convey sanitary sewage (wastewater) from individual users to the Collector line.
22. **Shall** – A mandatory condition. Where certain requirements in the design or application are described with the “shall” stipulation, it is mandatory that these requirements be met.
23. **Should** – An advisory condition. Where the word “should” is used, it is considered to be advisable usage, recommended but not mandatory. Deviations may be allowed when reasons are given which show intent of the design standards is met.
24. **Standard Street Specifications** – The current Larimer County Urban Area Street Standards (LCUASS).
25. **Street** – A general term denoting a public way for purposes of vehicular travel, including the entire area within the right of way (including alleyways).
26. **Storm Drain** – Any conduit and appurtenance intended for the reception and transfer of storm water.
27. **Work** – the entire completed construction of the various separately identified parts required to be furnished for the project. Work is the result of performing services, furnishing the labor and furnishing and incorporating materials and equipment into the construction.

B. Terms

1. Wherever the words “**as described**,” “**as required**,” “**as permitted**,” or words of like meaning are used, it shall be understood that the direction, requirements or permission of the Engineer is intended. Similarly, the words “accepted”, “**approved**,” “**acceptable**,” “**satisfactory**” shall refer to approval by the Engineer or District.

2. References to standards, methods of testing materials, testing materials codes, practices or other requirements refer to the latest edition, including amendments in effect and published at the time of approval in issuing a permit.
3. **"These Standards"** or words of similar connotation shall mean the District specifications including all parts, supplements, and revisions pertaining thereto.
4. **"Provide"** shall mean furnish and install complete in place.
5. **"Remove"** shall mean remove and dispose of properly.
6. **"Shall"** shall mean a mandatory condition.
7. **"Ability"** shall mean that which a person can do on the basis of present development and training.
8. **"Competent"** shall mean a person who has the natural powers, physical, or mental to meet the demands of a situation or work. The word is widely used to describe the ability to meet all requirements, natural, legal, or other of a given task.
9. **"Qualified"** shall mean acquired abilities, skills, knowledge, experience, that fits a person for a position, office, or profession.
10. These Specifications contain many command sentences which are directed at the CONTRACTOR unless otherwise stated.

1.4 AUTHORITY OF THE ENGINEER

- A. The Engineer or their designated representative shall have the authority on behalf of the District to ascertain that all design and construction is equal to or exceeds the minimum requirements set forth in these standards.

1.5 AUTHORITY OF THE INSPECTOR AND/OR ENGINEER/UTILITY

- A. The Inspector shall have authority on behalf of the Engineer to make detailed inspections for compliance with Construction Drawings and specifications.

1.6 CONTRACTORS LICENSED AND BONDED

- A. The Contractor shall be licensed and bonded with the local jurisdiction where the work is to occur (for example, City of Fort Collins, Larimer County, Town of Timnath) prior to construction of facilities.

1.7 CONTRACTOR'S RESPONSIBILITY

- A. The Contractor shall be responsible to comply with these standards and other applicable laws and regulations.
- B. The Contractor shall furnish conveniences and assistance to the Inspector and Engineer/Utility for inspection of materials used and workmanship involved in construction.

- C. Contractor shall request clarification of all apparent conflicts by contacting the Engineer/Utility. The Engineer/Utility will not be responsible for any explanations, interpretations, or supplementary data provided by others.

1.8 NOTICE BEFORE BEGINNING WORK

- A. The Contractor shall notify the District office a minimum of 48 hours before beginning construction.

1.9 CONNECTION TO EXISTING PIPELINES AND STRUCTURES

- A. All connections to existing sewer infrastructure shall be made at a time authorized by the Engineer/Utility.

1.10 TRAFFIC CONTROL

- A. The Contractor shall provide a traffic control plan and permits per the requirements of the local jurisdiction. If the Engineer finds the construction area to have inadequate traffic control he has the authority to stop that portion of work until corrective measures are taken.

1.11 PRESERVATION OF PROPERTY

- A. Existing improvements, adjacent property utilities, trees, and plants that are not to be removed shall be protected from injury or damage resulting from the Contractor's operations.

1.12 REPLACEMENT OF SURFACE IMPROVEMENTS

- A. All improvements removed within the public right of way shall be replaced in accordance with the Larimer County Urban Areas Streets Standards (LCUASS). Other improvements shall be replaced as shown on the Construction Drawings.

1.13 REJECTED MATERIALS

- A. The Contractor shall remove defective or inferior materials from the work area within a reasonable length of time. The Contractor shall separately stockpile rejected materials until they are removed from the work area.

1.14 SITE MAINTENANCE AND CLEANUP

- A. Throughout all phases of construction, including suspension of work, and until final acceptance of the project, the Contractor shall keep the work site clean and free from rubbish and debris. Materials and equipment shall be removed from the site as soon as they are no longer necessary. Upon completion of the work, the Contractor shall clear the work site of equipment, unused materials, and rubbish.

1.15 SAFETY REQUIREMENTS

- A. The Contractor shall comply with Federal, State, and local safety requirements.
- B. Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the work. Contractor shall take all

necessary precautions for the safety on, and shall provide the necessary protection to prevent damage, injury or loss to:

1. Employees on the work and other persons who may be affected.
2. The work and materials or equipment to be incorporated therein, whether in storage on or off the site.
3. Other property at the site or adjacent thereto, including, but not limited to trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

1.16 ENFORCEMENT – EROSION CONTROL

- A. Changes to the erosion control plan or time sequence must be submitted in writing to the District for approval prior to implementing changes. Deviations from the plan or original time sequence without District approval may result in:
 1. Stoppage of all or part of the work,
 2. Calling of the security.
- B. Approval or disapproval of plan or sequence changes will be made in five working days.

1.17 WARRANTY – EROSION CONTROL

- A. The Developer shall warrant that the measures shown on the approved erosion control plan are properly constructed, installed, and are free from defective materials and/or workmanship with said warranty to continue for the terms set forth below.
- B. The Developer shall warrant and maintain all structural measures and vegetative measures for a two-year (2) maintenance guarantee and a five-year (5) guarantee covering all errors and omissions in the design and/or construction of the improvements and which guarantees shall run concurrently and shall commence upon the date of completion of the improvements and acceptance thereof by the District. Any acceptance of installed measures shall not be construed to relieve the Developer of the duty to warrant and maintain as aforesaid.

1.18 WARRANTY

- A. Developer shall maintain and repair all work that was installed incorrectly, or otherwise prove to be defective. Developer shall provide a two-year (2) maintenance guarantee and a five-year (5) guarantee covering all errors and omissions in the design and/or construction of the improvements and which guarantees shall run concurrently and shall commence upon the date of completion of the improvements and acceptance thereof by the District.

1.19 UNDERGROUND UTILITIES

- A. It shall be the responsibility of the Contractor to verify the existence and location of all underground utilities, including service connections, along the route of the work at least 48 hours prior to interruption of service or operation and to coordinate the construction schedules with these utility owners.

- B. The Contractor shall field verify all utilities and coordinate construction with utility owners prior to starting construction. The Contractor shall be responsible for protecting utilities during construction and scheduling utility adjustments to eliminate conflict with progress of the work. Any damage to existing utilities shall be repaired at the Contractor's expense.
- C. The Contractor shall notify the Engineer/Utility and Design Engineer immediately of any field condition not consistent with the Construction Drawings.

1.20 SPECIAL REQUIREMENTS

- A. All items and work not covered by these specifications shall be discussed with the District, and the Contractor shall receive approval from the District, in writing, prior to beginning work.
- B. All work must be accepted by the Engineer/Utility prior to being placed in service.
- C. No work shall take place on weekends or holidays without prior authorization from Engineer. Contact Engineer at least 48 hours (exclusive of holidays and weekends) prior to working in areas near underground utilities, pole lines, or on private property. The District will make every effort to assist with notifications received less than the 48 hours required.
- D. Prior to commencing work, Contractor shall designate, an authorized representative who shall have complete authority to represent Contractor and shall be on construction site at all times during work activities.
- E. Developer's Contractor shall not be allowed to start construction of above ground structures until all underground construction problems have been resolved, and tests have been performed and accepted.

1.21 FIELD CHANGES

- A. Field changes from the accepted plans shall not be permitted without prior permission from the District.

1.22 UTILITY FURNISHED MATERIALS

- A. If the District furnishes any materials, Contractor shall be responsible for such materials once materials have been picked up or delivered to job site.
- B. Contractor shall repair, in a manner acceptable to Engineer/Utility, or replace any 'District furnished material', which has been damaged or stolen, at his/her own expense.
- C. Contractor is responsible for careful inspection of 'District furnished material' at time of delivery.
- C. District is responsible for quality and operational design aspects of furnished material.

1.23 QUALITY CONTROL

- A. Inspection.
 - 1. Engineer shall make periodic checks to verify the quality and progress of Work. The authorized agents and their representatives of the Engineer/Utility shall be provided safe access to the work, whenever it is in preparation or progress.
 - 2. Contractor shall provide for such access and for inspection, including maintenance of temporary and permanent access.
 - 3. Materials and equipment rejected by Engineer shall be identified and remain on site until approved for removal by Engineer.

1.24 LAND MONUMENTS

- A. Private monuments shall be preserved, or replaced by a licensed surveyor at the Contractor's expense.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

END OF SECTION

SECTION 01340

SHOP DRAWINGS, SAMPLES, AND OPERATION AND MAINTENANCE MANUALS

PART 1 – GENERAL

1.1. DESCRIPTION

- A. This Section covers the submittal and review of Shop Drawings, Samples, and Operation and Maintenance Manuals. Refer to the General Conditions for basic requirements and responsibilities.

1.2. SUBMITTAL REQUIREMENTS

- A. Submit Shop Drawings, Samples, Operation and Maintenance Manuals, and other submittals as required by individual specification sections in accordance with the accepted schedule of Shop Drawing submissions.
 - 1. Engineer will not accept Shop Drawings or other submittals from anyone but Contractor.
- B. Do not submit operation and maintenance data with Shop Drawings unless so specified or required by Engineer, to determine whether equipment will comply with the Contract Documents.
- C. Submit operation and maintenance manuals to the Engineer before the lesser time of:
 - 1. equipment arrival, or
 - 2. job completion has reached fifty percent.
- D. Identify, in writing on the submittal cover sheet, all deviations of submittal from Contract Documents.
- E. Before Contractor submits a Shop Drawing, Submittal, or Sample, Contractor shall have determined and verified:
 - 1. all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - 2. the suitability of all materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work;
 - 3. all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precaution and program incident thereto; and
 - 4. shall also have reviewed and coordinated each Shop Drawing, Submittal, or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.
- F. Unless otherwise specified, submit all associated items in groups to ensure that information is available for checking each item when it is reviewed. Make sure each submittal contains items that are in one specification section only. Partial submittals may be rejected as not complying with the Contract Documents.

- G. If contractor desires to send submittals in by email, all submittals shall be in pdf format, the email header shall be filled in with specification number - submittal number, and item description. In addition, the contractor shall supply to the Engineer a full version of Adobe Acrobat Professional program that the Engineer will retain.

- H. Submit the information identified by the code symbol in the individual specification sections; or, if not so identified, submit the appropriate information outlined below required to define each item proposed to be furnished. The information to be submitted for each code symbol is defined as follows:

DATA REFERENCE SYMBOLS AND DESCRIPTIONS

<u>Symbol</u>	<u>Description</u>
A	Letters of Certification of Compliance on materials, equipment, etc.
B	Samples.
C	Final certified drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
D	Field erection instructions, assembly drawings and/or diagrams, detail reference drawings lists, and lists of erection details.
E	Shop detail drawings showing individual subassemblies and fabricated pieces, with material specifications and other applicable data.
F	Installation instructions, Operation and Maintenance Manuals, and preventive maintenance instructions and recommended frequency.
G	Schematic diagrams of power, control, and piping systems.
H	General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
I	Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty of the equipment.
J	Head capacity curves for pumps, with impeller size furnished and maximum size available indicated.
K	Curves and/or data for over-all range of operation, from minimum to maximum capacity or load, showing utilities motive medium required, total or incremental differential head, and other pertinent information applicable to the equipment or component assemblies.
L	Materials of construction of all components.
M	Renewal parts list with diagrammatic or cross-section drawings showing part identification. Include material analysis or trade designation for each significant part on parts lists.
N	Stuffing box sizes; packing sizes; and mechanical seal details, arrangement, specifications, etc., if furnished in equipment.
O	Bearing Manufacturer's standard identification and/or interchangeable number for all anti-friction bearings in the equipment proper and its accessory items.
P	Material gradation, design mix, job-mix formula, and/or material analysis.

- I. Minimum Numbers Required.
 1. Shop Drawings.
 - a. Number Contractor requires plus three (3) copies which will be retained by Engineer, five (5) copies minimum.
 - b. Submit four (4) additional copies for inclusion in Operation and Maintenance Manuals where Operation and Maintenance Manuals are called for. Where field modifications are made after acceptance, indicate "AS-CONSTRUCTED" conditions, mark copies "AS-CONSTRUCTED," and submit prior to Substantial Completion.
 2. Samples.
 - a. Two (2) unless required otherwise by individual specification sections.
 3. Operation and Maintenance Manuals.
 - a. The number required by Contractor plus four (4) copies to Engineer.

1.3. RESUBMITTAL REQUIREMENTS

- A. Make corrections or changes required by Engineer and re-submit as specified in paragraph 1.2 above until acceptable.
- B. Identify in writing all revisions other than those called for by Engineer on previous submissions.
- C. Any need for one (1) or more re-submissions will not entitle Contractor to an extension of Contract Time.
- D. Excessive resubmittals, more than two (2) on each submission, will be retained without review unless Contractor agrees to pay, through the Owner, for Engineer's review time.

1.4. SHOP DRAWINGS

- A. Include the following pertinent information for each submittal:
 1. Field dimensions, clearly identified as such.
 2. Applicable standards, such as ASTM or Federal Specification numbers.
 3. Motors – include the following:
 - a. Horsepower.
 - b. Voltage.
 - c. Temperature rating.
 - d. Service factor.
 - e. Full load current.
 - f. Full load rotative speed.
 - g. Power factor at full load.
 - h. Efficiency at full load.
 - i. Code letter.
 - j. Design letter.
 4. Color charts and similar items.
- B. Manufacturer's standard drawings, schematics, and diagrams.
 1. Clearly mark each copy to identify pertinent products and models and to describe exactly which parts of the Drawings apply to the equipment being furnished.
 2. Delete information not applicable to the Work.

- C. Reproductions or copies of portions of Contract Documents are not acceptable as complete fabrication or erection drawings. However, they may be used as a drawing upon which to indicate information on erection or to identify detail drawings.
- D. Format.
 - 1. Minimum sheet size: Eight and one-half inches by eleven inches (8-1/2" x 11").
 - a. Date of submission.
 - b. Project title and number.
 - c. Name of Contractor, supplier, and manufacturers.
 - d. Specification section number, intended use of item in the Work, and equipment designation.
 - e. Identify details by reference to sheet, detail, schedule, or room numbers shown in the Contract Documents.
 - f. Deviations from Contract Documents.
 - g. Revisions on re-submittals.
 - h. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the Work and the Contract Documents.
 - i. Provide a clear space approximately three and one-half inches by two and one-half inches (3-1/2" x 2-1/2") for Engineer's stamp.
 - 2. The submittal number shall be clearly visible on the shop drawing cover sheet. The first submittal for a specific specification section such as Concrete Formwork section 3100 shall be 3100-1. The next product in that specific specification section shall be 3100-2, and so on. By way of example, if a resubmittal is required for submittal 3300-12, the first resubmittal shall be numbered 3300-12.a, and so on.

1.5. SAMPLES

- A. Samples shall be of sufficient size and quantity to clearly illustrate the functional characteristics of the product with integrally-related parts and attachment devices and the full range of color, texture, and pattern.

