CITY OF NEWTON, KANSAS

STANDARD SPECIFICATIONS

FOR SANITARY SEWER IMPROVEMENTS

OCTOBER 2017

No.	Revision	Date

TABLE OF CONTENTS

	PAGE
GENERAL CONDITIONS	00700-1 - 45
SUPPLEMENTARY CONDITIONS	00800-1 - 9
SPECIFICATIONS	
DIVISION 1 - GENERAL REQUIREMENTS	
SECTION 01030 - SPECIAL PROJECT PROCEDURES	01030-1
SECTION 01040 - COORDINATION	01040-1
SECTION 01050 - FIELD ENGINEERING	01050-1
SECTION 01060 - REGULATORY	01060-1
SECTION 01100 - ALTERNATIVES	01100-1
SECTION 01150 - MEASUREMENT AND PAYMENT	01150-1 - 4
SECTION 01300 - SUBMITTALS	01300-1
SECTION 01510 - TEMPORARY UTILITIES	01510-1
SECTION 01700 - CONTRACT CLOSEOUT	01700-1
DIVISION 2 - SITE WORK	
SECTION 02001 - GENERAL	02001-1
SECTION 02100 - SITE PREPARATION	02100-1
SECTION 02200 - EARTHWORK	02200-1 - 5
SECTION 02206 - EXCAVATION, TRENCHING AND BACKFILLING FOR UTILITIES	02206-1 - 6
SECTION 02221 - FLOWABLE FILL	02221-1 - 2
SECTION 02400 - DRAINAGE	02400-1
SECTION 02485 - SEEDING, SPRIGGING AND SODDING	02485-1 - 7
SECTION 02601 - MANHOLES AND CLEANOUTS	02601-1 - 4
SECTION 02605 - SANITARY SEWER CONSTRUCTION	02605-1 - 7
SECTION 02626 - VACUUM TESTING OF MANHOLES	02626-1 – 2
SECTION 02650 – HORIZONTAL DIRECTIONAL DRILLING, BORING AND JACKING	02650-1-11
DIVISION 3 - CONCRETE	
SECTION 03010 - CONCRETE WORK	03010-1 - 14
DIVISION 9 – FINISHES	
SECTION 09902 – SANITARY SEWER MANHOLE COATINGS	09902-1 - 7

00800 SUPPLEMENTARY CONDITIONS

The following revisions apply to the Standard General Conditions of the Contract for Construction (No. 1910-8, 1996 Edition prepared by Engineers Joint Contract Documents Committee).

Where any article, paragraph, or sub-paragraph of the General Conditions is supplemented by one of the following paragraphs, the provisions of such article, paragraph, or sub-paragraph shall remain in effect, and the supplementary provisions of such shall be considered as added thereto. Where any article is superseded by one of the following paragraphs, the provisions of such article, paragraph or sub-paragraph not so amended, voided or superseded shall remain.

1. ARTICLE 1 - DEFINITIONS - No changes, additions, or amendments.

2. ARTICLE 2 - PRELIMINARY MATTERS

2.02 Copies of Documents: A. - delete the phrase "ten copies" from the first sentence and insert the phrase "six copies" in lieu thereof.

2.05 Before Starting Construction: C. - delete the paragraph in its entirety and substitute the following:

> "C. Evidence of Insurance: Before any work at the site is started, CONTRACTOR shall file certificates of Insurance acceptable to the OWNER with the OWNER which the CONTRACTOR is required to purchase and maintain in accordance with Article 5."

3. ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 Intent: - add the following paragraph:

> "D. Within the Specifications the order of precedence shall be as follows: Addenda, Supplementary General Conditions, Information for Bidders, General Conditions, and Technical Provisions."

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

4.02 Subsurface and Physical Conditions: A.1 and A.2. - delete these paragraphs in their entirety and substitute the following:

> "1. See Section 01030 - Special Project Procedures."

4.05 Reference Points: - add the following paragraph:

> "B. Surveys to be furnished to the CONTRACTOR by the OWNER will be as specified in Division 1 GENERAL REQUIREMENTS."

5. ARTICLE 5 - BONDS AND INSURANCE

5.01 Performance, Payment and Other Bonds: - add the following sentence to paragraph "B":

"The CONTRACTOR shall furnish a Statutory Bond which is a surety bond, running to the State, conditioned that the CONTRACTOR, as principal, shall pay all indebtedness incurred for labor, supplies, equipment and materials furnished in making the improvements called for by the contract documents."

5.04 Contractor's Liability Insurance: - add the following paragraph.

"C. The CONTRACTOR shall not commence work under this contract until the insurance required by OWNER is obtained, approved and filed with the OWNER; nor shall the CONTRACTOR allow any subcontractor to commence work until the insurance required of the subcontractor has been obtained, approved and filed with the OWNER. The certified Insurance Policy to be filed by the CONTRACTOR with the OWNER shall provide the following coverages:

1. Comprehensive General Liability covering premises---operations, xcu hazards when applicable, Products/Completed operations, Broad Form Property Damage and Contractual Liability with minimum limits as follows:

Bodily Injury Liability	$1,000,000 Each Occurrence $1,000,000 Each Aggregate
Property Damage Liability	$1,000,000 Each Occurrence $1,000,000 Each Aggregate
Or	
Bodily Injury and Property Damage Liability (Combined Single Limit)	$1,000,000 Each Occurrence $1,000,000 Each Aggregate

2. Automobile Liability-Comprehensive Form including all owned, hired and non-owned vehicles with minimum limits for

Bodily Injury Liability	$1,000,000 Each Accident
Property Damage Liability	$1,000,000 Each Accident
Or	
Bodily Injury and Property Damage Liability (Combined Single Limit)	$1,000,000 Each Accident

3. Workers' Compensation/Employers Liability for minimum limits of

Employers Liability:	Statutory

In the Insurance Policy, the Insurance Company must state that the Contractual Liability includes the Liability of the OWNER and ENGINEER assumed by CONTRACTOR in the Contract Documents. The Policy must also state that the OWNER will be given written notice if the policy is cancelled or changed within ten (10) days prior to the effective date thereof.

Said Insurance Policy shall be furnished to the OWNER before the agreement is issued."

5.05 Owner's Liability Insurance: A. - delete the paragraph in its entirety and substitute the following:

"A. CONTRACTOR shall include OWNER and ENGINEER as additional insureds under CONTRACTOR'S general liability policy requirements set forth in Article 5.04 of the General Conditions."

5.06 Property Insurance: A.- delete the first sentence and substitute the following in lieu thereof.

"CONTRACTOR shall purchase and maintain property insurance upon the Work at the site to the full insurable value thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations)."

5.06 Property Insurance: B. and E. - delete these paragraphs in their entirety. No substitution will be made.

5.07 Waiver of Rights: A. - delete the last sentence of the paragraph in its entirety. No substitutions will be made.

5.08 Receipt and Application of Insurance Proceeds: A. and B. - delete these paragraphs in their entirety. No substitutions will be made.

5.09 Acceptance of Bonds and Insurance; Option to Replace: A. - Delete the first sentence and substitute the following in lieu thereof.

"A. If the OWNER has any objections to the coverage afforded by or other provisions of the Bonds or Insurance required to be purchased and maintained by the CONTRACTOR in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the OWNER shall so notify the Contractor in writing within 10 days after receipt of the certificates (or other evidence required) required by Paragraph 2.05.C."

6. ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.10 Taxes: - add the following paragraph

"B. For tax exempt status see Section 01060 Regulatory".

6.11 Use of Site and Other Areas: A. Limitation of Use of Site and Other Areas - add the following paragraph:

"4. During the progress of the work the convenience of the local public and of residents along the work shall be considered and, where possible, their rights of access shall be preserved. Temporary driveways, approaches and crossings shall be provided where practicable and maintained in good condition. Construction materials shall be so stored or stockpiled as to cause as little obstruction as possible and still be readily accessible for use or inspection. No material shall be stored within 2 feet of any tree or building nor within 5 feet of any fire hydrant; fire hydrants shall remain ready for immediate use by the fire department. The CONTRACTOR'S proposed schedule for beginning new sections of the work shall be coordinated with and approved by the ENGINEER. To prevent extended inconvenience to the local residents, the CONTRACTOR will not be permitted to open up extensive areas for work during periods when cold or other weather conditions which would curtail the work are normally expected."

Shop Drawings and Samples: 6.17A and B - The number of copies of shop drawings and samples to be submitted will be six.

7. ARTICLE 7 - OTHER WORK - No changes, additions or amendments.

8. ARTICLE 8 - OWNER'S RESPONSIBILITIES - delete paragraph 8.06.A in its entirety, no substitution will be made.

9. ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.03 Project Representation: - add the following paragraph:

"B. Exhibit SG-1 - "A LISTING OF THE DUTIES, RESPONSIBILITIES AND LIMITATIONS OF AUTHORITY OF THE RESIDENT PROJECT REPRESENTATIVE" is attached hereto and is a part of these supplemental conditions."

10. ARTICLE 10 - CHANGES IN THE WORK; CLAIMS - No changes, additions, or amendments.

11. ARTICLE 11 - COST OF THE WORK; CASH ALLOWANCES; UNIT PRICE WORK - No changes, additions, or amendments.

12. ARTICLE 12 - CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

Add the following paragraph to 12.01.

"B.4. CONTRACTOR shall not be entitled to a change in the Contract Price, payment, or other compensation at any time due to damages caused by inaccuracy or admission of information referred to in Article 4 of the General Conditions. A claim for an extension of Contract time may be made as provided in Article 12".

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

13.02 Access To Work: - add the following paragraph.

"B. The ENGINEER and/or OWNER may provide one or more Resident Project Representatives to inspect materials to be used in the work and observe construction methods to determine compliance with the Contract Requirements. The ENGINEER and the Resident Project Representatives shall be provided free access to all parts of the work at the project site and to offsite locations where materials or equipment proposed for use in the work are to be produced or fabricated. Resident Project Representatives shall have the authority to reject defective materials; to delay specific construction operations while the acceptability of materials is being determined, or while equipment or machines are being adjusted or calibrated; and to suspend operations on any part of the work not meeting Contract Requirements. Project Representatives shall have no authority to deviate from or waive the requirements of the specifications without written permission of the ENGINEER. Resident Project Representatives will not perform as Superintendent or Foreman for the CONTRACTOR and neither the presence or absence of the Project Representative on the work shall relieve the CONTRACTOR of his responsibility to perform all work in accordance with the Contract Requirements."

13.03 Tests and Inspections: - Add the following paragraph:

"B. So long as the CONTRACTOR'S work progresses in an orderly and reasonable manner the costs of field sample preparation and testing of all specimens will be borne by the OWNER. Should the CONTRACTOR use methods or procedures that require unreasonable or excessive field testing to determine whether specification requirements are being met, or if field testing is performed with continued negative results that indicate the CONTRACTOR'S methods or procedures are not adequate to provide the specified results, the ENGINEER will notify the CONTRACTOR in writing that the costs of all additional testing beyond specific limits, which shall be set out in the written notice for the particular area or material in question, shall be the responsibility of the CONTRACTOR. Such costs will then be deducted from the monies due the CONTRACTOR for the work performed."

14. ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

14.02 Progress Payments: A. Applications for Payment - add the following paragraph:

"4. The Contractor shall submit three (3) copies of each Application for Payment to the Engineer for review."

15. ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION - No changes, additions or amendments.

16. ARTICLE 16 - DISPUTE RESOLUTION - No changes, additions and amendments.

17. ARTICLE 17 - DUTIES, RESPONSIBILITIES AND LIMITATIONS OF AUTHORITY OF THE RESIDENT PROJECT REPRESENTATIVE

17.01 General: RPR is ENGINEER's agent at the site, will act as directed by and under the supervision of ENGINEER, and will confer with ENGINEER regarding RPR's actions. RPR's dealings in matters pertaining to the on-site work shall in general be with ENGINEER and CONTRACTOR keeping OWNER advised as necessary. RPR's dealings with subcontractors shall only be through or with the full knowledge and approval of CONTRACTOR, RPR shall generally communicate with OWNER with the knowledge of and under the direction of ENGINEER.

17.02 Duties and Responsibilities of RPR

A. *Schedules*: Review the progress schedule, schedule of Shop Drawing submittals and schedule of values prepared by CONTRACTOR and consultant with ENGINEER concerning acceptability.

B. *Conferences and Meetings*: Attend meetings with CONTRACTOR, such as preconstruction conferences, progress meetings, job conferences and other project-related meetings, and prepare and circulate copies of minutes thereof.

C. *Liaison*:

1. Serve as ENGINEER'S liaison with CONTRACTOR, working principally through CONTRACTOR's superintendent and assist in understanding the intent of the Contract Documents; and assist ENGINEER in serving as OWNER's liaison with CONTRACTOR when CONTRACTOR's operations affect OWNER's on-site operations.

2. Assist in obtaining from OWNER additional details or information, when required for proper execution of the Work.

3. Refer all contacts or inquiries by the general public (any person who does not represent an agency which has jurisdiction over the project) to the Engineer.

D. Shop Drawings and Samples:

1. Record date of receipt of shop Drawings and samples.

2. Receive samples which are furnished at the site by CONTRACTOR, and notify ENGINEER of availability of samples for examination.

3. Advise ENGINEER and CONTRACTOR of the commencement of any Work requiring a shop Drawing or sample if the submittal has not been approved by ENGINEER.