1.6. OPERATION AND MAINTENANCE MANUALS

- A. Submit Operation and Maintenance Manuals by the time the Work is fifty percent (50%) complete for all equipment so designated in the individual Specification Sections and for which the Shop Drawings were reviewed and marked "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED." In addition, submit instruction books and other pertinent information for equipment not so designated which required special instruction or knowledge for proper operation and maintenance.
- B. Do not start or operate equipment until the respective operation and maintenance data has been reviewed, approved, and copies are made available at the site.
- C. The Operation and Maintenance Manuals shall be in addition to instructions or parts lists packed with or attached to equipment when delivered.
- D. Include (as a minimum) the following information:
 - 1. Equipment function, normal operating characteristics and limiting conditions, complete motor data, test data, and performance curves where applicable.

2. Operating instructions for start-up, routine and normal operations, regulations and control, shutdown, and emergency conditions.
3. Lubrication and routine maintenance instructions.
4. Guide to "troubleshooting."
5. Parts lists, predicted life of parts subject to wear, and recommended list of spare parts to be on hand.
6. Outline, cross-section, and assembly drawings; Engineering data; and wiring diagrams.
7. Copy of accepted or as-constructed Shop Drawings.
8. Temperature control diagrams.
9. System balance report including a description of system operation as prepared by the balancing Contractor, which includes a schedule of inspection and maintenance.
10. System schematic flow diagrams.

E. Format.

1. Submit in a format suitable for binding in a three-ring binder or a post binder.
2. Minimum sheet size: Eight and one-half inches by eleven inches (8-1/2" x 11").
3. Fold drawings larger than eleven inches by seventeen inches (11" x 17") and insert into individual pockets bound into the manuals.
4. Enclose pages subject to frequent usage by operators in clear plastic.
5. Individually annotate standard drawings that are furnished and describe exactly which parts of the drawing apply to the equipment being furnished.
6. Identify each submission with the following:
 - a. Date of submission.
 - b. Project title and number.
 - c. Names of Contractor, supplier, and manufacturers (include telephone numbers and addresses).
 - d. Names of subcontractors (with telephone numbers and addresses), contracted by Contractor for servicing and maintenance of portions of the project.
 - e. Specification section number, intended uses of item in the Work, and equipment designation.
 - f. Identify details by reference to sheet detail, schedule, or room numbers shown in the Contract Documents.

1.7. REVIEW OF SUBMITTALS

- A. A minimum of fourteen (14) days will be required for Engineer to review each submittal or re-submittal following the receipt of said submittal in Engineer's office of all information required for review of the submittal. Engineer will notify Contractor when the review time must be extended in order to correlate the submittal with other forthcoming submittals or for any other reason that prevents Engineer's timely review.

- B. Engineer will review submittals, affix a stamp and initials or signature, will indicate subsequent action to be taken, and will return the submittals to Contractor for distribution. The review actions listed on Engineer's stamp are defined as follows:
1. **NO EXCEPTION TAKEN** – Signified material or equipment represented by the submittal conforms to the design concept and complies with the information given in the Contract Documents. Contractor is to proceed with fabrication or procurement of the items and with related work.
 2. **MAKE CORRECTIONS NOTED** – Signified material or equipment represented by the submittal conforms to the design concept and complies with the information given in the Contract Documents and in accordance with Engineer's notations. Contractor is to proceed with the Work in accordance with Engineer's notations.
 3. **REVISE AND RESUBMIT** – Signified material or equipment represented by the submittal conforms to the basic design concept; however, it does not comply with the information given in the Contract Documents. Contractor is to submit a revised submittal responsive to the notations marked on the returned submittal and to the information in the Contract Documents.
 4. **REJECTED** – Signifies material or equipment represented by the submittal does not conform to the design concept to comply with the information given in the Contract Documents and is not acceptable for use in the Work. Contractor is to submit material or equipment responsive to the Contract Documents.
 5. **SUBMIT SPECIFIED ITEM** – Signifies material or equipment represented by the submittal is not the item specified in the Contract Documents and is not to be incorporated into the Work. Contractor is to submit only the material or equipment specified in the Contract Documents.
- C. Engineer will return the number of copies of submittals specified below depending on the action taken.

Action by Engineer	No. Retained by Engineer	No. Returned to Contractor**	No. Required for Re-submittal
No Exception Taken	3	1	0
Make Corrections Noted	3	1	0
Revise & Resubmit	2	2	4
Rejected	2	2	4
Submit Specified Item*	2	2	4

* Only one (1) copy of the submittals returned to the Contractor marked with these actions will be stamped annotated.

** If a reproducible transparency is submitted, Engineer will return the transparency with the stamp and annotations.

- D. Shop Drawings submitted to Engineer for review not meeting the requirements of this specification will automatically be returned to the Contractor with revise and resubmit action.

1.8. DISTRIBUTION

- A. Distribute reproduction or copies of Shop Drawings that carry Engineer's stamp of acceptance to the Contractor's personnel, the job site file, the project record document file, the subcontractors, the suppliers, the manufacturers, and other affected Contractors.
- B. Distribute samples which carry Engineer's stamp of acceptance to the project record file and the affected supplier or manufacturer.

END OF SECTION

SECTION 01600

MATERIAL, EQUIPMENT AND WORKMANSHIP

PART 1 GENERAL

1.1 MATERIALS AND EQUIPMENT

- A. Contractor shall furnish all materials, equipment, labor, and all other facilities and incidentals necessary for the execution, disinfection, testing, and completion of the work, with the exception of certain District furnished material.
- B. All materials and equipment shall be of good quality and new, except as otherwise provided on the Construction Drawings.
 - 1. When requested by the District, the Contractor shall furnish satisfactory evidence (including manufacturer's certification) as to the kind and quality of materials and equipment, and their compliance with these specifications.
 - a. It is the Contractor's responsibility to insure that the manufacturer's materials supplied, meet these specifications.
 - b. The District shall test any manufacturer's material it deems necessary.
 - 2. Prior to using existing materials, written approval must be obtained from the District.
- C. All materials and equipment shall be installed and used in accordance with the instructions of the applicable manufacturer, fabricator, supplier or distributor, except as otherwise provided in these specifications.
- D. The specification of materials and equipment shall be understood to be representative of a quality of performance, operation and construction acceptable to the District.
 - 1. The District shall evaluate all written requests for product substitution.
 - a. Such requests shall include detailed product literature and a description of benefits which might be achieved by this substitution.
- E. In approving materials or equipment for installation, the District assumes no responsibility for injury or claims resulting from failure of the materials or equipment to comply with the applicable National, State, and local safety codes or requirements, or the safety requirements of a recognized agency; or failure due to faulty design concepts, or defective workmanship.

1.2 WORKMANSHIP

- A. Contractor shall provide competent, disciplined, suitably qualified personnel to supervise the work and perform the construction.
 - 1. Any workmen deemed not qualified, in the opinion of the District, shall not be allowed to perform any construction, and shall be restricted from participating in the Work.

- B. The construction standards, tests and methods outlined in these specifications are considered adequate to produce the product desired by the District.
 - 1. The District shall evaluate alternative methods of construction upon request.
 - a. Requests for alternative methods of construction shall include detailed descriptions of the equipment, methods and controls needed for the alternative, and a description of the benefits which might be achieved by this substitution.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

END OF SECTION

SECTION 01710

SITE CLEANUP

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General:

1. This Section includes requirements for cleanup of the construction site.
2. When the work is being done as a part of a contract between a Developer and a Contractor, this Section shall be used as a guideline. The actual requirements should be contained in the contract between the Developer and Contractor.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 SITE CLEANUP

- A. Site cleanup shall be executed during the progress of the work, and at completion of the work.
- B. Site cleanup shall be maintained in a safe condition at all times.
- C. Construction materials shall be neatly stored.
- D. Containers shall be provided for the collection of waste material and debris.
 1. Containers shall not be stored in any existing public right-of-way without the written permission of the local street or road authority.
- E. Construction materials, equipment, waste containers, construction buildings, parking, etc., shall not be allowed within any existing public right-of-way without written permission from the public right-of-way authority.
 1. Any off-site storage of construction material, equipment, waste containers, construction buildings, parking, etc., shall be allowed only after the Contractor has obtained the written permission of the property owner.
 - a. A copy of the agreement shall be available at the job site at all times.
- F. During construction the job site shall be adequately protected from soil erosion in accordance with these Specifications.
- G. Sanitary facilities shall be provided for all workers whom are working outdoors.
- H. Upon completion of the construction, the job site shall be restored in accordance with these Specifications.

- I. All exterior paved surfaces shall be broomed and/or washed clean and left in good repair.
 - 1. Engineer and Contractor shall inspect all exterior paved surfaces before and after construction to insure their condition.
- J. In order to maintain an orderly site, waste material and debris shall be removed weekly.
- K. Volatile wastes shall be stored in clearly marked, covered, metal containers and removed daily in accordance with federal, state and local requirements.
- L. Contractor shall conform to the requirements set forth in the local jurisdiction's Erosion Control Reference Manual.

END OF SECTION

SECTION 01720

FIELD ENGINEERING AND SURVEYING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surveying: It shall be the responsibility of the Developer to provide construction staking for horizontal and vertical alignment of the centerline, grading, and all appurtenant features of the work including all offset lines necessary for construction.
- B. All construction surveying provided by the Developer shall be completed under the supervision of a Colorado Registered Land Surveyor.

The Design Engineer shall provide the elevations and descriptions of the original and temporary project benchmarks.

Adequate staking shall be provided to establish acceptable horizontal and vertical control.

Offsets shall be staked so that vertical and horizontal alignment may be checked.

All survey data, which is developed by the Contractor or the Design Engineer in performing surveys which are required by the work, shall be available to the District for examination throughout the construction period.

- B. Supervision: The Contractor shall have supervision, knowledge of the project requirements and proper installation, and construction procedures, available in the field at all times that work is progressing.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

END OF SECTION

SECTION 01780
RECORD DRAWINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Final Paperwork:

The Contractor shall deliver the following items to the Engineer/Utility upon completion of the Work:

1. Record Drawings
 - a. Record Drawings should be prepared with a cooperative effort of the Design Engineer and the Contractor.
 - b. Record Drawings shall be provided to the Utility from the Design Engineer.
 - c. Each drawing shall be labeled: "RECORD DRAWING" in neat large printed letters.
 - d. Construction information shall be recorded concurrently with construction progress.
 - e. Record Drawings shall record actual construction information and contain, at minimum, the following:
 - 1) Field dimensions, elevations, and details.
 - 2) Field changes which are made by modification.
 - 3) Details that are not on the original Construction Drawings.
 - 4) Elevations of manhole inverts in relation to project datum.
 - f. Record Drawings shall be submitted to the Engineer containing the following:
 - 1) The signature of the Design Engineer, and his/her Professional Engineering Stamp and date.
 - g. Record Drawings shall be submitted in an 11" x 17" format and shall include one (1) set paper copy, one (1) set on reproducible, double matte Mylar, one digital version in Adobe (pdf) format, and one digital version in AutoCAD. The Design Engineer shall coordinate with the District on the digital software versions to be submitted.
 - h. Receipt, review, and acceptance of the Record Drawings by the Engineer shall be a condition for acceptance of the Work.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

END OF SECTION

SECTION 02050

DEMOLITION AND SALVAGE

PART 1 – GENERAL

1.1. DESCRIPTION

- A. Complete all demolition items shown and noted on the Drawings. Dispose of or claim demolition items at CONTRACTOR's option unless otherwise stipulated herein. All items called for to be salvaged shall become the property of District.
- B. Fencing to be reused in construction shall remain the property of the OWNER.

1.2. JOB CONDITIONS

- A. Provide the District with two (2) weeks notice of date when demolition is to begin.
- B. CONTRACTOR is responsible for acquiring all approvals and permits required for the demolition including traffic control.
- C. Perform demolition work items with proper sequencing to ensure minimum interruption of traffic flows.
- D. Utility Services.
 - 1. Provide temporary utilities and protect against damage during construction operations.
 - 2. Do not interrupt utilities serving operating facilities unless approved by the District.

PART 2 – PRODUCTS – NOT APPLICABLE

PART 3 – EXECUTION

3.1. DEMOLITION

- A. General
 - 1. Proceed with demolition in a systematic manner.
 - 2. Demolish concrete and asphalt in small sections.
 - 3. Demolish and remove all foundations, footings, concrete slabs on ground, and all other below-grade construction.
- B. Disposal of Demolished Materials.
 - 1. Remove all debris, rubbish, and other materials resulting from demolition operations from the site.
 - 2. Burning of removed materials from demolished structures will not be permitted.
- C. Promptly repair damages caused to adjacent facilities by demolition operations in a manner acceptable to ENGINEER and at no cost to the District.

END OF SECTION

SECTION 02100
SITE PREPARATION

PART 1 GENERAL

1.1 DESCRIPTION

This Section covers the removal, stockpiling, replacement and disposal of materials existing on site.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 STRIPPING

- A. Any material containing roots, grasses and other deleterious or organic matter generally found in the top twelve inches of undisturbed natural terrain shall be stripped from all areas requiring excavation, grading, trenching, subgrade preparation for foundations and embankment work. Stripped top soil deemed suitable for spading over the finished grades shall be stockpiled and preserved until the finished grading operation, at which time it shall be spread uniformly over areas to be seeded or sodded.
- B. Whenever it is necessary to disturb existing grass or soil, from the yards of existing residences, care shall be taken so as to strip existing grass and topsoil in a manner that will permit the replacement thereof as close as possible to the original condition and to the satisfaction of the property owner and/or Developer. Tarps or suitable drop cloths shall be spread over all undisturbed areas in such a manner that will protect all areas adjacent to excavations.

3.2 REMOVAL OF EXISTING IMPROVEMENTS

- A. Bituminous Pavement - Bituminous pavement and concrete pans (and sidewalks, if required).

The Contractor shall be responsible for removal and disposal of all bituminous pavement and concrete to be removed as part of the project.

END OF SECTION

SECTION 02221

TRENCHING, BACKFILLING, AND COMPACTING

PART 1 – GENERAL

1.1. DESCRIPTION

- A. This Section covers earthwork requirements for underground pipelines and appurtenances including excavation and trenching, drainage, preparation of subgrades, pipe bedding, backfilling, compacting, and finish grading.
- B. Classification of Excavated Material.
 - 1. Excavation includes the removal and subsequent handling of all materials excavated or otherwise removed in performance of the Work, regardless of the type, character, composition, or condition thereof.
 - 2. Excavated materials for use as backfill will be classified in accordance with ASTM D2487. Identification and classification of materials will be based upon visual examination and simple manual tests performed under the direction of the Engineer by an independent testing laboratory. If visual examination and manual tests are inadequate for the required identification and classification, the Engineer will require the testing laboratory to determine definite index properties of questionable material.
 - 3. Excavated materials not used as backfill will not be classified.
 - 4. Stockpile materials to be used as backfill separate from other materials.

1.2. SUBMITTALS

- A. Test Certificates.
 - 1. Submit test certificates to enable Engineer to determine compliance with the Specifications for imported materials from each proposed source of supplier.
 - a. ASTM D698 or ASTM D1557.
 - b. ASTM D4253, D4254.
 - c. ASTM D422.
 - d. ASTM D4318.
 - 2. All testing shall have been completed within the six (6) months prior to using the material on the project.

1.3. PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Select transportation schedule and truck routes with approval of District to minimize impacts to the public.
- B. Do not mix stabilization material or bedding material with topsoil or job excavated material.

1.4. MAINTENANCE AND CORRECTION

- A. Maintain and correct all trench settlement and make necessary repairs to pavement, sidewalks, or other structures which may be damaged as the result of backfill or settlement for a period of two (2) years after Substantial Completion.

- B. Contractor may perform such maintenance and correction by subcontract. If subcontracted, submit with application for final payment a copy of any subcontract or authorization as evidence of Contractor's faithful intention to perform necessary corrections during the two (2) year correction period.