E. *Review of Work, Rejection of Defective Work, Inspections and Tests*:

1. Conduct on-site observations of the Work in progress to assist ENGINEER in determining if the Work is in general proceeding in accordance with the Contract Documents.

2. Report to ENGINEER whenever RPR believes that any Work is unsatisfactory, faulty or defective or does not conform to the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise ENGINEER of work that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.

3. Verify that tests, equipment and systems startups and operating and maintenance training are conducted in the presence of appropriate personnel, and that CONTRACTOR maintains adequate records thereof; and observe, record and report to ENGINEER appropriate details relative to the test procedures and startups.

4. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Project, record the results of these inspections and report to ENGINEER.

F. *Interpretation of Contract Documents*: Report to ENGINEER when clarifications and interpretations of the Contract Documents are needed and transmit to CONTRACTOR clarifications and interpretations as issued by ENGINEER.

G. *Modifications*: Consider and evaluate CONTRACTOR's suggestions for modifications in Drawings or Specifications and report with RPR's recommendations to ENGINEER. Transmit to CONTRACTOR decisions as issued by ENGINEER.

H. *Records*:

1. Maintain at the job site orderly files for correspondence, reports of job conferences, Shop Drawings and samples, reproduction of original Contract Documents including all Work Directive Changes, Addenda, Change Orders, Field Orders, additional Drawings issued subsequent to the execution of the Contract, ENGINEER's clarifications and interpretations of the Contract Documents, progress reports, and other Project related documents.

2. Keep a diary or log book, recording CONTRACTOR hours on the job site, weather conditions, data relative to questions of Work Directive Changes, Change Orders or changed conditions, list of job site visitors, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to ENGINEER.

3. Record names, addresses and telephone numbers of all CONTRACTORS, subcontractors and major suppliers of materials and equipment.

I. *Reports*:

1. Furnish ENGINEER periodic reports as required of progress of the Work and of CONTRACTOR's compliance with the progress schedule and schedule of Shop Drawing and sample submittals.

2. Consult with ENGINEER in advance of scheduled major tests, inspections or start of important phases of Work.

3. Draft proposed Change Orders and Work Directive Changes, obtaining backup material from CONTRACTOR and recommend to ENGINEER Change Orders, Work Directive Changes, and Field Orders.

4. Report immediately to ENGINEER and OWNER upon the occurrence of any accident.

J. *Payment Requests*: Review applications for payment with CONTRACTOR for compliance with the established procedure for their submission and forward with recommendations to ENGINEER, noting particularly the relationship of the payment requested to the schedule of values. Work completed and materials and equipment delivered at the site but not incorporated in the Work.

K. *Certificates, Maintenance and Operation Manuals*: During the course of the Work, verify that certificates, maintenance and operation manuals and other data required to be assembled and furnished by CONTRACTOR are applicable to the items actually installed and in accordance with the Contract Documents, and have this material delivered to ENGINEER for review and forwarded to OWNER prior to final payment for the Work.

L. *Completion*:

1 Before ENGINEER issues a Certificate of Substantial Completion, submit to CONTRACTOR a list of observed items requiring completion or correction.

2. Conduct final inspection in the company of ENGINEER, OWNER and CONTRACTOR and prepare a final list of items to be completed or corrected.

3. Observe that all items on final list have been completed or corrected and make recommendations to ENGINEER concerning acceptance.

17.03 Limitations of Authority

A. Resident Project Representative:

1. Shall not authorize any deviation from the contract Documents or substitution of materials or equipment, unless authorized by ENGINEER.

2. Shall not exceed limitations of ENGINEER's authority as set forth in the Contract Documents.

3. Shall not undertake any of the responsibilities of CONTRACTOR, subcontractors or CONTRACTOR's superintendent.

4. Shall not advise on, issue directions regarding or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction unless such advice or directions are specifically required by the Contract Documents.

5. Shall not accept Shop Drawings or sample submittals from anyone other than CONTRACTOR.

7. Shall not authorize OWNER to occupy the Project in whole or in part.

8. Shall not participate in specialized field or laboratory tests or inspections conducted by others except as specifically authorized by ENGINEER.

SECTION 01030 - SPECIAL PROJECT PROCEDURES

1. GUARANTY

The Contractor shall guaranty all materials and equipment as specified in Article 13 of the General Conditions Page 00700-19. It shall be the Contractor's responsibility to notify all suppliers of materials and equipment that the guaranty shall extend one year from the date of substantial completion or as specified otherwise.

2. NOTIFICATION

It shall be the Contractor's Responsibility to notify the Owner a minimum of two weeks prior to all construction which requires interfacing with the existing water, sewer, or electrical systems.

3. DISPOSAL OF WASTE MATERIALS

The Contractor shall have full responsibility for proper disposal of waste materials. They shall be disposed of at the locations provided by contractor and approved in writing by the Engineer.

4. TRAFFIC CONTROL

The Contractor shall protect traffic by the use of proper and necessary flags, lights, signals, barricades or other warning devices as needed, all in accordance with the latest edition of the Manual On Uniform Traffic Control Devices, U.S. Department of Transportation, Federal Highway Administration.

5. UTILITIES

The Contractor will be required to obtain and pay for all utilities used for the project.

SECTION 01040 - COORDINATION

1. COOPERATION

The Contractor shall cooperate with the Engineer, the Owner and other contractors in performing the work involved in the entire project. Fairness shall prevail as regards use of access roads, storage space, space for temporary office, utility services, and other facilities. In any arrangement as to the proportion of facilities between contractors, the decision of the Resident Engineer shall be final.

SECTION 01050 - FIELD ENGINEERING

1. SURVEYS

The surveys available to the Contractor have been performed by others for this project.

The Contractor shall re-establish all P.I.'s and Bench Marks. Prior to using any Bench Mark, the Contractor shall verify its accuracy.

Construction Staking shall be provided by the Owner unless a specific bid item has been listed for Construction Staking in the project proposal. All other surveys necessary to prosecute the work shall be done by the Contractor with his own surveyors, materials and equipment at his own expense.

No special payment will be made to the contractor for survey work and such work will be considered subsidiary to other related items of work.

SECTION 01060 - REGULATORY

1. PERMITS

All necessary State, City, County, Local and Federal Permits required for construction shall be furnished by the Contractor.

2. CODES

Execute work in compliance with all applicable Federal, State and Municipal laws, codes, ordinances, and local customs regarding the trade to perform the work.

Codes shall govern in case of any direct conflict between codes and plans and specifications; except when plans and specifications require higher standards than those required by code.

3. TAXES

Materials and equipment incorporated for the Sanitary Sewer are exempt from the payment of sales tax under the laws of the State of Kansas and shall not be included in the bid of the bidders.

Owner will provide the Contractor with a proper exemption certificate within 10 days of the date of the Agreement. Should the Owner fail to provide an exemption certificate number within the required time period, the Contractor will be reimbursed monthly for sales tax amounts for which he becomes liable until such certificate number is provided.