PART 2 – PRODUCTS

2.1. STABILIZATION MATERIAL

- A. If determined by the Engineer that the existing soil in the trench bottom is unsuitable, a minimum of six inches (6") of pipe subgrade shall be removed and replaced with a stabilization material.
- B. Subgrade below top six inches (6").
 - 1. Pit-run gravel or crusher-run rock meeting ASTM D448 gradation No. 357 (two inches (2") to No. 4 sieve), or
 - 2. Same as top six inches (6") except that broken concrete and rock may be included in size permitting compaction specified without discernible voids.
- C. Geosynthetics may be used in conjunction with stabilization material, with prior approval by the Engineer.

2.2. BEDDING MATERIALS

- A. Concrete.
 - 1. Meet requirements of Section 03300 – Cast-In-Place Concrete with a minimum twenty-eight (28) day compressive strength of 3,000 psi.
 - a. Backfilling against bedding concrete shall not commence until concrete has attained eighty percent (80%) of its specified field compressive strength.
- B. Squeegee Sand.
 - 1. Squeegee sand with the following gradation.

Sieve Size	% Passing
3/8 inch	100
No. 200	0 - 3

- C. Granular Material.
 - 1. Screened rock or gravel with one hundred percent (100%) passing a one-inch (1") sieve; ninety-five percent (95%) passing a three-quarter-inch (3/4") sieve; and not more than five percent (5%) passing No. 4 sieve.
 - 2. Or, well-graded screened stone or gravel meeting requirements of ASTM D448, gradation 67.
- D. Select Soil.
 - 1. Material free from rocks, clods, and stones greater than one and one-half-inches (1-1/2") in any dimension and meeting other requirements of trench backfill material OR granular material.
 - 2. Native clay and claystone soils may not be used as bedding material.

2.3. TRENCH BACKFILL MATERIAL

- A. Trench backfill may be job excavated granular material or imported backfill material as specified below.
- B. Job-excavated material shall be free of frozen material, stumps, roots, brush, other organic matter, cinders, other corrosive material, debris, rocks, or stones greater than the following dimensions.
 - 1. Job-excavated material shall meet the requirements of Subsection 2.2.C. for use as select material within twelve inches (12”) of the top of the pipe.
 - 2. Six inches (6”) in any dimension for the remainder of the trench provided they are distributed in the finer material.
 - 3. Three inches (3”) in any dimension for material placed within one foot (1’-0”) of pavement subgrade or finished surface in unpaved areas.
- C. Imported Backfill Material.
 - 1. Pit-run gravel or crusher-run rock with the following gradation. (Coarse Aggregate No. 4 from Table 703-2.)

Sieve Size	% Passing
2 inch	100
1 inch	20-55
3/4 inch	0-15
3/8 inch	0-5

- 2. Material passing a No. 40 sieve shall have a liquid limit less than thirty-five (35) and a plastic index less than six (6) when tested in accordance with ASTM D4318 or AASTHO T-89 and T-91, respectively.
- D. Highway Right-of-Way.
 - 1. Obtain approval by the agency having jurisdiction over highway maintenance for material placed within the limits of paved surfacing, gravel shoulders, or shoulder slopes.

2.4. BARRIER MATERIAL

- A. Finely divided, job excavated material free from stones, organic matter, and debris meeting a soil classification of SC, CL, or ML-CL.

2.5. GEOTEXTILES

- A. Filter Fabric.
 - 1. Mirafi S600, or approved equal.

PART 3 – EXECUTION

3.1. PREPARATION

- A. Clearing.
 - 1. Remove and dispose of trees, shrubs, bushes, downed trees, upturned stumps, weeds, and other vegetation within the limits of clearing.

2. Limit clearing to as narrow a width as practical within the right-of-way or permanent easements.
3. Remove only non-cultured shrubs, bushes, and other vegetation within the limits of the temporary easements.
4. Trim trees in lieu of removal when practicable.
5. Apply wound paint to cuts or scarred surfaces of trees or shrubs.
6. Protect root zones of trees and cultivated plants not removed.

B. Topsoiling.

1. Remove topsoil from all areas to be disturbed by construction.
2. Minimum depth of removal.
 - a. Equal to depth of existing topsoil or eight inches (8"), whichever is greater.
3. Stockpile topsoil and keep segregated from granular materials and inorganic trench materials and debris.

C. Sod Removal.

1. In lawn areas, cut and roll back sod before trenching.
2. If sod is to be reused, store and protect sod from damage and drying.
3. Do not reuse when stored for more than forty-eight (48) hours.

D. Pavement Removal.

1. Remove pavement, drives, curbs, and sidewalks to clean straight lines. Saw cutting is required if a clean straight line cannot be obtained by other methods.
2. On concrete surfacing if saw cut would fall within three feet (3'-0") of a construction joint, cold-joint, or edge, remove concrete to that location.

3.2. JOB CONDITIONS

A. Right-of-Way.

1. Haul and stockpile excess material or erect suitable bulkheads to prevent deposition of excavated material where permanent right-of-way or temporary construction easement is not adequate to stockpile all excavated material without depositing it on private property.

B. Blasting.

1. No blasting or other use of explosives will be permitted.

C. Drainage and Groundwater.

1. Comply with all federal, state, and local regulations dealing with site drainage, dewatering, and erosion and sediment control including permitting requirements.
2. Provide all means necessary to accomplish drainage, dewatering, and erosion control required for completion of the Work.
3. Provide drainage control measures to prevent surface runoff from entering trench excavations.
4. Maintain excavations and trench free from water during construction.
5. Remove water encountered in the trench to the extent necessary to provide a firm subgrade, to permit joints to be made in the dry, and to prevent the entrance of water into the pipeline.
6. Maintain the excavation or trench free from water until the structure, or pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

7. Use pumps, gravel blankets, well points, drain lines, or other means necessary to accomplish the above.
 8. Obtain approval of individual owners and ditch companies for discharge to their property or facilities.
 9. Prevent ponding or continuous running water around trees or cultured plants.
 10. Control dewatering discharge operations and surface runoff in accordance with necessary permits.
- D. Sheeting and Shoring.
1. Use sheeting and shoring where banks are not cut back on a stable slope and as necessary to prevent caving or sliding; and to protect the Work and adjacent structures and facilities. All work shall conform to current applicable regulations.
 2. Sheeting and shoring shall be designed by a Professional Engineer registered in the same state as the project is located to withstand all applicable earth, surcharge, and hydrostatic loads and shall be built and maintained in accordance with the design.
 3. Support sheeting to avoid load concentration or horizontal thrust on underground structures.
 4. Sheeting removal.
 - a. Do not remove prior to backfilling.
 - b. Use effective methods to protect construction, other structures, utilities, and properties during sheeting removal.
 - c. Fill voids left by sheeting removal with dry sand.
- E. Sequence of Operation.
1. Install the pipeline within a minimum of one hundred linear feet (100 L.F.) of trench excavation in developed areas and three hundred feet (300') in all other locations.
 2. Backfill the trench within a minimum of one hundred fifty linear feet (150 L.F.) of the pipe installation in developed areas and two hundred feet (200') in all other locations.
 3. Clean up the right-of-way within a minimum of five hundred linear feet (500 L.F.) of trench excavation in developed areas and one thousand feet (1000') in all other locations.
- F. Underground Obstructions.
1. Underground obstructions known to Engineer are shown on Drawings.
 - a. Locations shown may prove inaccurate and other obstructions not known to Engineer may be encountered.
 - b. Contractor shall field locate and verify all obstructions whether or not shown on the Drawings.
 2. Notify each utility owner and request utilities be field located by surface reference at least forty-eight (48) hours prior to trenching or excavation.
 3. Expose and verify size, location, and elevation of underground utilities and other obstruction where conflicts might exist sufficiently in advance to permit changes in the event of conflict.
 - a. Notify Engineer in case of conflict.
 4. Maintain, protect, and support by shoring, bracing, or other means existing utilities and appurtenances.
 5. Take such protective measures as the utility may direct where alterations or moving of utilities is required.
 6. If Contractor elects to remove underground obstructions such as sprinklers, drainage culverts, catch basins, or other structures, the following shall apply:

- a. Restore to original conditions or better, unless otherwise noted on drawings.
7. Maintain the flow in field drains at the quantity, quality, and velocity present prior to the temporary removal of the drain pipe unless otherwise noted on the Drawings.
8. Maintain drainage during construction, clean drainage culverts so they are free of sediment after construction.

3.3. TRENCHING

- A. Excavate trenches by open cut methods except where boring or tunneling is indicated in the Contract Documents, required by jurisdictional agencies, or desired by Contractor to avoid removal of obstruction.
- B. Do not use mechanical equipment in locations where its operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground. In all such locations, hand excavating methods shall be used.
- C. Use mechanical equipment so designed and operated that the rough trench excavation bottom elevation can be controlled with uniform trench widths and vertical sidewalls from an elevation of one foot (1'-0") above the top of the installed pipe to the bottom of the trench, and trench alignment sufficiently accurate to permit pipe to be aligned properly with adequate clearance between the pipe and sidewalls of the trench. Do not undercut the trench sidewall to obtain clearance.
- D. Excavation in Rock.
 1. Over-excavate a minimum of six inches (6") below the bottom of the pipe for pipe twenty-four inches (24") in diameter or less, and nine inches (9") for pipe larger than twenty-four inches (24"), wherever the trench bottom is rock, shale, or other hard or semi-hard material.
 2. Backfill over-excavation with Stabilization Material.
- E. Preparation of Trench Bottom.
 1. Grade trench bottoms uniformly to provide clearance for each section of pipe.
 2. Remove loose materials, water, and foreign objects.
 3. Provide firm subgrade suitable for application of bedding material.
 4. Wherever unstable material that, in the opinion of the District's Representative, is incapable of supporting the pipe is encountered in the bottom of the trench, over-excavate such material to a depth suitable for construction of a stable subgrade. Backfill over-depth excavation with Stabilization Material and compact.
 5. In areas where subgrades cannot be stabilized with Stabilization Material, install filter fabric in accordance with the manufacturer's recommendations in the bottom of the trench and cover with a minimum of twelve inches (12") of Stabilization material.
- F. Stockpiling Excavated Materials.
 1. Pile suitable material for backfilling in an orderly manner and a sufficient distance from banks of the trench to avoid overloading and to prevent slides or cave-ins.
 2. Stockpile excess excavated materials not suitable or not required for backfilling on-site at District's Direction.
 3. Do not stockpile excavated material against existing structures, appurtenances, trees, or cultivated shrubs.

- G. Limiting Trench Widths.
1. Excavate trenches to provide adequate working space and pipe clearances for proper pipe installation, jointing, and embedment. Provide a minimum clearance of six inches (6") on each side of the pipe for pipe twelve inches (12") in diameter or less; eight inches (8") for pipe between fourteen inches (14") and thirty inches (30") in diameter; and twelve inches (12") for pipe larger than thirty inches (30") in diameter.
 2. If PVC pipe is used and maximum cover over the pipe exceeds seventeen feet (17'), use granular material compacted to ninety-five percent (95%) of maximum density as determined by ASTM D698 to an elevation one foot (1'-0") above the top of the pipe.
 3. Maximum trench width shall be the pipe O.D. plus two feet-six inches (2'-6").
- H. Over-depth Excavation.
1. Restore over-excavated subgrades to proper elevation with Stabilization Material.

3.4. PIPE BEDDING

- A. Bedding Classes.
1. Place pipe bedding in accordance with the details shown on the Drawings.
 2. Bedding shall be Modified Class B or better except where other Classes are specifically indicated on the Drawings.
 3. Provide higher-class bedding where maximum trench width is exceeded and the higher class is required to avoid overloading the strength of pipe being placed as determined by Engineer.
- B. Placement and Compaction.
1. Distribute and grade bedding material to provide uniform and continuous support beneath the pipe at all points between bell holes or pipe joints.
 2. Deposit bedding material and compact uniformly and simultaneously on each side of the pipe to prevent lateral displacement.
 3. Compact to densities specified in this section.
- C. Groundwater Barriers.
1. To impede passages of water through granular bedding material, construct a groundwater barrier the full trench width approximately four feet (4'-0") long, and from the bottom of all Granular Material to one foot (1'-0") above top of pipe.
 2. Location.
 - a. Sanitary Sewers: Approximately ten feet (10') upstream from each manhole or concrete structure.
 - b. All other pipelines: Approximately seventy-five feet (75') apart.
 - c. For all pipelines: Approximately ten feet (10') upstream and downstream of all ditch and creek crossings.
 - d. For all pipelines: Approximately at the mid-section of the pipe, and in no case within three feet (3'-0") of a pipe joint.

3.5. BACKFILLING AND COMPACTION

- A. Sheeting Removal.
1. Do not remove sheeting prior to backfilling.
 2. Use effective methods to protect the construction, other structures, utilities, and properties during sheeting removal.
 3. Fill voids left by sheeting removal with dry sand.

- B. Deposit backfill material in uniform layers not exceeding eight inches (8") in uncompacted thickness. Increased layer thickness may be acceptable provided it is demonstrated that the specified compacted density will be obtained.
- C. Use methods and equipment appropriate for the backfill material. Do not use equipment or methods that will transmit damaging shocks to the pipe.
 - 1. Do not perform compaction by jetting.
- D. Import material for trench backfill if compaction can not be obtained with job-excavated material.
- E. Backfill in Fields.
 - 1. Do not mechanically compact the top two feet (2'-0") of backfill in fields.
 - 2. Estimate the amount of material required to backfill the trench and form a sufficient mound so that after normal settlement has occurred the finished surface will match the existing grade.
- F. Topsoiling.
 - 1. Replace topsoil to the depth of stripping over all areas disturbed by construction operations and which will not receive other surface treatment.
- G. Spoil excess excavated materials and material not suitable for backfilling on-site at District's Direction.

3.6. FIELD QUALITY CONTROL

- A. Moisture and Density Tests.
 - 1. The following tests shall be conducted, where applicable, on representative samples of each type of material encountered or utilized and will be used as a basis for compaction control.
 - a. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (Standard Proctor) or ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (Modified Proctor).
 - 1) Use method A, B, C, or D, as appropriate, based on soil condition and judgment of the testing laboratory.
 - 2) Sample tests will be representative of materials to be placed.
 - 3) Determine and provide optimum density curve for each type of material encountered or utilized.
 - 4) Include Atterberg Limits, grain size determination, and specific gravity.
 - b. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - c. ASTM D4254 - Standard Test Methods for Minimum Index Density and Unit Weight of Soils Using a Vibratory Table.
- B. Compaction shall be to the following minimum densities and within the moisture content range specified.
 - 1. Subgrade:
 - a. Material containing more than ten percent (10%) passing the No. 200 Sieve: Ninety-eight percent (98%) of maximum dry density at plus or minus two percent (+/-2%) of optimum moisture content in accordance with ASTM D698.

- b. Disturbed native material may not be used for subgrade material.
 - c. ASTM D2167 - Tests for Density of Soil In-Place by Rubber-Balloon Method.
 - 2. Barrier material: Ninety-five percent (95%) of maximum dry density at plus or minus two percent (+/-2%) of optimum moisture content in accordance with ASTM D698.
 - 3. Pipe bedding.
 - a. Carefully compacted select soil: ASTM D698 - Ninety-five percent (95%) of maximum dry density at plus or minus two percent (+/-2%) of optimum moisture content.
 - b. Compacted granular material: Seventy percent (70%) relative density in accordance with ASTM D4253, D4254.
 - 4. Trench backfill.
 - a. Paved roadways, sidewalks, and other areas to receive pavements.
 - 1) Top four feet (4'-0"): ASTM D698 - Ninety-eight percent (98%) of maximum dry density at minus two percent to plus two percent (-2% to +2%) of optimum moisture content.
 - 2) Remainder of trench: ASTM D698 - Ninety-five percent (95%) of maximum dry density at plus or minus two percent (+/-2%) of optimum moisture content.
 - b. Gravel roadways: ASTM D698 - Ninety-five percent (95%) of maximum dry density at minus two percent to plus two percent (-2% to +2%) of optimum moisture content.
 - c. Sodded or lawn areas: ASTM D698 - Eighty-eight percent (88%) of maximum dry density at plus or minus two percent (+/-2%) of optimum moisture content for top foot of trench only.
 - d. Fields and all other areas: ASTM D698 - Ninety-five percent (95%) of maximum dry density at plus or minus two percent (+/-2%) of optimum moisture content, or equal to the density of undisturbed adjacent material, whichever is greater, unless otherwise indicated.
 - e. Under footings, foundations, or structures:
 - 1) ASTM D698 - One hundred percent (100%) of maximum dry density at plus or minus two percent (+/-2%) of optimum moisture content.
 - 2) Where pipe crown is within three feet (3'-0") of the underside of the structure, encase pipe in concrete and rebar all the way to the bottom of the structure and support from piers.
 - f. All other locations: ASTM D698 - Ninety-five percent (95%) of maximum dry density at plus or minus two percent (+/-2%) of optimum moisture content.
 - 5. Where granular materials are used in lieu of cohesive soils, seventy-five percent (75%) relative density in accordance with ASTM D4253, and D4254 shall apply unless noted otherwise.
 - 6. Compaction around structures.
 - a. Structures include manholes, meter pits, vaults, curb boxes, and other similar structures that break the horizontal plane of the backfill.
 - b. Mechanically compact.
 - c. Use manually operated platform-type tampers or similar equipment within twelve inches (12") of any structure.
- C. Moisture Content.
- 1. Add water, harrow, disc, blade, or otherwise work material as required to ensure uniform moisture content prior to compaction.

- D. Field Testing.
1. Field tests will be conducted to determine compliance with compaction and moisture content requirements in accordance with:
 - a. ASTM D2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 2. Conduct a minimum of two (2) tests for every five hundred linear feet (500 L.F.) of trench each twenty-four inches (24") of rise.
 3. Contractor shall coordinate all the testing with District's Testing Company.
- E. In case of a conflict or disagreement between codes, standards, laws, ordinances, rules and regulations, or within any document itself, the more stringent requirements as determined by the Engineer apply.

END OF SECTION

SECTION 02240

WATER CONTROL AND DEWATERING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The work of this section consists of controlling groundwater, site drainage, and storm flows during construction. The Contractor shall be cautious when work involves construction in and around drainage channels, local streams or rivers, and areas of local drainage. These areas are subject to frequent periodic inundation.

1.2 RELATED SECTIONS

- A. Section 02225 – Trenching, Bedding and Backfill
- B. Section 02722 – Sanitary Sewerage Systems

PART 2 PRODUCTS

2.1 MATERIALS

- A. On-site materials may be used within the limits of construction to construct temporary dams and berms. The materials such as plastic sheeting, sand bags, and storm sewer pipe may also be used if desired by the Contractor.

PART 3 EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

- A. General: For all excavation, the Contractor shall provide suitable equipment and labor to remove water, and he shall keep the excavation dewatered so that construction can be carried on under dewatered conditions. Water control shall be accomplished such that no damage is done to adjacent channel banks or structures. The Developer, through their Design Engineer, is responsible for investigating and familiarizing himself with all site conditions that may affect the work including surface water, level of groundwater and the time of year the work is to be done. All excavations made as part of dewatering operations shall be backfilled with the same type material as was removed and compacted to 95% of Maximum Standard Proctor Density (ASTM D698) except where replacement by other materials and/or methods are required.

The Contractor shall conduct his/her operation in such a manner that storm or other waters may proceed uninterrupted along their existing drainage courses.

At no time during construction shall the Contractor affect existing surface or subsurface drainage patterns of adjacent property. Any damage to adjacent property resulting from the Contractor or Developer's alteration of surface or subsurface drainage patterns shall be repaired by the Contractor.

Contractor shall remove all temporary water control facilities when they are no longer needed or at the completion of the project.

B. Surface Water Control: Surface water control generally falls in to the following categories:

1. Normal low flows along the channel;
2. Storm/flood flows along the channel;
3. Flows from existing storm drain pipelines; and,
4. Local surface inflows not conveyed by pipelines.

The Contractor shall coordinate, evaluate, design, construct, and maintain temporary water conveyance systems. These systems shall not worsen flooding, alter major flow paths, or worsen flow characteristics during construction. The Contractor is responsible to ensure that any such worsening of flooding does not occur. The Contractor is solely responsible for determining the methods and adequacy of water control measures.

At a minimum, the Contractor will be responsible for diverting the quantity of surface flow around the construction area so that the excavations will remain free of surface water for the time it takes to install these materials, and the time required for curing of any concrete or grout. The Contractor is cautioned that the minimum quantity of water to be diverted is for erosion control and construction purposes and not for general protection of the construction-site. It shall be the Contractor's responsibility to determine the quantity of water which shall be diverted to protect their work from damage caused by storm water.

The Contractor shall, at all times, maintain a flow path for all channels. Temporary structures such as berms, sandbags, pipeline diversions, etc., may be permitted for the control of channel flow, as long as such measures are not a major obstruction to flood flows, do not worsen flooding, or alter historic flow routes.

C. Groundwater Control: The Contractor shall install adequate measures to maintain the level of groundwater below the foundation subgrade elevation and maintain sufficient bearing capacity for all structures, pipelines, earthwork, and rock work. Such measures may include, but are not limited to, installation of perimeter subdrains, pumping from drilled holes or by pumping from sumps excavated below the subgrade elevation.

The foundation bearing surfaces are to be kept dewatered and stable until the structures or other types of work are complete and backfilled. Disturbance of foundation subgrade by Contractor's operations shall not be considered as originally unsuitable foundation subgrade and shall be repaired.

Contractor shall obtain all necessary permits prior to starting dewatering operations.

- a. If groundwater will be discharged into an irrigation ditch, pond, stream or other waterway, or will drain to an irrigation ditch, pond, stream or waterway, a Colorado Department of Public Health and Environment (CDPHE) dewatering permit and permission from the associated ditch company will be required.
- b. Permit applications may take up to 30 days to be reviewed by the Colorado Department of Public Health and Environment (CDPHE).
- c. Contractor or their designated representative is required to complete and process Discharge Monitoring Reports (DMR) that are typically a part of the dewatering permit.

- d. Upon finishing the work, Contractor or their designated representative shall be responsible for completing a Colorado Department of Public Health and Environment Discharge Termination Notice.

END OF SECTION

SECTION 02315

PIPE BORING AND JACKING

PART 1 – GENERAL

1.1. DESCRIPTION

- A. This Section covers the furnishing and installation of casing pipe by boring, jacking, or tunneling.
- B. Contractor shall meet or exceed all City, Larimer County, CDOT, and Railroad Standards for construction and insurance, whether specified or not, and shall be aware of the allowable variances.

1.2. QUALITY ASSURANCES

- A. Perform all work as specified herein and in accordance with the latest revisions of the following codes and standards.
 - 1. Federal, state, and local codes, regulations, and ordinances.
 - 2. American Society of Testing and Materials (ASTM).
 - 3. American Welding Society (AWS).
 - 4. American Wood Products Association (AWPA).
 - 5. American Petroleum Institute (API).
- B. Welding procedures, welders, and welding operations shall be qualified and certified in accordance with the AWS.
 - 1. Maintain welders' certification on file at site.
 - 2. Certification or re-certification shall be within six (6) months prior to commencing any welding operations.
- C. Design Criteria.
 - 1. Specified thicknesses for pipe and casings are based upon the superimposed loads and not upon the loads which may be placed on the pipe as a result of jacking operations.
 - 2. Provide increased pipe strength necessary to withstand jacking loads.
- D. Requirements of Regulatory Agencies.
 - 1. Owner will obtain the necessary permits from the appropriate entities.
 - 2. Obtain bonds or indemnity required by the permits for protection against damage and interference with traffic and service by construction activities.
- E. Certificates of Insurance.
- F. In case of conflict or disagreement between codes, standards, laws, ordinances, rules and regulations, or within any document itself, the more stringent requirements as determined by Engineer shall govern.
 - 1. Where work required by the drawings and specifications is above the standard required by local regulations or recommended standards, it shall be completed as shown and/or specified.
- G. All excavations shall meet the trenching, backfilling, and compaction requirements

set forth in Section 02221 – Trenching, Backfilling, and Compacting.

1.3. RELATED WORK

- A. Consult all other Specification sections, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete operational installation.

1.4. SUBMITTALS

- A. Certification.
 - 1. Submit Manufacturer's Certification that materials meet referenced standards.
 - a. All testing and certification shall have been completed within six (6) months prior to incorporating the product into the Project.
- B. Shop Drawings.
 - 1. Submit details of the method of operation, support system, and liner to be used.
 - 2. If tunnel liner plates are to be used, submit Manufacturer's drawings and specifications on the materials.

1.5. ALTERNATIVES

- A. Request for substitution of "reject" or used pipe in lieu of new pipe may be made after award of the Contract.
 - 1. Used pipe shall be clean, free from heavy corrosion, patches, cuts, and holes and shall be straight and true in centerline alignment and circular in cross-section.
 - 2. Pipe shall in all other respects meet the requirements specified for new pipe.

PART 2 – PRODUCTS

2.1. CASING PIPE

- A. Smooth Steel Pipe.
 - 1. Nominal inside diameter: Thirty inches (30").
 - 2. Standard: ASTM A 139 grade B.
 - 3. Yield Point: 35,000 psi.
 - 4. Wall Thickness: One-half-inch (1/2") or thicker if required by local jurisdiction.
 - 5. Ends: Beveled for field welding.
 - 6. Coating:
 - a. All field welds shall be painted with an epoxy polyamide exterior coating, or a coal tar enamel exterior coating, which conforms to AWWA C203, Section 2. Minimum thickness of sixteen (16) mil.
 - b. All smooth steel casing pipe shall have an epoxy polyamide exterior coating of if the Contractor elects to omit the exterior coating, one-sixteenth-inch (1/16") shall be added to the required thickness of the casing pipe.

2.2. ACCESSORIES

A. Casing Seals.

1. Materials.
 - a. High density rubber.
 - b. Stainless steel bands.
 - 1) Two (2) each bands on each end of seal.
 - c. Model S pull-on type.
2. Manufacturer.
 - a. Link-seal modular seal, model "C" or "S" wrap around end seal with stainless steel bands, Pipeline Seal and Insulator, Inc.
 - b. Or approved equal.

B. Pipe Supports.

1. Insulators (Casing Chocks).
 - a. Bands and Risers:
 - 1) Stainless steel, Type 304.
 - 2) Minimum twelve-inch (12") wide.
 - 3) Minimum fourteen (14) gauge thickness.
 - 4) Riser height as required by casing and carrier pipe.
 - b. Two-piece construction.
 - c. Liner.
 - 1) Elastomeric PVC or Neoprene rubber.
 - 2) Minimum three-thirty-second-inch (3/32") thickness.
 - d. Runner.
 - 1) Width: Two-inch (2") minimum.
 - 2) Length: Eleven-inch (11") minimum.
 - 3) Material: UHMW polyethylene.
 - 4) Heavy-duty, high abrasion resistance.
 - 5) Low friction coefficient.
 - e. Non-corrosive bands and fasteners.
 - f. Minimum five-sixteenths-inch (5/16") diameter bolts.
 - g. Number of runners.
 - 1) Four-inch (4") - fourteen-inch (14"): Two (2) top and two (2) bottom.
 - 2) Sixteen-inch (16") – thirty-six-inch (36"): Two (2) top and four (4) bottom.
 - 3) Thirty-eight-inch (38") and larger: Three (3) top and four (4) bottom.
2. Manufacturer.
 - 1) PowerSeal.
 - 2) Calpico.
 - 3) Pipeline Seal & Insulator.
 - 4) Or approved equal.
3. Provide minimum two-inch (2") clearance between carrier pipe largest O.D. and casing I.D.
4. Pipe supports shall be anti-flotation design.
5. Number and spacing of supports shall be the more stringent of that required by pipe manufacturer or as specified below.
 - a. Ductile iron pipe.
 - 1) Minimum three (3) insulators per pipe joint.
 - b. PVC pipe.
 - 1) Minimum three (3) insulators per pipe joint.

- C. Vents (When Indicated).
 - 1. Provide when indicated and/or required by jurisdictional entity.
 - 2. Schedule 40 galvanized steel pipe.
 - 3. Minimum three-inch (3") diameter.
 - 4. Provide downturned bend at top of vent with screened opening.

- D. Grout.

PART 3 – EXECUTION

3.1. CASING INSTALLATION

- A. General.
 - 1. Install the casing by jacking or tunneling through the earth.
 - 2. Open trench excavation shall not be permitted where boring or jacking is specified.
 - 3. When indicated on the Drawings, install the casing by open-cut methods in accordance with Section 02221 – Trenching, Backfilling, and Compacting.
 - 4. Actual construction shall be such that alignment, grade, and clearance for carrier pipe specified in this Section 02315 – Pipe Boring and Jacking and Section 02722 – Sanitary Sewage Systems are not exceeded.
 - 5. Procedure for abandonment of installed casing pipe with unacceptable grade and alignment.
 - a. All casing pipe shall be removed and the resulting cavity completely grouted, or.
 - b. The casing pipe shall be abandoned in place and the resulting cavity completely grouted.
 - c. Acceptable method of casing abandonment shall be at the sole discretion of Engineer and the agency or entity with regulatory authority.
 - d. Relocate boring as directed by Engineer.

- B. Smooth Steel Pipe.
 - 1. Provide adequate equipment to ensure a smooth, continuous, and uniform casing with no exterior voids.
 - 2. Weld each section of pipe with a full penetration butt weld around the entire circumference of the joint to form a continuous conduit capable of resisting all stresses, including jacking stresses.

- C. Vents.
 - 1. Weld vent pipe to casing pipe at each end of casing.
 - 2. Extend vent pipe four feet (4'-0") minimum above finish grade.
 - 3. In flood plain areas, extend vent pipe above high water elevation.

- D. Grouting.
 - 1. Fill all spaces between the lining and the earth with grout.
 - 2. Perform grouting operations in a sequence that will preclude deflections exceeding five percent (5%) of the tunnel diameter.
 - 3. Plug each hole after pumping through it has stopped to prevent backflow of grout.

3.2. CARRIER PIPE INSTALLATION

- A. Install pipe in accordance with the applicable pipe specifications sections.
- B. Individually attach each skid to the pipe with steel bands and insert the carrier pipe.
 - 1. Adjust pipe support height to accommodate variations in casing elevation.
 - 2. Install pipe supports a maximum one foot (1'-0") each side of pipe joint.
 - 3. Support pipe within six inches (6") of end of casing.
 - 4. Carrier pipes that exceed 20 L.F. shall have mechanical joint restraints installed at each joint.
- C. Seal the ends of the casing with casing seals.

END OF SECTION

SECTION 02321

CONTROLLED LOW STRENGTH MATERIAL BACKFILL (FLO-FILL)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The Contractor shall furnish and place controlled low strength material (CLSM) backfill where required by the Engineer.