Upon issuance of a proper exemption certificate number to CONTRACTOR, CONTRACTOR shall assume full responsibility for his own proper use of the certificate number, and shall pay all costs of any legally assessed penalties relating to CONTRACTOR's improper use of the exemption certificate number."

SECTION 01100 - ALTERNATIVES

1. SUBSTITUTION OF EQUIPMENT

Whenever a material, article or piece of equipment is identified on the drawings or specifications by reference in brand name or catalog number, it shall be understood that this is referenced for the purpose of defining the performance or other salient requirements and that other products of equal capacities, quality and function shall be considered.

Prior to receiving bids the Contractor may recommend the substitution of a material, article, or piece of equipment of equal substance and function for those referred to in the Contract Documents by reference to brand name or catalog number, and if, in the opinion of the Engineer, such material, article, or piece of equipment is of equal substance and function to that specified, the Engineer may approve its substitution, and an addendum will be issued naming those additional manufacturer's which will be acceptable to the Engineer. The requests for substitutions must be received 10 days prior to bidding.

After execution of the contract, substitution of equipment of makes other than those specifically named in the contract documents will be approved by the Engineers only if the equipment named in the specifications cannot be delivered to the job in time to complete the work in proper sequence to work of other Contractors, due to conditions beyond control of the Contractor.

Requests for substitutions must be accompanied by documentary proof of equality and difference in price and delivery, if any, in form of certified quotations from suppliers of both specified and proposed equipment.

The Owner shall receive all benefits of the difference in cost involved in any substitution, and the contract altered by change order to credit Owner with any savings so obtained.

SECTION 01150 - MEASUREMENT AND PAYMENT

1. GENERAL

The total bid price for each section of the contract shall cover all work shown on the contract drawings and required by the specifications and other contract documents. All costs in connection with the work, including furnishing of all materials, equipment, supplies, and appurtenances; providing all construction plant, equipment, and tools; and performing of all necessary labor to fully complete the work, shall be included in the unit and lump sum prices named in the Proposal. No item that is required by the Contract Documents for the proper and successful completion of the work will be paid for outside of or in addition to the prices submitted in the Proposal. All work not specifically set forth as a pay item in the Proposal shall be considered a subsidiary obligation of the Contractor and all costs in connection therewith shall be included in the prices named in the Proposal.

All incidental, subsidiary and miscellaneous items of work essential to completion of the project in a satisfactory manner shall be done at no additional cost to the Owner. Some, but not all, of the items that shall be considered incidental or subsidiary are as follows:

a. The support, protection and maintenance of existing utilities such as power and telephone poles, sanitary sewers, manholes, storm drains, and other such items that are to be maintained in place, before, during, and after construction of the proposed improvements.
b. Traffic control.
c. Acquisition of additional working space.
d. Other items as noted in these specifications or on the plans.

The method of measurement and basis of payment for each item as listed in the Proposal shall be as stipulated in the following paragraphs. Final payment to the contractor will be based on measured quantities, unless otherwise shown.

2. PIPE LINES

Pipe Lines shall be paid for on a linear foot basis as measured along the centerline of the pipe, no deductions being made for manholes, valves or fittings. All fittings such as tees, bends, crosses, reducers, couplings, clamps, sleeves, plugs, caps, etc. shown on the plans or required for satisfactory assembly and installation shall be considered subsidiary to the price bid for pipe. Trenching, pipe bedding, backfill, testing, disinfection, etc. shown on the drawings shall be considered subsidiary to the price bid for pipe. Abandonment of existing waterlines and the filling of existing casing with flowable fill/fill sand shall be considered subsidiary to the price bid for pipe. Pipelines at structures shall be measured to the outside wall line of the structure. Also included in this item is connecting the newly constructed system.

3. MANHOLES - Type A, B, and C

Manholes shall be paid for at the contract unit prices bid per each for the various types, based on a 6 vertical feet of manhole, which should include the base section, cone section, adjusting rings and frame and cover. The prices bid shall be full compensation for furnishing all materials, including gasketed frames and covers, pipe used for outside drop manholes, coatings, concrete, grout and for all equipment, tools, labor and incidentals necessary to complete the work. Excavation and compaction of earthwork for this item will not be paid for separately. Extra depth of manhole bid item shall include furnishing and installing the required barrel sections to achieve finished grade.

Vacuum testing is subsidiary to Manholes in Place.

4. MANHOLE GRADE ADJUSTMENT

Manhole grade adjustment shall be paid for at the contract unit prices bid per each, which should include the adjusting rings. The prices bid shall be full compensation for furnishing all materials, including gaskets, coatings, concrete, grout and for all equipment, tools, labor and incidentals necessary to complete the work. Excavation and compaction of earthwork for this item will not be paid for separately.

Vacuum testing is subsidiary to Manholes in Place.

5. MANHOLE AND SEWER SERVICE CONNECTIONS

This item shall be paid for at the contract unit price bid per each. The price bid shall be full compensation for pipe, fittings, plugs, caps, marking tape, trenching, backfilling, bedding, testing and incidentals necessary to complete the work.

6. BORING AND STEEL ENCASEMENT

Boring and Steel Encasement shall be paid for by the linear meter as shown on the plans and shall include the boring and receiving pit, steel encasement, wood skids, sand, concrete and all items described and necessary to complete the boring and encasement per the plans and the specifications.

7. STEEL CASING BY OPEN CUT

Steel Encasement shall be paid for by the linear meter as shown on the plans and shall include steel encasement, wood skids, sand, concrete, excavation, trenching, backfill, and all items described and necessary to complete the open cut and encasement per the plans and specifications.

8. REMOVE AND REPLACE PAVED AND GRAVEL PAVEMENT

This item shall be paid for at the contract unit price per Linear Foot to the width as required by trenching operations. The unit price bid shall be full compensation for

removal and replacement of the pavement and curb and gutter to the limits shown on the plans and includes the furnishing of all materials, equipment, labor, and incidentals necessary to complete the work. The existing material shall be replaced with either concrete, asphalt, or gravel as required and shown on the plans.

9 CONCRETE SIDEWALK PAVEMENT REMOVED. This item shall be paid for at the contract unit price bid per square foot for the area shown on the plans, and shall also include saw cuts, disposal of removed material, and backfilling the removal areas with suitable topsoil where necessary. Payment shall be full compensation for removal and disposal of the specified items; and for furnishing all equipment, tools, labor and incidentals necessary to complete the work.

10. CONCRETE DRIVEWAY REMOVED AND REPLACED. This item shall be paid for at the contract unit price bid per square foot for the area shown on the plans, and shall include saw cuts, removal, disposal of removed material; and for all excavation, compaction, concrete and concrete placement, reinforcement and its placement, forming, finishing, jointing, curing, and for furnishing all equipment, tools, labor and incidentals necessary to complete the work.