1.2 RELATED WORK

- A. Section 02240 - Water Control and Dewatering
- B. Section 02221 - Trenching, Backfilling, and Compacting

1.3 REFERENCES

- A. ASTM C 33 - Concrete Aggregates
- B. ASTM C 94 - Specification for Ready-Mixed Concrete
- C. ASTM C 143 - Test Method for Slump of Hydraulic Cement Concrete
- D. ASTM C 150 - Portland Cement
- E. ASTM C 494 - Chemical Admixtures for Concrete
- F. ASTM C 618 - Fly Ash in Portland Cement Concrete
- G. ASTM D 4832 - Standard Test Method for Preparation and Testing of Soil-Cement Slurry Test Cylinders
- H. ASTM PS 28 - Provisional Standard Test Method for Flow Consistency of Controlled Low Strength Material
- I. ASTM PS 29 - Provisional Standard Test Method for Unit Weight, Yield and Air Content (Gravimetric) of Controlled Low Strength Material
- J. ASTM PS 30 - Provisional Standard Practice for Sampling Freshly Mixed Controlled Low Strength Material
- K. ASTM PS 31 - Provisional Standard Test Method for Ball Drop on Controlled Low Strength Material to Determine Suitability for Load Application

PART 2 PRODUCTS

2.1 MATERIALS

- A. General: The CLSM shall consist of a mixture of sand, coarse aggregate, cement and water. Fly ash and approved admixtures may be used to obtain the required properties of the mix. The mix shall have good workability and flowability with self-compacting and self-leveling characteristics. Proportions of the mix shall be as given in the following table:

CLSM Mix Proportions

<u>Component</u>	<u>Amount</u>
Cement	42 lbs
Fine Aggregate	1,845 lbs
Coarse Aggregate	1,700 lbs
Water	325 lbs.

- B. Flowable Fly Ash Fill (May Be Used If Approved By Engineer)

<u>Materials</u>	<u>Pounds/Cubic Yard</u>
Class C fly ash	200 to 400
Class F fly ash	1600 to 1800
Water	800 (96 gallons or as needed)

- C. Cement: All cement used shall be Type II Portland cement, which shall conform to the requirements of ASTM C 150.
- D. Fly Ash: Fly ash may be either Class C or Class F. The fly ash shall conform to ASTM C 618.
- E. Aggregates:
1. Fine Aggregate: All fine aggregate shall conform to the grading and quality requirements of ASTM C 33.
 2. Coarse Aggregate: Coarse aggregate shall conform to the grading and quality requirements of ASTM C 33 for size No. 57 or No. 67.
- F. Water: The batch mixing water and mixer washout water shall conform to the requirements of ASTM C 94. The Water: Cement ratio shall be 5.6:1.
- G. Admixtures: Chemical admixtures that do not contain calcium chloride and conform to ASTM C 494 for concrete may be used in the CLSM mix. All chemical admixtures shall be compatible with the cement and all other admixtures in the batch.
- H. CLSM Properties:
1. Strength:
 - a. CLSM shall have a maximum 28 day compressive strength of 60 psi when molded and cured as in conformance with ASTM D 4832.
 - b. CLSM shall have minimum 24-hour strength of 10 psi.
 2. Air-Entrainment: All CLSM shall be air entrained to a total air content of 4% to 8%.

3. Slump: The minimum slump shall be seven inches (7") and the maximum slump shall be nine inches (9") as when tested in accordance with ASTM PS 28.
 4. Aggregate: Fine aggregate shall be between 50% and 60% by volume of the total aggregates in the CLSM mix.
 5. Consistency: The consistency of the CLSM slurry shall be such that the material flows easily into all openings and the area to be filled. When trenches are on a steep slope, a stiffer mix of slurry may be required to prevent CSLM from flowing down the trench. When a stiffer mix is used, vibration shall be performed to ensure that the CLSM slurry completely fills all spaces between the pipe and the lower portion of the trench.
- I. Flo-fill is prohibited as a temporary or permanent street surface.
 - J. No changes shall be made in the specified mix ingredients without the approval of the Engineer/Utility.

PART 3 EXECUTION

3.1 PLACEMENT

- A. CLSM shall be used as an alternative to backfill, as directed by the Engineer/Utility, but may not be used as a substitute for bedding material.
- B. Rodding, mechanical vibration and compaction of CLSM shall be performed to assist in consolidating the CLSM.
- C. CLSM shall be placed as closely behind pipe laying operations as possible.
- D. When required to prevent uplift, the CLSM shall be placed in two stages as required, allowing sufficient time for the initial set of the first stage before the remainder is placed. CLSM shall be deposited as nearly as practical in its final position and in no way disturb the pipe trench or cause foreign material to become mixed with the CLSM.
- E. Soil backfill shall not be placed until the CLSM has reached the initial set. If backfill is not to be placed over the CLSM within 8 hours, a 6-inch cover of moist earth shall be placed over the CLSM surface.
- F. If the air temperature is 50° F or less, the moist earth cover should be at least 18-inches thick. CLSM shall not be placed when the air temperature is below 40° F unless the air temperature is 35° F or more and the temperature is rising.
- G. CLSM shall not be placed, if, in the judgment of the Engineer/Utility, weather conditions are unsuitable.
- H. CLSM shall not be placed when the trench bottom or walls are frozen or contain frozen materials.

END OF SECTION

SECTION 02601

MANHOLES

PART 1 – GENERAL

1.1. DESCRIPTION

- A. This Section covers manholes, including ring and covers, steps, grade rings, fittings, and other appurtenances.

1.2. QUALITY ASSURANCE

- A. Manhole inverts shall not deviate from elevations shown on the Drawings by more than plus or minus (\pm) 0.03 ft.
- B. Related Sections:
 - 1. Section 02722 – Sanitary Sewerage Systems for manhole testing.
 - 2. Section 03300 – Cast in Place Concrete.
- C. Perform all work as specified herein and in accordance with the latest revisions of the following codes and standards.
 - 1. Federal, state, and local codes, regulations, and ordinances.
 - 2. American Society for Testing and Materials, (ASTM).
 - 3. American Concrete Institute, (ACI).
 - 4. American Concrete Pipe Association, (ACPA).
- D. In case of conflict or disagreement between codes, standards, laws, ordinances, rules and regulations, or within any document itself, the more stringent condition as determined by Engineer shall govern.

1.3. SUBMITTALS

- A. Submit the information identified by data reference symbols A, E, and L of Section 01340 – Shop Drawings, Samples, and Operation and Maintenance Manuals.

1.4. PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver pre-cast concrete sections to the job until concrete has attained at least eighty percent (80%) of specified strength.

1.5. ALTERNATIVES

- A. Manhole bases may be either monolithically pre-cast or cast-in-place.

1.6. MANHOLE SIZES

- A. Unless directed otherwise in the Contract Documents use the following:
 - 1. Forty-eight-inch (48") diameter manholes on sewers eight inches (8") through fifteen inches (15") in diameter.
 - 2. Sixty-inch (60") manholes on sewers eighteen inches (18") through thirty inches (30") in diameter.

3. Seventy-two-inch (72") manholes on sewers thirty-three inches (33") through forty-two inches (42") in diameter.

1.7 MANHOLE TOP SECTIONS

- B. Use the following.
 1. Eccentric cones.
 - a. Where manhole depth is sixty inches (60") or greater on forty-eight-inch (48") manholes.
 - b. Where manhole depth is seventy-two inches (72") or greater on sixty-inch (60") manholes.
 2. Flat top manholes.
 - a. When manhole depth is less than the above.
 - b. On all seventy-two-inch (72") manholes.

1.8 DROP MANHOLES

- A. Drop manholes shall utilize prefabricated PVC drop structures.
- B. Manhole diameter shall be increased by 1-ft whenever drop manholes are required.

PART 2 – PRODUCTS

2.1. CONCRETE

- A. Cast-In-Place.
 1. Meet the Requirements of Section 03300 – Cast-In-Place Concrete.
- B. Grout (Non-shrink).
 1. Pre-mixed.
 - a. Master Builders "Masterflow 713."
 - b. Sika "Grout 212"
 - c. Sonneborn "Ferrolith G-D.S. Redi-Mixed."
 - d. Or approved equal.
 2. Job Mixed.
 - a. One (1) part Portland Cement, ASTM C150, Type II with fly ash or Type V (per same specification in Section 03300 – Cast-In-Place Concrete).
 - b. One (1) part sand, ASTM C144.
 - c. One (1) part shrinkage-correcting aggregate.
 - 1) Master Builders "Embco Aggregate."
 - 2) Sonneborn "Ferrolith G-D.S."

2.2. PRECAST CONCRETE

- A. Bases, barrels, cones, and flat tops.
 1. Cast base and first barrel section monolithically.
 2. Meet Requirements of ASTM C478.
 3. Cement: Type I/II or Type II, Sulfate resistant (per same specification in Section 03300 – Cast-In-Place Concrete).
 4. Concrete: Use antimicrobial additive, ConShield, amount as recommended by the manufacturer of the additive.

5. Invert: Cast-In-Place concrete as specified in paragraph 2.1.A. – Cast-In-Place. Use antimicrobial additive, ConShield, amount as recommended by the manufacturer of the additive.
6. Provide horseshoe-shaped openings for manholes to be installed over existing lines.
7. Field repairs shall be made using ConShield Joint Set Grout pre-portioned and factory packaged that requires the addition of no other components. This repair grout shall be used for filling joints, lift holes, damaged areas, setting grade rings, and benches.

2.3. MANHOLE JOINT SEALANT

- A. Meet Requirements of
 1. F.S. SS-S-00210-A, Sealing Compound Preformed Plastic for Pipe Joints, Type I, Rope Form.
 2. ASTM C990 Standard Specifications for joints, concrete pipe, manholes and precast box sections using Preformed Flexible Joint Sealants
 3. ASTM C877 Type III and C923, Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
- B. All manhole sections shall have two (2) performed plastic gaskets and 1 external rubber sleeve.
- C. Gasket Diameter
 1. Forty-eight-inch (48") manholes: One and one-half inch (1-1/2").
 2. Sixty-inch (60") manholes: One and three-quarter inch (1-3/4").
 3. Seventy-two-inch (72") manholes: Two-inch (2").
- D. External joint wrap shall be 12-inches wide for all manhole sizes.
- E. Approved Manufacturers.
 1. Henry Company", "Ram-Nek."
 2. Sealing Systems, Infi-Shield Gator Wrap
 - 3 Or approved equal.

2.4. PIPE PENETRATION GASKETS

- A. Approved Manufacturers.
 1. Dukor Co., Kor-N-Seal.
 2. Press Seal Gasket Corp., PS-10.
 3. A-lok Corp., A-lok.
 4. Interpace Corp., Lock joint flexible manholes sleeve.
 5. Or approved equal.

2.5. RING AND COVER

- A. Material.
 1. Gray Iron meeting requirements of ASTM A48.
- B. Construction.
 1. Size: Minimum clear opening twenty-four-inch (24") diameter.

2. Weight: Heavy duty three hundred twenty-seven pounds (327 lbs.) minimum.
3. Bearing surfaces: Machined.
4. Lid pattern: Checkered top or indented top.
5. Pick hole: Concealed.
6. Load Rating: H-20 Loading minimum.
7. Frame Height: Eight inches (8").

- C. Approved Manufacturers:
1. Neenah, R-1706.
 2. Deeter, #1258.
 3. Or approved equal.

2.6. STEPS

- A. Materials.
1. Polypropylene plastic-coated steel meeting ASTM C-478 and OSHA STD 1-1.9-CFR 1910.27
- B. Construction.
1. Reinforcing rod: Grade 60 Steel, One-half-inch (1/2") diameter.
 2. Length: Fourteen inches (14"), designed for five-inch (5") protrusion from manhole wall.
 3. Tread: Notched ridge with retainer lugs on each end.
 4. Spacing: Twelve inches (12").
 5. The maximum distance from the cover of the manhole to the first step shall be 24-inches.
 6. The maximum distance from the bench of the manhole to the lowest step shall be 18-inches.
- C. Acceptable Step, and the Manufacturers are:
1. M. A. Industries, PS2-PFS.
 3. Or approved equal.

2.7 EXTERIOR SEALANT

- A. Provide exterior sealant where manholes will be exposed groundwater that is higher than the base of the manholes.
- B. Materials.
1. Water based acrylic resin waterproofing coating.
- B. Acceptable Manufacturers.
1. DECO Products: DECO 20 Seal Waterproofing Membrane.
 2. Or approved equal.

2.8 INTERIOR LINING

- A. Internal Sealant is required on all manholes connected to force mains and at other locations where corrosive environments may occur as determined by the District
- B. Materials.
 - 1. 100% solids solvent free, low odor, epoxy system.
- C. Acceptable Manufacturers.
 - 1. Environmental Coatings, LLC, Sewer Shield 100.
 - 2. Or approved equal.

2.9 DROP MANHOLES

- A. Provide inside drop bowl fabricated from marine grade fiberglass and finished in bright white gel coat.
- B. Manufacturer shall supply drop bowl, required stainless steel pipe support brackets, and stainless steel anchor bolt assemblies. Contractor shall supply flexible pipe coupler (Fernco or equal), down pipe, and bend, and install inside drop manhole per manufacturer's written instructions.
- C. Acceptable Manufacturer:
 - 1. Reliner/Duran Inc.: Inside Drop Bowl
 - 2. Or approved equal.

PART 3 – EXECUTION

3.1. INSTALLATION OF PRE-CAST MANHOLE SECTIONS

- A. Connect all pipes to pre-cast manhole sections using pipe penetration gaskets.
- B. If inverts are not constructed by pre-caster and wherever grade and alignment permit, lay the main sewer continuously through the manhole and split the pipe after construction of the invert. Where this is not possible, terminate pipe flush with interior manhole wall and construct transition smooth and of proper radius for uninterrupted flow. In no case shall the invert flow section through the manhole be greater than that of the outgoing pipe. Finish invert with a steel trowel prior to adding riser section to the base.
- C. Set each manhole riser section plumb. Brush and clean manhole joint surfaces. Joint surfaces shall be dry. Apply primer and apply butyl rubber sealant per manufacturer's written instructions and set next manhole riser section. An external sealing band shall also be applied to all joints. Brush and clean the joint area at least 2 inches wider than the width of the wrap. Prime surface and apply sealing band per manufacturer's written instructions. The last barrel section prior to placement of the eccentric cone or the flat top slab shall be the Manufacturer's shortest, but in no case greater than twenty-four inches (24") in height. Use sections of various heights to bring ring and cover to grade.
- D. Install ring and covers on one (1) or a maximum of two (2) pre-cast adjusting rings of varying heights, not to exceed eight inches (8") in height each. On buried manholes, the total allowable height of adjusting rings and the ring and cover shall be one inch (1") less than the Manufacturer's shortest pre-cast barrel section.

Apply primer and apply butyl rubber sealant per manufacturer's written instructions and set rings. Unless otherwise indicated, set the top of the rings twenty-four inches (24") below finished grade in farmed fields, one inch (1") below finish grade in gravel roadways, and such that no part of the ring or cover will project above a point one-quarter inch (1/4") below the finish surface of pavement in paved areas subject to cleaning by snowplows.

- E. Fill all lifting holes and other imperfections with grout.
- F. Exterior Sealant
 - 1. Apply sealant to exterior walls on all manholes that will be in contact with groundwater from base to finish grade:
 - 2. Apply coating per manufactures recommendations.
- G. Interior Lining:
 - 1. Concrete to be cured a minimum of 28 days prior to surface preparation. Fill all cracks and seams between manhole sections with sewer shield caulk. Apply 1/8" to 1/4" thickness of Sewer Shield 100.
 - 2. Surface preparation and application shall be by manufacturer certified installers in accordance with manufacturers surface preparation and application guidelines.
 - 3. Accepted applicators include C&L water solutions, 12249 Mead Way, Littleton, CO 80125, 303-791-2521.

3.2. CONSTRUCTION OF CAST-IN-PLACE BASES

- A. Set stubs and mains before concrete is placed and recheck for alignment and grade before concrete has set.
- B. Where grade and alignment permit, lay the main sewer continuously through manholes and split the pipe after construction of the base. Where this is not possible, terminate the pipe flush with the interior manhole wall and construct transitions smooth and of proper radius for uninterrupted flow. In no case shall the invert flow section be larger than that of the outgoing pipe.
- C. The bench height shall be the same as the diameter of the pipe and no higher than springline of the pipe. The bench shall slope downward from the wall to the pipe at a rate of between one-half inch (1/2") per foot and one inch (1") per foot.
- D. Shape the base with a wood float and finish with a steel trowel. Allow the base to set a minimum of twenty-four (24) hours before continuing construction.
- E. When thermoplastic pipe is used, connections to the manhole base shall be made using approved manhole couplings cast into the base, or a minimum of three (3) pipe gaskets spaced two inches (2") apart on the end of each pipe and cast into the base.
- F. If the pipe connection is to a pre-cast section, use pipe penetration gaskets as specified above.

- G. Install pre-cast manholes, risers, cones, tops, and the ring and covers as specified in paragraphs 3.1.C. through 3.2.D. above.

3.3. CONNECTIONS TO EXISTING MANHOLES

- A. Construct in such a manner that the finished work conforms as nearly as practicable to the requirements specified for new manholes.
- B. Where no provision has been made for additional connections, core drill as small an opening as necessary to insert the new pipe.
- C. Chip the existing manhole base to the cross-section of the new pipe and finish with mortar to form a smooth continuous invert.
- D. Seal the space between the new pipe and the manhole wall with non-shrink grout.

3.4 CLEANING

- A. Prior to completion of the Work, remove all accumulated construction debris, rocks, gravel, sand, silt and other foreign material from the manhole.
- B. Upon final inspection if any foreign matter is present in the system, re-clean the manhole as required.
- C. Fill all lifting holes and other imperfections with grout.

3.5. FIELD QUALITY CONTROL

- A. Inspect each manhole for, and repair all visible leaks and damp spots.
- B. Manhole Vacuum Test.
 - 1. Reference Section 02722 – Sanitary Sewerage Systems.

END OF SECTION

SECTION 02622

PLASTIC PIPE

PART 1 – GENERAL

1.1. DESCRIPTION

- A. This Section covers plastic pressure and non-pressure pipe and fittings to be furnished complete with all jointing materials.

1.2. SUBMITTALS

- A. Submit information identified by data reference symbols A and E.

1.3. PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Do not damage the pipe by impact, bending, compression, or abrasion during handling and storage.
- B. Store pipe on a flat surface which provides even support for the barrel with bell ends overhanging.
- C. Do not stack pipe higher than five feet (5'-0").
- D. Do not store pipe and fittings in direct sunlight for periods in excess of two (2) weeks.
- E. Ship rubber gaskets in cartons and store in a clean area away from grease, oil, ozone-producing electric motors, heat, and the direct rays of the sun.
- F. Use only nylon-protected slings or hands to handle pipe. Do not use hooks or bare cables.

PART 2 – PRODUCTS

2.1. POLYVINYL CHLORIDE (PVC) GRAVITY SEWER PIPE

- A. Pipe Standards: All pipe shall conform to the following standards.
 - 1. Pipe fifteen inches (15") and smaller: ASTM D3034, Type PSM, minimum SDR 35, or SDR 26 per Drawings.
 - 2. Pipe eighteen inches (18") and larger: ASTM F679, PS115.
 - 3. Joints: ASTM D3212, Push On.
- B. Pipe Fitting: Fittings shall be of the same material and class as the pipe to which it is attached.
 - 1. Plugs: P.V.C., size shall be the same as for the pipe. Plugs shall be air tight for testing of the lines.

2. Joints: ASTM F477 push-on. Joints: ASTM D3212, push-on with an O-ring rubber gasket conforming to ASTM Designation D3034. Solvent cement joints are strictly prohibited.
- C. Pipe Lengths: Maximum pipe length shall be twenty (20) feet and no shorter than twelve and one half (12 1/2) feet, except service tees and closure pieces.
 - D. Markings: All sizes of PVC pipe shall have the SDR rating, the ASTM Specification, nominal diameter, and name or trademark of the manufacturer imprinted on the outside of the pipe.
 - E. Couplings (including repair couplings): Acceptable manufacturers and models:
 1. Fernco, 5000 Series Strong Back (RC) Coupling
 2. Romac Industries, LSS Series Sewer Clamp Coupling
 3. Mission Rubber Company, Flex-Seal Adjustable Repair Coupling,
 4. GPK Product, Inc., Repair Coupling SDR 35 G X G
 5. Or approved equal.
 - F. Service Lateral Connection Fittings: Tee or wye connections suitable for assembly to 4-inch or 6-inch house or building service laterals shall be one of the following types.
 1. New Sewer Main Installation:
 - a. Service lateral connections to new sewer mains shall be reducing-branch tee or wye fittings with elastomeric-gasket joints same as pipe.
 - b. Saddle-type fittings not allowed except for connections to existing sewer mains.
 - c. Service line connection shall be bell-end with an elastomeric ring-gasket and a minimum wall thickness of SDR35.
 - d. Manufacturer and Type:
 - (a) GPK Industries Model 107 (gasket x gasket x gasket wye)
 - (b) GPK Industries Model 103 (gasket x gasket x gasket tee)
 - (c) Or approved equal
 2. Connection to Existing Sewer Mains:
 - a. Saddle-type fittings with an elastomeric ring-gasketed bell-end service connection and minimum wall thickness of SDR35.
 - b. Saddle-type fitting shall have "centering ring" integrally cast into fitting, and be supplied with a rubber sealing gasket and stainless steel straps for connection to pipe.
 - c. Manufacturer and Type:
 - (a) GPK Industries Saddle Wye G x G with Centering Ring, Model 135 (Part No. 135-0084CR for 8" x 4" saddle).
 - (b) No alternates allowed
 3. Furnish permanent plugs for future service line connections and testing.

PART 3 – EXECUTION

3.1. INSPECTION

- A. In addition to any deficiencies covered by ASTM D3034, PVC which has any of the following visual defects will not be accepted:
 - 1. Straight pipe, measured from the concave side, shall not deviate from straight by greater than 1/16 inch per foot of length.
 - 2. Pipe which is sufficiently out-of-round to prohibit proper jointing.
 - 3. Improperly formed bell and spigot ends.
 - 4. Fractured, cracked, chipped, dented, abrasions or otherwise damaged pipe.
 - 5. Pipe that has been damaged during shipment or handling. Acceptance of the pipe at point of delivery will not relieve the Contractor of full responsibility for any defects in material of the completed pipeline.
- B. Mark rejected pipe and remove from the site.

3.2. INSTALLATION

- A. Install pipe in accordance with 02722 – Sanitary Sewerage Systems.
- B. Cutting the Pipe.
 - 1. Cut pipe square with saw or pipe cutter designed specifically for the material.
 - 2. Apply lubricant furnished by the pipe manufacturer to the spigot end of the pipe.
 - 3. Insert the spigot to the reference mark.
 - 4. Do not disturb previously installed joints during jointing operations.

3.3. FIELD QUALITY CONTROL

- A. Refer to Section 02722 – Sanitary Sewerage Systems, for wastewater pipelines.

END OF SECTION

SECTION 02722

SANITARY SEWERAGE SYSTEMS

PART 1 – GENERAL

1.1. DESCRIPTION

- A. This Section covers the installation and testing of sanitary sewer pipelines plus the furnishing and installation of manhole materials and other appurtenances.
- B. Definitions.
 - 1. Manhole Depth: Distance measured at centerline from invert of lowest pipe to top of ring and cover.

1.2. QUALITY ASSURANCE

- A. Do not deviate from line or grade more than one inch (1”) for line and one-quarter inch (1/4”) for grade provided such deviation does not result in a level, more reverse, sloping invert. Measure for grade at the pipe invert, not at the top of the pipe.

1.3. SUBMITTALS

- A. Certification.
 - 1. Submit manufacturer’s certification that products meet requirements of referenced specifications.
- B. Shop Drawings.
 - 1. Submit shop drawing on pre-cast concrete sections, rings and covers, and steps.

1.4. JOB CONDITIONS

- A. Protection.
 - 1. Prevent foreign material from entering the pipe.
 - 2. Do not place debris, tools, clothing, or other materials in the pipe.
 - 3. Whenever pipe laying is stopped, close the open end of the pipe with a plug, cap, or end dam, to prevent the entry of foreign material into the pipe.
 - 4. Plugs or caps shall be installed on all temporary or permanent stub-outs and on all unused branch lines.
 - 5. Use effective measures to prevent the uplift or floating of the line before completion of the backfilling operation.
- B. Do not lay pipe in water or in unsuitable weather or trench conditions. Rubber-gasketed joints may be completed when the water is no higher than the pipe invert, and when the water is clear and the trench bottom is clean coarse gravel. Use extreme caution to ensure no gravel is in the joint.

PART 2 – PRODUCTS

2.1. PIPE MATERIALS

- A. Type.
 - 1. PVC: Refer to Section 02622 – Plastic Pipe.
 - 2. DIP: Refer to Section 02615 – Ductile Iron Pipe.

2.2. MANHOLE MATERIALS

- A. Refer to Section 02601 – Manholes.

2.3. COUPLINGS

- A. Couplings are not allowed within twenty (20) feet of a water/sewer or stormwater/sewer crossing.
 - 1. Exceptions may be made at the District's discretion on a case by case basis.
- B. At the District's discretion encase couplings in a concrete collar a minimum of six inches (6") thick and extending a minimum of six inches (6") either side of the joint.

PART 3 – EXECUTION

3.1. PREPARATION

- A. Dewater in accordance with Section 02240 – Water Control and Dewatering
- B. Excavate the trench in accordance with Section 02221 – Trenching, Backfilling, and Compacting.
- C. Where connections are to be made to existing pipes or appurtenances (the exact location of which cannot be determined without exposing the existing pipe or appurtenance), excavate and expose the existing pipe or appurtenance and specify any necessary adjustments in line or grade of the proposed pipe to accomplish the connection.

3.2. PIPE INSTALLATION

- A. Pipe-Laying.
 - 1. Begin pipe-laying at the lowest point, unless otherwise approved by **ENGINEER**, and install the pipe with the spigot ends pointing in the direction of flow.
 - 2. Lay pipe true to line and grade and join in such a manner that the offset of the inside of the pipe at any joint is held to a minimum at the invert. The maximum offset at the invert shall be one percent (1%) of the inside diameter or three-eighths inch (3/8"), whichever is smaller.
 - 3. As each length of pipe is placed in the trench, complete the joint in accordance with the applicable pipe material specification and adjust the pipe to the correct line and grade. Push spigot end in until the reference mark on the spigot end is flush with the end of the bell. Make adjustments by scraping away or filling pipe bedding under the body of the pipe and not by wedging or blocking up the bells.

4. Secure the pipe in place with the specified bedding tamped under and around the pipe except at the joints. Do not walk on small diameter pipe or otherwise disturb any conduit after the jointing has been completed.
 5. As shown on the accepted construction drawings or when groundwater is present, known to be seasonally present, or at the direction of the District, construct Groundwater Cut-Off Walls around the pipe using concrete or barrier material as specified in Section 02221 at a minimum distance of every three hundred feet (300') along the length of the pipe. Groundwater Cut-Off Walls will be constructed within five feet (5') upstream of every manhole, at the District inspector's option. The Cut-off wall shall extend into the native material a minimum of 12 inches (12") and extend around the full circumference of the pipe at a minimum and have a minimum width (measured parallel to the pipe) of twelve inches (12").
- B. Waterline Crossings.
1. Where sewer lines cross water mains and the sewer line is above the water main and there is less than eighteen inches (18") clear distance vertically between the lines, construct the crossing as shown on the District standard details and Encase the sewer pipe with reinforced concrete at least six inches (6") thick at all locations within ten feet (10') either side of the waterline. Minimum reinforcement shall consist of a No. 5 bar placed at each corner of the section tied with No. 3 bars at three-foot (3'-0") centers.
 2. Where sewer lines cross water mains and the sewer line is above the water main, construct the crossing per the water utility provider requirements.
 3. In all cases, provide suitable backfill or other structural protection to preclude settling or failure of the higher pipe.
- C. Service Connections.
1. Install "Y" or "T" branches and laterals using fittings per Section 02622 – Plastic Pipe. Verify that service connection locations have been marked before commencing construction of any segment of sewerline.
 2. Where an existing sewer is being replaced at the same alignment, locate and connect all existing services to the new sewer.
 3. Sewer service laterals shall be installed with a minimum depth of cover of six feet (6'-0").
 4. Install services for future service connections to a minimum three feet (3'-0") inside of property line.
 5. Install removable watertight plugs in each service lateral.
 6. Mark the location of each branch with a four-inch by four-inch (4" x 4") wooden marker extending from the branch vertically to one foot (1'-0") above finished grade. Anchor markers and maintain in a vertical position during backfilling.

3.3. MANHOLE CONSTRUCTION

- A. Construct manholes in accordance with Section 02601 – Manholes.
- B. Connections to Existing Manholes.
1. Construct in such a manner that the finished work conforms as nearly as practicable to the requirements specified for new manholes.
 2. Core-drill manhole for new service connection.
 3. Chip the existing manhole base to the cross-section of the new pipe and finish with mortar to form a smooth, continuous invert.

4. Seal the space between the new pipe and the manhole wall with non-shrink mortar or other methods to create a watertight connection.

3.4. CONSTRUCTION OF APPURTENANCES

- A. Install clean-outs and stubs at locations indicated on the Drawings. Insert removable watertight plugs or glued on caps in unused stubs and record location of clean-out or stub referenced to a minimum of three (3) permanent surface references.

3.5. FIELD QUALITY CONTROL

- A. Each section of sewer shall meet the requirements of the following tests. Repair all defects as indicated as a result of the tests. Furnish all equipment, labor, and incidentals necessary and conduct tests in the presence of ENGINEER.
- B. Pipe Deflection Tests.
 1. At the Owner's request, conduct mandrel test on each section of sewer line (manhole-to-manhole) for vertical ring deflection after backfill has been completed for not less than one (1) month.
 2. Maximum allowable deflection is five percent (5%) of the base internal diameter. Mandrel outside diameter in inches are as follows.

Pipe Size	Base I.D.	Mandrel O.D.
8	7.764	7.38
10	9.711	9.23
12	11.558	10.98
15	14.144	13.44
18	16.974	16.13
21	20.004	19.00
24	22.483	21.36

3. Uncover all pipe sections exceeding the maximum allowable deflection and replace the bedding and backfill to prevent excessive deflection.
4. Retest repaired sections after one (1) month.
- C. Air tests.
 1. Air tests may be used instead of exfiltration testing for PVC and ductile iron pipe.
 2. All air testing shall comply with the requirements of ASTM F1417.
 3. Preparation for tests:
 - a. Flush and clean the sewerline before testing in order to wet the pipe surfaces and produce more consistent results.
 - b. Plug and brace all openings in the main sewerline and the upper end of any connections or service laterals.