11. TEMPORARY AND PEMANENT PROJECT SEEDING. These items shall be paid for at the contract contract unit prices bid per acre. The price bid shall be full compensation for furnishing seed, fertilizer, mulch, and water; ground preparation; application of seed, fertilizer and mulch as required by the plans and specifications; watering as required in Section 02487 of these specifications; and for all tools, labor, and incidentals necessary to complete the work.

12. EXCAVATABLE FLOWABLE FILL

This item shall be paid for at the unit price bid per linear foot of trench filled regardless of trench depth and/or pipe sizes unless indicated otherwise by plans or contract. The unit price bid shall include all materials, excavation, backfilling, equipment, labor, miscellaneous items and incidentals necessary to complete this work.

13. EROSION CONTROL (BMP's)

This item shall be paid for at the contract ump sum bid installed at the locations as shown on the plans or detailed. The unit price id shall include sediment barriers, inlet protection, temporary construction entrances and all other materials, equipment, labor and incidentals necessary to complete the work. Also included in this item is maintenance of the sediment barriers throughout construction and removal of these barriers once a substantial stand of protective cover is established, as approved by the Engineer.

14. SITE CLEARING AND RESTORATION

Site Clearing and Restoration shall be paid for at the Contract lump sum price bid and shall be full compensation for clearing, grubbing of shrubs, trimming of trees and plant where permitted; removal of trees; removal and replacement of fences, culverts, and signs; removal of debris, placement of safety fencing, and temporary fencing, barricades and flashers, clean-up, and seeding or sodding of all disturbed areas in kind. Removal, repair, and replacement of damaged pavements and travelways for removal and replacement shown in the drawings shall be considered subsidiary to site clearing and restoration. The price bid shall cover all incidental items affected by the work including furnishing all material, equipment, tools, energy and labor necessary to complete the work.

SECTION 01300 - SUBMITTALS

1. CONSTRUCTION SCHEDULE

The Contractor shall submit his proposed progress schedule for the Engineer's approval within 10 days after the effective date of the Notice To Proceed. The Contractor's progress schedule, when approved by the Engineer, shall be used to establish major construction operations and to check on progress of the work. The Contractor shall provide sufficient materials, equipment and labor to assure completion of the work in accordance with the approved schedule.

The Contractor shall review the construction phasing or sequencing requirements noted on the plans when preparing the construction schedule. Any deviation from the phasing or sequencing requirements shall be noted and an alternative submitted in writing to the Engineer for approval.

If the Contractor's progress falls significantly behind the approved schedule, the Contractor shall, upon the Engineer's request, submit a revised schedule for completion of the work within the contract time and modify his operations to provide such additional materials, equipment and labor necessary to meet the revised schedule. Should the prosecution of the work be discontinued for any reason the Contractor shall notify the Engineer at least 24 hours in advance of resuming operations.

2. SUBMITTALS

a. The Contractor shall within 15 days after award of contract start sending submittals for approval. The Contractor shall prepare or have prepared in a neat and workmanlike manner, submittal drawings and shop details for all equipment and materials furnished under this Contract. The submittals shall contain the following:

(1) Six sets of identical submittal data separately stapled with Engineer's submittal form as a cover sheet.

(2) Where catalog cuts are used mark them to indicate equipment, capacities, controls, fittings, valves, sizes, etc.

(3) Reference each item to applicable specification paragraph number and plan sheet number. Reference items not appearing in base specification to applicable alternate numbers, change order numbers, letters of authorization, etc.

(4) Shop drawings:

(a) All shop drawings shall be checked and signed by the contractor prior to submittal to the Engineer.

(b) Shop drawings submitted without contractor's signature or approval and verification will not be approved.

SECTION 01510 - TEMPORARY UTILITIES

1. GENERAL

The Contractor shall furnish and pay for all compressed air, electricity, gas, telephone and potable water service required at the project site. Water necessary for earthwork compaction or other construction operations shall be furnished and paid for by the Contractor. The utilities are as scheduled on the drawings.

2. TEMPORARY SANITARY FACILITIES

The Contractor shall furnish and pay for temporary toilet facilities for use by his employees. Facilities shall be serviced regularly and maintained so as to not constitute a nuisance or health hazard.

SECTION 01700 - CONTRACT CLOSEOUT

1. CLEANING

The Contractor shall remove all debris and thoroughly clean the project prior to final inspection.

DIVISION 2 - SITEWORK

SECTION 02001 - GENERAL

1. SCOPE OF WORK

The work covered under this Section shall include clearing and grubbing; all excavation required for construction of roads, streets, drives, and parking areas; formation of embankments, fills, and backfills; demolition, dewatering, excavation for culverts, storm drains, sanitary sewers, water lines, manholes, drainage structures, channels, and ditches; subgrade preparation, area and finish grading; hauling, placing, watering and compacting; disposal of surplus and waste materials; utilities; and all miscellaneous and incidental operations necessary to construct and complete the work in compliance with the dimensions, lines and grades as shown on the plans.

2. OBSTRUCTIONS

The Contractor shall work around all utilities, structures, fences, trees, shrubs, pavement, and other items shown to remain within the work site, easements, and rights-of-way, unless he determines removal, resetting, replacement, or adjustments will be required to accomplish the work. The Contractor shall bear all costs for the removal, resetting, replacement, and/or adjustment or repair of those items affected as directed by the Engineer, at no additional cost to the Owner.

3. CLEANUP

Upon completion of construction the Contractor shall remove all debris resulting from construction. All soil banks shall be leveled and excess material disposed of as specified in Section 02200, for Type B Compaction. The entire area involved in this contract shall be left in a clean and sightly condition.

4. DISPOSAL OF WASTE MATERIALS

Materials obtained from demolition of the existing facilities, sewer lines, manholes, concrete rubble, concrete encasement excavation, existing fence, trees, shall be removed from the project site and disposed of at the County Landfill or as directed by the Engineer. Material containing vegetation stripped from the site shall be stockpiled during construction and spread for topsoiling of grassed areas after the site grading is completed. Excess soil shall be wasted on site or at other approved sites and placed in accordance with Type B compaction requirements.

SECTION 02100 - SITE PREPARATION

1. STRIPPING

The Contractor shall strip all vegetation and other objectionable material from all areas of original ground on which pavement, concrete slabs, fill or footings are to be placed. Where shown on plans, the strippings shall be deposited at approved locations on the site, but shall not be used for backfilling trenches, or structures. No direct payment will be made for stripping.

2. DISPOSAL OF SURPLUS MATERIALS

All material from stripping and all excess excavation or trenching material not required for filling or backfilling shall be wasted at the jobsite, as shown in the plans or as directed by the Engineer.

SECTION 02200 - EARTHWORK

1. GENERAL

1.1 Related Documents: General Conditions and Supplementary Conditions apply to this Section.

1.1.1 Related Work Specified Elsewhere Are Titled:

(1) "Excavation, Trenching and Backfilling for Utilities" Section 02206.

(2) “Manholes and Cleanouts”; Section 02601.

(3) "Sanitary Sewer Construction": Section 02605.

1.2 Description: Upon completion of the backfilling of trenches and placing fill around structures, the entire site of the work included in this Contract shall be graded to form smooth, uniform slopes around structures. All the remaining area included in this Contract shall be graded to the elevations shown on the Plans to provide adequate drainage away from the structures and to present a neat and workmanlike appearance.

1.3 Quality Assurance: Equipment: Type approved prior to use, for capability of equipment to perform work in an acceptable manner. Compact using tamping rollers, pneumatic tired rollers, three-wheeled power rollers or other type equipment.

1.4 Compaction Control: Owner shall at his expense, make field density tests to assure correct moisture content and compaction.

2. MATERIALS

2.1 Satisfactory Materials: All suitable material taken from excavations shall be used in the formation of embankments, subgrade, and backfill to complete the site grading as indicated on the plans or as directed by the Engineer. All unsuitable excavated materials together with all debris, junk, stones, logs, stumps, roots, and other unsuitable materials shall be removed from the site and disposed of by, and at the expense of, the Contractor.

Satisfactory and unsatisfactory materials will be determined by the engineer.

2.2 Topsoil: If quantity of topsoil is not available on site and additional topsoil is required, provide approved crumbly surface soil having characteristics of soils in vicinity that produce heavy growth of vegetation.

3. EXECUTION

3.1 Conservation Of Topsoil: In cut areas, and in areas under proposed paving, walks, structures and/or buildings, remove topsoil without contamination with subsoil. Spread topsoil in areas prepared for topsoil, or when directed stockpile in locations convenient to areas to receive topsoil later. Strip to depth of 6-inches and keep free of roots, stones or other undesirable materials.

3.2 Excavation: General: Excavate to lines and grades indicated. If unsatisfactory material is encountered, stop work and notify Engineer of condition. Use satisfactory excavated material for fills. Remove unsatisfactory material and surplus excavated material not required for fill and dispose of off site, unless specified otherwise.

3.2.1 Under Proposed Walks: Excavate to subgrade elevations.

3.2.2 For excavation under proposed buildings, paving, utilities, sewers and subdrains see the section noted in Paragraph 1.1.

3.2.3 Classification of Excavation: Unclassified regardless of nature of material encountered.

3.2.4 Protection or Removal of Utility Lines: Protect from damage existing utility lines, etc., shown on the drawings or in locations made known to Contractor prior to excavation and to be retained, as well as utility lines constructed during excavation operations; if damaged, repair at Contractor's expense. Existing utility lines not shown on drawings and existing utility lines in locations not known by Contractor, if damaged, shall be repaired and restored to service at Contractor's expense. When utility lines to be removed are encountered, notify Engineer in ample time for necessary measures to be taken to prevent interruption of service.

3.3 Preparation Of Ground Surfaces For Fill: Strip or remove unsatisfactory material within area upon which fill will be placed. Scarify to depth of 9" and compact to required density at a moisture content of at least optimum.

3.4 Fills and Embankments: Construct at locations and to lines and grades indicated; conform to shape of typical section indicated. Provide and haul in approved material for fill, if material is not available from excavated areas. Fill material shall be satisfactory materials, reasonably free of roots, and other organic material and trash, and from stones greater than 6 inches maximum diameter. Frozen materials are not acceptable for fill. Stones over 3" maximum diameter not acceptable in upper six inches in fills or embankments. Place material in successive horizontal layers of 6" to 9" in loose depth. Compact each layer to required density.

3.5 Backfill Adjacent To Structures: Place and compact uniformly in manner to prevent wedging action or eccentric loading upon or against structures. During backfilling and in forming embankments, do not use equipment that will overload structure in compacting fills. Additional requirements for backfilling for pavements, buildings, sewers and utilities are specified in related sections.

3.6 Compaction Of Earthwork

3.6.1 General: This item shall consist of the compaction of earthwork by rolling or tamping, or any combination of these methods in accordance with the method and/or type and at the location indicated on the plans or ordered by the Engineer.

3.6.2 Standard Density Tests: This test is designed to determine the moisture content at which maximum compaction is obtained, and to determine the density (dry weight per unit volume) which is obtained at the moisture content and the test will be made as described in the latest edition of ASTM D698.

3.6.3 Moisture Content Requirement: When sufficient moisture does not exist in the soil or earth material to provide thorough bonding under rolling, a sufficient amount of water shall be added to the soil before it is rolled or tamped to insure bonding during the compaction process. Moisture control shall be one of the following types. The type of moisture control to be used at a specific location shall be as depicted on the plans.

3.6.3.1 Moisture Range 03 (MR 0-3). The moisture content of the soil shall be uniform and shall not be higher than three (3) percentage points above optimum nor lower than optimum of the soil involved. If the soil is unstable at this moisture range, the moisture shall be lowered to the point it is stable as determined by the Field Engineer.

3.6.3.2 Moisture Range 90 (MR-90). The moisture content of the soil shall be uniform and shall be such that the soil can be compacted to the requirements of the type of compaction designated on the plans or ordered by the Engineer.

If Type B compaction is specified with this moisture control, the moisture content shall be sufficient to produce a uniform mixture of the soil and moisture. It will be determined by visual inspection that satisfactory compaction and moisture content is obtained.

The water may be added to the material as it is placed in the embankment, or to the cut area and borrow pits. When it is added to the embankment it shall be thoroughly and uniformly mixed with the material before compaction. The mixing shall be accomplished by the use of spring tooth harrows, disc harrows, disc plows or other equipment, or by other methods approved by the Engineer. When water is added to cut areas or borrow pits, the surface of the areas shall be plowed or otherwise roughened or shaped to permit more rapid penetration of the water and to prevent undue loss of the water.

3.6.4 Compaction Requirements: Compaction requirements are separated into types, depending upon the nature of the soil to be compacted and the degree of compaction desired. The method of attaining the compaction for each of the several types shall be as herein described.

3.6.4.1 Type AA The Contractor shall carefully level up each successive lift or layer and shall make a sufficient number of trips with the roller over the entire surface to insure that all soils are uniformly compacted to a density equal to or greater than ninety-five (95) percent of the Standard Density for each soil in conformance with the latest edition of ASTM-D-698. Each successive lift shall contain only that amount of soil material which will insure sufficient and uniform compaction, but in no instance shall any lift or layer exceed six (6) inches of compacted depth.

3.6.4.2 Type B The Contractor shall carefully level up each successive lift or layer and shall make a sufficient number of trips with tamping or sheepsfoot type rollers over the entire surface to insure that all soils are uniformly compacted. Compaction shall be continued until the roller feet ride the surface of the compacted lift. Compaction will be considered as adequate when additional trips do not result in additional compaction or in bringing the roller feet closer to the surface of the lift. Each successive lift shall contain only that amount of material which will insure efficient and uniform compaction, but in no instance shall any lift or layer exceed six (6) inches of compacted depth.