- c. Check all pipe plugs with a soap solution to detect any air leakage. If leaks are found, release the air pressure, eliminate the leaks, and start the test procedure over again.
 - d. Brace all plugs sufficiently to prevent blowouts, and vent the pipeline completely before attempting to remove the plugs.
 - e. Provide pressurizing equipment with a regulator set at five (5) psi to avoid over-pressurizing and damaging an otherwise acceptable line.
 - e. Provide pressure gauges with range of 0 – 10 psi.
 - f. Provide adequate notification to the ENGINEER that test will occur such that ENGINEER can schedule witnessing of the test.
4. Procedure of test:
 - a. Add air until the internal pressure of the sewerline is raised to approximately four (4.0) psi gauge greater than the average back pressure of any ground water pressure that may submerge the pipe.
 - b. Shut off/reduced the air flow and allow the air temperature in the test section to come equilibrium. Maintain the pressure between three and one half (3.5) and four and one-half (4.5) psi gauge for a sufficient time (minimum two minutes) to allow the air temperature to come to equilibrium with the temperature of the pipe.
 5. After the temperature has stabilized, permit the pressure to drop to three and one-half (3.5) psi gauge at which time a stop watch, sweep second hand watch, or other timing device acceptable to the ENGINEER shall be used to determine the time lapse required for the air pressure to drop to two and one-half (2.5) psi gauge.
 6. The time elapsed shall not be less than:

**MINIMUM SPECIFIED TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015 (Leak rate per ASTM F1417)**

1 Pipe Diameter (in)	2 Minimum Time (min: sec)	3 Length for Minimum Time (ft)	4 Time for Longer Length (sec)	Specified Minimum for Length (L) Shown (min:sec)								
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	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	15:49	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	102:3	
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:5	115:2	3	
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:5	7	2	129:4	
33	31:10	72	25.852 L	43:05	64:38	86:10	107:4	0	124:3	142:2	8	
36	34:00	66	30.768 L	51:17	76:55	102:3	3	129:1	8	6	160:1	
42	39:48	57	41.883 L	69:48	104:4	4	128:1	6	150:4	172:2	5	
48	45:34	50	54.705 L	91:10	2	139:3	2	153:5	3	1	193:5	
54	51:02	44	69.236 L	115:2	136:4	7	174:3	0	179:2	205:0	3	
60	65:40	40	85.476 L	4	5	182:2	0	209:2	9	7	230:4	
				142:2	173:0	1	227:5	4	244:1	279:1	6	
				8	5	230:4	5	273:3	9	3	314:0	
						7	288:2	1	319:0	364:4	7	
						213:4	9	346:1	6	2	410:1	
						1	284:5	1	403:5	461:3	7	
							5	356:0	3	4	519:1	
								9	427:2	569:5	6	
									3	7	641:0	
										0	4	

11. All tests shall be witnessed by the ENGINEER.
12. All newly constructed sewer lines shall be tested for compliance with the Specifications. If leaks are discovered, they shall be repaired by the Contractor at their sole expense.
13. All equipment and appurtenances shall be repaired or replaced and the tests repeated at the Contractor's expense until the pipe, appurtenances and equipment are in satisfactory compliance with these specifications in the judgment of the ENGINEER and the District.

D. CCTV Inspection

1. The Contractor will provide TV inspection in order for the ENGINEER to inspect each section of sewer between manholes.
2. Inspected lines shall exhibit no visible defects, including but not limited to:
 - a. Visible infiltration
 - b. Visible 'sags' or 'bellies' in the line

- c. Rolled gaskets
- d. Out-of-round pipe
- e. Cracked pipe
- f. Offset joints
- g. Poor alignment

- 3. Contractor will repair any pipe(s) identified during to the CCTV inspection to exhibit defects. The District shall have sole discretion in determining defective pipe requiring repair(s).

E. Manhole Testing

1. Reference.

- a. All manhole testing shall comply with ASTM C 1244 – Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.

2. Preparation.

- a. Test shall be conducted prior to installing grade rings or manhole ring and cover.
- b. All lift holes shall be permanently plugged.
- c. All pipes entering the manhole shall be temporarily plugged and securely braced to prevent them from being drawn into the manhole.
- d. Test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations.

3. Test Procedure.

- a. A vacuum of ten-inches (10") of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off.
- b. The time shall be measured for the vacuum to drop from ten-inches (10") of mercury to nine-inches (9") of mercury.

4. Minimum Test Times.

- a. The manhole shall pass if the time for the vacuum reading to drop one inch (1") of mercury meets or exceeds the values calculated with the equations in the following table.
- b. Minimum test duration shall be no less than one (1) minute.

Minimum Vacuum Test Times

Manhole Diameter (inches)	Minimum Test Time, T_{min} (minutes)
30	0.023H
36	0.029H
42	0.035H
48	0.041H
54	0.048H
60	0.054H
66	0.060H
72	0.067H

Where: H (ft) = depth of manhole from top of cone section to center of invert at flowline in feet.

5. Acceptance.
 - a. Acceptance shall be on the basis of minimum test times.
 - b. All equipment and appurtenances shall be repaired or replaced and the tests repeated at the Contractor's expense until the manhole, appurtenances and equipment are in satisfactory compliance with these specifications in the judgment of the ENGINEER and the District.
 - c. Repeat test until test times are within permitted allowance.

3.6. CLEANING

- A. At all times when pipe-laying is not actually in progress, the open ends of the pipe shall be closed by temporary, watertight plugs or by other approved means. If water is in the trench when work is resumed, the plug shall not be removed until all danger of water entering the pipe has passed.
- B. Before substantial completion, Contractor shall remove, by sewer jetting, all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the sewer system. Mechanical rodding or bucketing equipment will not be allowed.
- C. Prior to final TV/alignment inspection, flush and clean each sections of the line. At downstream manhole, provide screen to collect any large materials accumulated during flushing. Remove and dispose of all materials.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.1. DESCRIPTION

- A. This Section covers cast-in-place concrete; including forms, reinforcing steel, materials, transporting, placing, finishing, curing, and other appurtenant items of construction.
- B. Inform Engineer at least forty-eight (48) hours in advance of time and places at which Contractor intends to place concrete.

1.2. QUALITY ASSURANCE

- A. Perform all work as specified herein and in accordance with the latest revisions of the following codes and standards.
 - 1. Federal, state, and local codes, regulations, and standards.
 - 2. American Society for Testing and Materials, (ASTM).
- B. Reference Standards.
 - 1. Except as noted or modified in this Section, all concrete materials, transporting, placing, finishing, and curing shall conform to the requirements of the following standard specifications.
 - a. American Concrete Institute Standards (ACI).
 - 1. 301 – Specifications for Structural Concrete.
 - 2. 304 – Guide for Measuring, Mixing, Transporting, and Placing Concrete.
 - 3. 305 – Hot Weather Concreting.
 - 4. 306 – Cold Weather Concreting.
 - 5. 309 – Guide for Consolidation of Concrete.
 - 6. 315 – Details and Detailing of Concrete Reinforcement.
 - 7. 318 – Building Code Requirements for Reinforced Concrete.
 - 8. 347 – Recommended Practice for Concrete Formwork.
- C. In case of conflict or disagreement between codes, standards, laws, ordinances, rules and regulations, or within any document itself the more stringent requirements as determined by Engineer shall govern.
 - 1. Where work required by the drawings and specifications is above the standard required by local regulations or recommended standards, it shall be completed as shown and/ or specified.

1.3. SUBMITTALS

- A. Test Results.
 - 1. Perform and submit test reports for the following products in accordance

with the above general reference standards and specific standards of these specifications.

B. Proposed Mix Design.

1. Prior to commencing concrete work, submit certified test reports describing proposed concrete mix design, including:
 - a. Fine aggregate - Source, type, gradation, deleterious substances, and bulk-specific gravity on the basis of weight of saturated surface - dry aggregate (ASTM C 128).
 - b. Coarse aggregate - Source, type, gradation, deleterious substances, and bulk-specific gravity on the basis of weight of saturated surface - dry aggregate (ASTM C 217).
 - c. Reactive aggregate test reports.
 - d. Ratio of fine to total aggregates.
 - e. Weight (surface dry) of each aggregate per cubic yard.
 - f. Total water content in gallons per cubic yard and proposed source.
 - g. Slump on which design is based.
 - h. Brand, type, and quantity of cement.
 - i. Brand, type, and quantity of admixtures.
 - j. Air content.
 - k. Two (2) sets of compression test cylinders, two (2) cylinders per set, shall be made for each proposed mix design.
 1. Test one (1) set of two (2) cylinders at age seven (7) days and other set at twenty-eight (28) days.

C. Cylinder Compression Test Reports.

1. Submit two (2) copies of certified test reports to Engineer.

D. Ready-mix Delivery Tickets.

1. Submit delivery tickets for each load at the time of delivery indicating the following.
 - a. Quantity delivered.
 - b. Quantity of each material in batch.
 - c. Outdoor temperature in shade.
 - d. Time at which water was added.
 - e. Elapsed time between when water was added and concrete load was in place.
 - f. Amounts of initial and supplemental water added.
 - g. Name of individual authorizing supplemental water.
 - h. Numerical sequence of delivery by indicating cumulative yardage delivered on each ticket.

E. Shop Drawings.

1. Show sizes, quantity, and dimensions for fabrication and placing of reinforcing bars, bar supports, and embedments.
2. Indicate bar schedules, stirrup and tie spacing, and diagrams of bent bars.

1.4. PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Cement.

1. Store in weather-tight enclosures and protect against dampness, contamination, and warehouse set.
 2. Do not use cement that has become caked or lumpy.
- B. Aggregates.
1. Stockpile to prevent excessive segregation or contamination with other sizes of aggregates.
 2. Use only one (1) supply source for each aggregate stockpile.
 3. The bottom six inches (6") of all aggregate piles in contact with the ground shall not be used.
- C. Admixtures.
1. Store to prevent contamination, evaporation, or damage.
 2. Protect liquid admixtures from freezing or harmful temperature ranges.
 3. Agitate emulsions before use.
- D. Mixing and Transporting Ready-mixed Concrete.
1. Maximum elapsed time from time water is added to mix until concrete is in place shall not exceed one and one-half (1-1/2) hours when concrete is transported in revolving-drum truck bodies.
- E. Reinforcing Steel.
1. Deliver to site in bundles marked with metal tags indicating bar size and length.
 2. Carefully handle and store on supports that will keep the steel from coming in contact with the ground.

1.5. JOB CONDITIONS

- A. Environmental Requirements.
1. Do not place concrete during rain, sleet, or snow unless adequate protection is provided.
 2. Do not allow rainwater to increase mixing water or damage surface finish.
- B. Cold Weather Concreting.
1. Conform to ACI 306.
 2. Temperature of concrete when placed shall not be less than following.

Air Temp. (°F.)	Sections with Least Dimension Under Twelve Inches (12")	Sections with Least Dimension Twelve Inches (12") and Over
30 to 45	60 °F.	50 °F.
0 to 30	65 °F.	55 °F.
Below 0	70 °F.	60 °F.

3. Heated concrete shall not be warmer than eighty degrees Fahrenheit (80 °F) when placed.

4. Prior to placing concrete, all ice, snow, and surface and subsurface frost shall be removed.
 - a. The temperature of the surfaces to be in contact with the new concrete shall be raised above thirty-five degrees Fahrenheit (35 °F) for a minimum of twenty-four (24) hours immediately prior to placing concrete.
5. Protect concrete from freezing during specified curing period.
 - a. Cold weather protection shall be maintained at a minimum temperature of fifty degrees Fahrenheit (50 °F) for a minimum of five (5) days.
6. Heated enclosures shall be strong and windproof to ensure adequate protection of corners, edges, and thin sections.
7. Do not permit heating units to locally heat or dry the concrete.
8. Do not use combustion heaters during the first twenty-four (24) hours unless the concrete is protected from exposure to exhaust gases that contain carbon dioxide.

C. Hot Weather Concreting.

1. Conform to ACI 305.
2. Take precautions when ambient air temperature is ninety degrees Fahrenheit (90 °F) or above.
3. Temperature of concrete, when placed, shall not exceed eighty-five degrees Fahrenheit (85 °F).
4. Cool forms and reinforcing to a maximum of ninety degrees Fahrenheit (90 °F) by spraying with water before placing concrete.
5. Do not use cement that has reached a temperature of one hundred seventy degrees Fahrenheit (170 °F) or more.
6. Prevent plastic shrinkage and cracking due to rapid evaporation of moisture.
7. Do not place concrete when evaporation rate (actual or anticipated) equals or exceeds specified limits in ACI 305.
8. Set-retarding and water-reducing admixtures may only be used with Engineer's concurrence.

1.6. ALTERNATIVES – NOT USED

1.7. GUARANTEE – NOT USED

PART 2 – PRODUCTS

2.1. MATERIALS

A. Concrete.

1. Cement.
 - a. ASTM C 150, Type I/II or Type II, sulfate resistant.
 - b. Tricalcium Aluminate (C₃A) in the Type II cements shall not exceed eight percent (8%).
2. Aggregates.
 - a. Fine aggregate: ASTM C 33.

- b. Coarse aggregate: ASTM C 33.
 - 1. Air-cooled blast furnace slag will not be allowed.
 - 2. Nominal maximum size of coarse aggregate shall conform to ACI 318.
- 3. Water.
 - a. Shall be clean, fresh, and free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances that may be deleterious to concrete reinforcement.
- 4. Admixtures.
 - a. Do not use admixtures that cause accelerated setting of cement.
 - b. Calcium chloride is not permitted.
 - c. Air-entraining agent: ASTM C 260, nontoxic after thirty (30) days and containing no chlorides.
 - d. Water-reducing and retarding: ASTM C 494, Type A or Type D.
 - 1. May only be used with Engineer's concurrence.
 - e. Pozzolan (Fly Ash): Class C or Class F fly ash in accordance with ASTM C618, Tables 1 and 2, except as modified herein:
 - 1. Loss on Ignition: Maximum three percent (3%).
 - 2. Water Requirement: Maximum one hundred percent (100%) of control.
 - 3. Available Alkalies: Maximum of one and one-half percent (1-1/2%) Na₂O determined in accordance with ASTM C311 when any portion of aggregates are potentially reactive as defined in Appendix X1 of ASTM C33.
 - 4. Maximum of one and one-half percent (1-1/2%) Na₂O determined in accordance with ASTM C311 when any portion of aggregates are potentially reactive as defined in Appendix X1 of ASTM C33.
 - 5. ASTM C618, Table 3, Effectiveness in Controlling Alkali-Silica Reaction, applies when any portion of aggregates are potentially reactive as defined in Appendix X1 of ASTM C33.
 - 6. ASTM C618, Table 2A, Uniformity Requirements, apply when loss on ignition of fly ash furnished exceeds three percent (3%).
 - f. Superplasticizers: ASTM C 494.
 - 1. Use in all structural walls and beams. Use in other elements and slabs at Contractor's option.

B. Form Materials

- 1. General.
 - a. Reference ACI 301.
 - b. Where "Smooth and Finish" or "Grout Cleaned Finish" is specified, use prefabricated plywood panel forms, job-built plywood forms, forms lined with plywood or fiberboard, or steel forms.
 - c. Where "Rough Form Finish" is specified, unlined wooden forms may be used.
 - d. Lumber.
 - 1. Straight, uniform width and thickness; free from knots, offsets, holes, dents, and other surface defects.

2. Chamfer Strips: Clean, white pine; surface against concrete planed.
 2. Form Ties.
 - a. Removable end, permanently-embedded body type, with cones on outer ends.
 1. Provide form ties with center waterstop ring at locations where surface water, ground water or hydrostatic conditions may be encountered, as indicated on the drawing, or as directed by Engineer.
 - b. Sufficient strength and rigidity to support and maintain the form in proper position and alignment without the use of auxiliary spreaders.
 - c. The permanently-embedded portion shall be recessed a minimum of one inch (1") from concrete surface.
 3. Form Coating.
 - a. Non-staining chemical release agent that will not damage the concrete surface.
 - b. For all exposed surfaces not in contact with earth backfill, use:
 1. Symons Corporation, "Magic Kote."
 2. Or approved equal.
- C. Reinforcement Material.
1. Rebar.
 - a. Conform to ACI 315 and ACI 318.
 - b. Bars shall be Grade 60 unless indicated otherwise on the Drawings, ASTM A 615.
 - c. Column spirals shall be cold-drawn wire, ASTM A 82.
 - d. Tie wire shall be annealed steel, sixteen (16) gauge minimum ASTM A 510.
 - e. Bar Supports.
 1. Where concrete surface will be exposed to weather, the portions of the supports or accessories within one-half inch (1/2") of the concrete surface shall be non-corrosive or protected against corrosion (epoxy covered).
 2. Plastic bar supports are not acceptable.
 2. Welded Wire Fabric.
 - a. Plain Wire: ASTM A 185.
 - b. Deformed Wire: ASTM A 497.
- D. Concrete Accessory Materials.
1. Curing Materials.
 - a. Water.
 - b. Sheet material: ASTM C 171.
 - c. Liquid membrane: ASTM C 309.
 2. Expansion Joint Filler.
 - a. Bituminous type: ASTM D 994.
 - b. Cork type: ASTM D 1752, Type 2 or 3.
 - c. Fiber type: ASTM D 1751.
 3. Bond Break Material.
 - a. Felt: ASTM D 2475.