If, due to the sandy material that may be encountered, or due to the high moisture content that may be encountered with some of the soils, the roller will not "build up" so that the tamping feet will ride the surface, or the roller continues to pick up excessive amounts of soil due to excessive moisture content to the soil, the sheepsfoot roller may be discontinued and a pneumatic tired roller used, with the permission of the Engineer. When pneumatic tired rollers, meeting the requirements as set out above or as approved by the Engineer are used, each lift shall be rolled not less than ten (10) trips over its entire surface and not more than fifteen (15) trips will be required.

3.6.5 Tamping Adjacent to Structures: Whenever embankments are placed adjacent to structures or at locations where it is not practical to use a roller, the embankment materials shall be tamped by the use of mechanical rammers or tampers. Each layer shall be compacted to a density equal to or greater than that obtained under the above rolling procedure for the type of compaction designated. Each successive lift shall contain only that amount of material which will insure proper compaction, but in no instance shall any layer be greater than six (6) inches of compacted depth. When the quantity of work is small, a hand tamper may be used with the permission of the Engineer.

4. BORROW

4.1 General: If there is insufficient material from the excavations to build the embankments and fills required, the Contractor shall borrow the additional fill material required.

4.2 Dressing of Borrow Pits: Upon completion of work, borrow pits shall be dressed, graded, and sides trimmed to uniform slopes and left in a condition which will present a neat appearance, minimize soil erosion and standing water, and permit accurate measurement.

5. SETTLEMENT

The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within one year after final completion of the contract under which the work was performed.

The Contractor shall make, or cause to be made, all repairs or replacement made necessary by settlement, within 48 hours after notice from the Engineer or Owner.

6. DRAINAGE

6.1 Drainage in Vicinity of Structures: The Contractor shall control the grading in the vicinity of structures and trenches so that the ground surface is properly pitched to prevent water from running into the excavated areas. Water which has accumulated in the excavation through the failure of the Contractor to take proper precautions to prevent such accumulation, shall be removed by the Contractor at his own expense, and the subgrade shall be restored to its proper bearing capacity.

7. TOPSOILING

7.1 Location: Apply topsoil to areas of project other than areas to receive structures, buildings, walks, gravel strips and pavings. Coordinate with landscape drawings and specifications.

7.2 Preparation: Excavate cut areas 4" below finish elevation and scarify and compact to required density. Leave fill areas down 4" below finish elevations.

7.3 Installation: Place and compact to 90% of Standard Proctor Density to a thickness after compaction of 4". Finish to elevations called for on the drawings and to a smoothness suitable for seeding, sprigging or planting as called for on landscape drawings.

7.4 Protection: Protect newly graded areas from traffic and erosion. Repair areas of settlement or washing away that may occur and reestablish grades to required density, elevations and slopes.

SECTION 02206 - EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES

1. GENERAL

1.1 Related Documents: General Conditions and Supplementary Conditions apply to this Section.

1.1.1 Related Work Specified Elsewhere Are Titled:

(1) “Earthwork”: Section 02200.

(2) “Manholes and Cleanouts”; Section 02601.

(3) “Sanitary Sewer Construction”: Section 02605.

1.2 Description: This Section includes Trenching and Backfilling for Site Utilities from 5 feet outside building lines to the connection with City utilities and/or for City utilities within City or Public Easements. Also included in this Section is the excavation and backfilling for incidental utility structures.

1.3 Quality Assurance: Equipment: Type approved prior to use, for capability of equipment to perform work in an acceptable manner. Compact using vibrating plates, tamping rollers, pneumatic tired rollers, three-wheeled power rollers or other type equipment.

1.4 Compaction Control: Owner shall at his expense, make field density tests to assure correct moisture content and compaction.

2. MATERIALS

2.1 Satisfactory Materials:

2.1.1 Pipe Bedding Material:

2.1.1.1 Granular Bedding Material shall be an approved material consisting of a durable crushed rock conforming with the requirements of the latest revision of ASTM C-33 Size No. 67 (3/4" to No. 4); to be placed in not more than 6" layers and compacted by slicing with a shovel or vibrating. Soundness, abrasion, and absorption limits shall be as required for coarse aggregates in Section 03010-Concrete Work.

2.1.1.2 Sand-Gravel Bedding Material - sand-gravel mix meeting Type UD-1 of the 1990 Kansas Standard Specifications for State Road and Bridge Construction.

2.1.1.3 Compacted Embedment shall be an approved sand material free from debris, organic material, and stones with 100% passing thru 3/4" sieve to be placed in uniform layers not more than 6" thick and compacted to 95 percent maximum density as determined by ASTM D698. Granular Bedding Material may be substituted for all or part of Compact Embedment Materials.

2.1.2 Trench Zone Material:

2.1.2.1 Compacted Granular Backfill material shall be an approved sand material free from debris, organic material and stones with 100% passing the 3/4" sieve and not more than 15% passing a No. 200 sieve; to be jetted and mechanically vibrated into place and compacted to 95% density as determined by ASTM D698.

2.1.2.2 Uncompacted Earth Backfill material may be natural soil free from large clods or stones, brush, roots more than 2 inches in diameter, debris, and junk. Flooding with water shall be provided as directed by the Engineer.

2.1.2.3 Compacted Earth Backfill shall consist of material existing prior to trenching or selected material as directed by the Engineer, and shall be compacted to 90% density as determined by ASTM D698. For backfilling at grade beneath existing streets or proposed streets see paragraph 3.3.5. For backfilling at grade under graveled streets see Paragraph 3.3.6.

2.2 Satisfactory and unsatisfactory bedding and trench backfilling materials will be determined by the engineer.

2.3 Topsoil: If quantity of topsoil is not available on site and additional topsoil is called for, provide approved crumbly surface soil having characteristics of soils in vicinity that produce heavy growth of vegetation.

3. EXECUTION

3.1 Structure Excavation And Backfilling: General: The Contractor shall perform all excavation to the dimensions and elevations indicated on the drawings for all structures and all incidental work thereto. After the completion of excavation, and prior to commencement of foundation footings, floor or slab construction, the excavation will be inspected and approved by the Engineer to insure that suitable subgrade has been reached. Care shall be taken not to excavate below the depths indicated on the drawings. Where the excavation is made below the elevation indicated on the drawings through the fault of the Contractor, the excavation shall be restored to the proper elevation in accordance with the procedure described below for backfill, or the heights of the walls or footings shall be increased, at the expense of the Contractor. Excavation shall extend a sufficient distance from walls and footings to allow for forms, for installation of services and for inspection, except where concrete for walls and footings is authorized to be deposited directly against excavated surfaces.