- b. Polyethylene sheet material.
- 4. Joint Sealers.
 - a. Cold-application type: ASTM D 1850.
 - b. Hot-poured elastic type: ASTM D 1190.
 - c. Hydrostatic pressure resistant type sealant.
 - 1. Sikaflex 2C NS/SL.
 - 2. Or approved equal.
- 5. Waterstop.
 - a. Material: Polyvinyl chloride, (PVC).
 - b. Type.
 - 1. Construction joints: Ribbed with center bulb.
 - 2. Expansion joints: Ribbed with center bulb.
 - 3. Greenstreak.
 - 4. Or approved equal.
 - c. Size.
 - 1. Six inches (6") wide, minimum.
 - 2. Three-eighths-inch (3/8") thick, minimum.
 - d. Hydrophilic waterstop – where specifically noted on Drawings.
 - 1. Hydrotite hydrophilic waterstop as supplied by Greenstreak.
 - 2. Or approved equal.
- 6. Vapor Barrier Material.
 - a. Polyethylene sheet.
- 7. Curing Compounds.
 - a. Liquid membrane-forming.
 - b. Pigmented and non-pigmented ASTM C 309.
 - 1. "Klearseal."
 - 2. Or approved equal.
- 8. Non-Shrink Grout.
 - a. Master Builders 713.
 - b. SonogROUT 14K.
 - c. Or approved equal.

2.2. MIXES – NOT USED

2.3. FABRICATION AND MANUFACTURE

- A. Concrete Production.
 - 1. Ready-mixed Concrete.
 - a. Mixed and delivered, reference ACI 304.
 - 2. Batching and Mixing Equipment.
 - a. Conform to ACI 304.
 - 3. Proportioning.
 - a. Proportion ingredients to produce a well-graded mix of high density and maximum workability consistent with submitted mix design and subject to the following minimum twenty-eight (28) day compressive strength:
 - 1. 4000 psi for all structural concrete.
 - 2. 3000 psi for manhole bases, thrust blocks, pipe encasements, curbs and gutters, and sidewalks.

- b. Minimum entrained air for concrete exposed to weather and for sidewalks, curbs, gutters, and pavements.
 - 1. Six percent plus or minus one percent ($6\% \pm 1\%$) for three-quarter-inch ($3/4''$) coarse aggregate.
 - 2. Five percent plus or minus one and one-half percent ($5\% \pm 1-1/2\%$) for one and one-half-inch ($1-1/2''$) coarse aggregate.
 - 3. Refer to ACI 301 for further requirements.
- c. Minimum entrained air for concrete required to be watertight including concrete for all liquid-containing structures.
 - 1. Six percent plus or minus one percent ($6\% \pm 1\%$) for three-quarter-inch ($3/4''$) or one-inch ($1''$) coarse aggregate.
 - 2. Five percent plus or minus one percent ($5\% \pm 1\%$) for one and one-half-inch ($1-1/2''$) coarse aggregate.
- 4. Strength.
 - a. Design and proportion concrete to meet the following minimum compressive strengths.

Specified Strength, psi	7-Day Test, psi	28-Day Test, psi	W/C Ratio Non-Air Entrained	W/C Ratio Air Entrained
3000	2100	3000	0.58	0.46
4000	2800	4000	0.44	0.40

- b. Water/cement ratios greater than those shown above may be submitted for consideration in accordance with quality provisions of ACI 318.
- 5. Slump Range at Site:
 - a. Nonsuperplasticized Concrete: Three inches ($3''$) minimum, five inches ($5''$) maximum.
 - b. Superplasticized Concrete: Four and one-half inches ($4-1/2''$) minimum, eight inches ($8''$) maximum.
 - c. Take design mix test cylinders from concrete with slump equal to that used on Project at the point of discharge into the forms.
- 6. Mixing - Minimum time.
 - a. Central-mixed concrete, one (1) minute for mixer capacities of one cubic yard (1 CY) or less, plus fifteen (15) seconds for each cubic yard, or fraction thereof, of additional capacity.
 - b. Truck-mixed concrete, one hundred (100) revolutions after introduction of all ingredients.
- 7. Admixtures:
 - a. Water-reducing and retarding agents: May only be used with Engineer's concurrence.
 - b. Fly Ash: Maximum twenty-five percent (25%), minimum fifteen percent (15%) of total weight of fly ash plus cement.
 - c. Superplastizicers: Use at Contractor's option. Control the slump and workability to at least a four and one-half inch ($4-1/2''$) slump at

discharge into forms by adjusting the superplasticizer at the batch plant.

- B. Rebar Fabrication.
 - 1. No plus or minus (\pm) tolerance shall be allowed for rebar fabricated with multiple bends.
 - a. Rebar with multiple bends shall be fabricated such that concrete coverage specified herein or as otherwise indicated in the Specifications or the Drawings shall be maintained.

PART 3 – EXECUTION

3.1. INSPECTION

- A. General.
 - 1. Assure that excavations and formwork are completed.
 - 2. Assure that dirt, mud, encrusted concrete, debris, and excess water have been removed.
 - 3. Check that reinforcement is properly positioned and secured in place.
 - 4. Verify that expansion joint material, anchors, waterstops, and other embedded items are secured in proper position.
 - 5. Verify that all required tests for pipes under slabs have been completed.

3.2. PREPARATION

- A. Concrete Surfaces.
 - 1. Before placing fresh concrete against surface of hardened concrete or rock.
 - a. Roughen, clean, and thoroughly wet hardened surface to sound concrete.
 - b. Remove all laitance, foreign substances (including curing compound), wash with clean water, and thoroughly wet hardened surface before placing fresh concrete.
 - c. Blast cleaning shall be required when necessary to assure a clean-bonded joint.
 - 2. Prepare slab subgrades in accordance with ACI 301.
- B. Form Surfaces.
 - 1. Remove mortar, grout, and other foreign material from form surfaces.
 - 2. Coat form surfaces with form coating material before either the reinforcing steel or concrete is placed.
 - 3. Do not allow form coating to:
 - a. Stand in puddles in the forms.
 - b. Come in contact with the reinforcing steel.
 - c. Come in contact with adjacent hardened concrete against which fresh concrete is to be placed.
- C. Reinforcement.
 - 1. Remove all mud, oil, loose rust, mill scale, and other foreign materials that may reduce bond of the concrete to the steel reinforcing.

2. Rust or mill scale that is “tight” will be permissible without cleaning or brushing provided weights, dimensions, cross-sectional area, and tensile properties meet requirements of ASTM A 615.

3.3. INSTALLATION, APPLICATION, AND PERFORMANCE

A. Form Erection.

1. General.

- a. Erect forms substantially and sufficiently tight to prevent leakage of mortar, and braced or tied to maintain the desired position, shape, and alignment before, during, and after concrete placement.
- b. Use adequate walers, stiffeners, and braces to ensure proper alignment.
- c. Provide temporary openings at the bottom of column and wall forms and at other locations where necessary to facilitate cleaning and inspection.
- d. Provide temporary openings in wall or column forms to limit the free fall of concrete to a maximum of four feet (4'-0").
 1. If tremies of proper lengths are used for depositing concrete in walls or columns, temporary openings for concrete placement will not be required.
- e. At other locations, bring forms to a true line and grade, or provide a wooden guide strip at the proper location on the forms so that the top surface can be finished with a screed or template for concrete which is to have a specified elevation, slope, or contour.
- f. At horizontal construction joints in walls, do not extend the forms on one (1) side more than two feet (2'-0") above the joint.
- g. Anchor bolts, castings, steel shapes, conduits, sleeves, masonry anchorage, and other materials that are to be embedded in the concrete shall be accurately positioned in the forms and securely anchored.

2. Edges and Corners.

- a. Place chamfer strips in forms to bevel exposed edges and projecting corners.
- b. Tool the top edges of walls and slabs not indicated on the Drawings to be beveled.
- c. Form beveled edges for all vertical and horizontal corners of equipment bases unless indicated otherwise on the Drawings.
- d. Chamfer strips shall be three-quarter inch (3/4") unless indicated otherwise on the Drawings.

3. Form Removal.

- a. Reference ACI 347.
- b. Do not remove or disturb forms until the concrete has attained sufficient strength to safely support all dead and live loads.

B. Reinforcement Installation.

1. Bar Placement.

- a. Conform to ACI 318.

2. Bar Supports.

- a. Conform to ACI 315.

- b. Do not use pebbles, rocks, pieces of broken stone, common or face brick, metal pipe, or wood blocks to support reinforcement.
 - c. Use one-half (1/2) solid concrete bricks to support rebar on ground.
 - 3. Placement, and Coverage Tolerances.
 - a. Reference ACI 318.
 - 4. Splices.
 - a. Do not splice bars except at locations shown on the Drawings unless reviewed by Engineer.
 - b. Minimum lay distance shall be as shown on the Drawings. If not shown, splices shall be as specified in ACI 318.
 - 5. Welded Wire Fabric.
 - a. Install in longest practicable length.
 - b. Lap adjoining pieces one (1) full mesh plus two inches (2"), minimum.
 - c. Offset laps in adjacent widths to prevent contiguous laps.
 - d. Extend fabric through contraction joints and construction joints unless otherwise indicated on the Drawings.
- C. Concrete Placement.
 - 1. General.
 - a. Conform to ACI 304.
 - 2. Conveying.
 - a. Convey concrete from mixer to final position as rapidly as practicable without segregation or loss of material.
 - 3. Depositing.
 - a. Deposit concrete in a continuous operation until section is completed.
 - b. Regulate rate of placement so concrete remains plastic and flows into position.
 - c. Each layer of concrete shall be plastic when covered with the following layer.
 - d. Use tremies to prevent free fall of more than four feet (4'-0").
 - e. Do not allow concrete to fall on reinforcement or other objects that would cause segregation.
 - f. Do not exceed six feet (6'-0") of vertical height for any portion of wall or column placed monolithically with floor or roof slab.
 - 4. Consolidation.
 - a. During and immediately after placement, thoroughly compact and work around all reinforcements, embedments, and corners of forms.
 - b. Number and type of vibrators shall be subject to concurrence with Engineer.
 - c. Do not use vibrators to transport concrete laterally in forms.
 - d. Operate vibrators in order to avoid segregation of materials.
- D. Joints.
 - 1. Watertight Joints.
 - a. Provide on water bearing structures.
 - b. Provide on structures submerged in groundwater.
 - c. Provide at all locations shown on the Drawings.

2. Expansion and Contraction Joints.
 - a. At all locations shown on the Drawings.
 - b. Do not extend reinforcement continuously through expansion joint unless specifically shown on the Drawings.
 - c. Form joint with felt extending full depth, where "bond break" or "isolation" joint is indicated.
 3. Construction Joints.
 - a. Where shown on the Drawings.
 - b. Obtain Engineer's concurrence for location of construction joints not shown on the Drawings.
- E. Finishing.
1. Unformed Surfaces
 - a. Finish unformed surfaces as specified herein and as shown in the Finish Schedule at the end of this Section.
 2. Slabs, floors, stairs, pavements, sidewalks, driveways, curb and gutters, and similar structures.
 - a. Provide surface conforming to proper elevation and contour with all aggregates completely embedded in mortar by screeding.
 - b. Provide an initial float finish as soon as concrete has stiffened sufficiently for proper working.
 1. Produce a surface of uniform texture and appearance with initial floating, without unnecessary working of surface.
 - c. Provide a second floating at time of initial set.
 1. Produce a finish of uniform texture and color with second floating.
 3. Brooming.
 - a. Follow second floating with a broomed treatment of surface to provide a uniform abrasive texture of constant color, in areas where concrete is to remain exposed.
 4. Troweling.
 - a. Perform steel troweling after second floating when surface has hardened sufficiently to prevent excess of fines being drawn to surface.
 1. Produce a dense, smooth, uniform surface, free from blemishes and trowel marks within plus or minus one-quarter-inch ($\pm 1/4"$) of specified grade.
 5. Finishing Surfaces for Bonding to be Covered with Concrete Topping.
 - a. Float finish all surfaces.
 - b. Remove by brushing or air blasting at time of initial set, all laitance, surface mortar, and unsound material.
 - c. Surfaces shall be rough, clean, and sound.
 - d. Edging.
 1. Edge exposed edges of floated or troweled surfaces with a tool having a minimum one-quarter-inch ($1/4"$) corner radius unless these edges are specified to be beveled.
 6. Finishing Formed Surfaces
 - a. Finish formed surfaces as specified herein and as shown in the Finish Schedule at the end of this Section.

- b. Rough form finish all surfaces not exposed to view such as surfaces in contact with earth.
 - 1. Remove all fins and other surface projections when damp-proofing is specified.
 - 2. Provide a flush surface and use a power grinder, if necessary, to remove fins and projections.
 - 3. Fill all tie holes with non-shrink grout.
- c. Smooth form finish all exposed surfaces not generally exposed to view including submerged surfaces of tanks.
 - 1. Use form facing to produce a smooth, hard, uniform surface.
 - 2. Keep number of seams to a minimum.
 - 3. Remove all fins and projections.
 - 4. Clean, wet, and fill all tie holes with non-shrink grout.
 - 5. Repair all defects.
- d. Grout clean finish all concrete surfaces exposed to view.
 - 1. Complete operations for smooth form finish.
 - 2. Wet surface and apply grout mix of one (1) part of Portland Cement and one and one-half (1-1/2) parts of fine sand.
 - 3. Use bonding agents as necessary to ensure grout adherence.
 - 4. Substitute white Portland Cement for gray as required to match surrounding concrete.
 - 5. Rub surface with cork float or stone to fill all air bubbles and holes.
 - 6. Remove excess grout by rubbing with a rubber float, burlap bag, or other means.
 - 7. Do not begin cleaning until all contiguous surfaces are completed and accessible.

F. Curing.

- 1. Moisture Cure.
 - a. Keep concrete continuously moist for at least seven (7) days after placement by use of:
 - 1. Ponding, continuous sprinkling, wet burlap or wet absorptive mats.
- 2. Membrane Curing Compound.
 - a. Use only with Engineer's concurrence on a pour-by-pour basis.
 - b. Spray apply at coverage as recommended by Manufacturer.
 - c. Membrane curing compound shall be reapplied each day during curing period after any work activity has occurred on concrete surface.
 - d. For concrete surfaces to be painted or top coated, neutralize and remove curing compound after curing period.
- 3. Film Curing.
 - a. Use only with Engineer's concurrence on a pour-by-pour basis.
 - b. Begin as quickly as possible after initial set of concrete.
 - c. Cover surfaces completely with polyethylene sheeting.
 - d. Anchor continuously all edges and anchor surface as necessary to prevent billowing.

- e. Keep concrete continuously wet during curing period.

3.4. FIELD QUALITY CONTROL

A. Concrete Tests.

- 1. Concrete tests shall be in accordance with the requirements of ACI 301 except as noted or modified in this Section.
 - a. Strength test.
 - 1. Mold and cure four (4) cylinders from each sample.
 - 2. Test one (1) cylinder at seven (7) days for information, two (2) cylinders at twenty-eight (28) days for acceptance, and hold one (1) cylinder for future break.
 - 3. If additional cylinders are required for Contractor's information, said cylinders will be in addition to those listed above.
 - b. Minimum samples.
 - 1. Collect one (1) sample set for each fifty (50) cubic yards or as designated by Engineer.
 - c. Slump test.
 - 1. Conduct test for each batch.
 - d. Air content.
 - 1. Conduct test for each batch.

3.5. ADJUST and CLEAN

A. Repair of Defective Concrete.

- 1. Repair work shall conform to ACI 301.

3.6. SCHEDULES

A. Finish Schedule.

FINISH SCHEDULE	
Surface	Finish
Floor Slabs	Non-slip, mag float
Formed Surface Exposed to View	Sack Rub
Curbs	Light Broom
Sidewalks	Light Broom

END OF SECTION