3.1.1 Drainage in Vicinity of Structures: The Contractor shall control the grading in the vicinity of structures and trenches so that the ground surface is properly pitched to prevent water from running into the excavated areas. Water which has accumulated in the excavation through the failure of the Contractor to take proper precautions to prevent such accumulation, shall be removed by the Contractor at his own expense, and the subgrade shall be restored to its proper bearing capacity.

3.1.2 Shoring: The Contractor shall do all shoring required for safety of personnel and protection of the Engineer in performing the prescribed excavation and trenching. Shoring and bracing near structures shall remain, when directed by the Engineer.

3.1.3 Pipes Under Concrete Floors: All pipes under concrete floors shall be tested before the trenches are backfilled. After testing the pipe lines, the trenches shall be backfilled with sand and compacted to a density equal to that of the adjacent earth.

3.1.4 Backfill Around Structures: After completion of foundation footings and walls and other construction below the elevation of the final grades, all forms shall be removed and the excavation cleaned of all trash and debris prior to backfilling. Material for backfilling shall consist of that excavated, or approved borrow, and shall be free of trash, lumber, or other debris. Backfill shall be placed in 6 inch layers properly moistened to approximate optimum requirements. Each layer shall be compacted by hand, machine tampers, or other suitable equipment, to a density equal to that of the adjoining earth.

3.1.5 Wet Excavation: Where ground water is encountered in excavating or trenching, the Contractor shall remove or lower the ground water by means of well point systems, sheeting and pumping, or other approved methods which will permit preparation of a satisfactory pipe bed or structural subgrade, free from running water. No additional or separate payment will be made for wet excavating or trenching.

3.2 Trenching, Backfilling And Compacting: Classification of Excavated Materials: No classification of excavated materials will be made. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition, or condition thereof.

3.2.1 Trenching Through Earth: The Contractor shall perform all trench excavation of every description and of whatever substances encountered, to the depth shown on the plans or as directed by the Engineer. All trenching shall be done with a ladder wheel machine (commonly referred to as trenching machines) or a backhoe. The use of other type machines for trenching will be permitted only by written permission of the Engineer and then only when unusual trenching conditions are encountered. All excavated material not required for fill or backfill shall be removed and wasted as indicated on the plans, or removed and wasted as directed by the Engineer. The excavated material shall be laid compactly along the trench and kept trim so as to be of least inconvenience to the public and adjoining tenants. The Contractor shall not obstruct any drainage courses with excavated material.

Trenches shall be not less than 12 inches nor more than 18 inches wider than the outside diameter of the pipe to be laid therein. Excavation for manholes and other accessories shall have 12 inches minimum and 24 inches maximum clearance on all sides.

The Contractor shall excavate the trench to a minimum of four inches below the pipe barrel for placement of embedment material in the bedding zone in accordance with paragraph Pipe Zone Backfilling. Bell holes shall provide adequate clearance for tools and methods used in installing pipe. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or granular embedment when the pipe is jointed.

The ground adjacent to all excavation shall be graded to provide drainage away from the work. The Contractor shall remove by pumping or other means approved by the Engineer, any water accumulated in or encountered in the excavation, as specified under Wet Excavation.

The banks of trenches shall be kept as nearly vertical as possible, and shall be properly shored and braced. Shoring and sheet bracing near structures shall remain, as directed by the Engineer. Any deviation from vertical trench walls must be requested in writing from the Engineer.

Temporary support, adequate protection and maintenance of all underground and surface utility structures, drains, sewers and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his own expense.

3.2.2 Trenching Through Rock: Whenever rock is encountered in the trench or elsewhere in any excavation required to be made, the rock shall be excavated to a minimum depth of six (6) inches below bottom of the barrel of the pipe for placement of embedment material in the bedding zone in accordance with paragraph Pipe Zone Backfilling. Special care shall be taken to insure that the bells do not rest on rock.

Rock shall not be drilled and blasted with explosives, unless permitted by the Engineer.

3.2.3 Trenching Through Pavement: All concrete or bituminous pavement or stabilized base encountered in the line of trenching shall be removed and replaced in a neat line. The pavement replaced shall conform in type and quality to the pavement removed, and shall be one and one third (1-1/3) times the thickness of the original pavement. The existing pavement shall be cut vertically and horizontally to a straight line.

The original cut in the pavement shall be of the same width as the trench to be excavated. After backfilling and tamping as hereinafter specified, the pavement cut shall be widened to give the new pavement base twelve (12) inches bearing on solid, undisturbed ground on each side of the trench. In the case of concrete pavement, the pavement replaced shall be reinforced with one-half (1/2) inch round bars spaced twelve (12) inches both ways, or equivalent mesh reinforcement.

Whenever the edge of the cut through concrete pavement is within five (5) feet of a joint parallel with the cut, then the pavement shall be removed to the joint and replaced as above.

The provisions of the paragraph "Trenching Through Earth" shall also apply to "Trenching Through Pavement" wherever applicable.

3.2.4 Trenching Through Graveled Surfacing: The Contractor shall carefully remove the existing gravel surfacing material over the area to be disturbed, and conserve the material free from admixture with other materials. After the gravel has been removed and the trenching performed as specified under the paragraph "Trenching Through Earth," and backfilled as hereinafter specified, the gravel surfacing material shall be replaced to a depth at least equal to the undisturbed gravel surfacing. If the gravel taken from the disturbed area has been allowed to become mixed with other material, it shall not be re-used but shall be replaced with approved clean gravel.

3.2.5 Temporary Trench Crossing: Temporary bridges or crossings over the trench shall be built and maintained by the Contractor where required to maintain traffic.

3.3 Backfilling: After the pipe joints are set and approved, backfilling shall be carefully performed and the surface brought to existing grade or to the elevations shown on the plans. Backfilling of open trenches shall be completed prior to the close of each days' work.

3.3.1 Pipe Zone Backfilling: Bedding material placement both below and above the bottom of the pipe shall conform to Figure 02206-1 and to the following:

(1) Class A "Concrete Cradle" and/or Class A "Concrete Encasement" is not required unless specified on the plans. However, where unexpected trench conditions exist or improper trenching is performed Class A Bedding may be required as determined by the Engineer.

(2) Class B Bedding shall be used for all flexible pipe.
   a. Class B Normal Bedding shall be used for PVC Pipe.
   b. Class B Improved Bedding shall be used for other flexible pipe.

(3) Class C Bedding shall be used for all rigid pipe.
   a. Class C Ordinary Bedding shall be used for all rigid pipe unless wet conditions are encountered.
   b. Class C Improved Bedding shall be used for wet conditions existing in the trench, as directed by the Engineer, at no additional cost to the Engineer. The dimensions shall be equal to that required for "rock" excavation.

3.3.2 Placement and Compaction: After each pipe has been graded, aligned, shoved home and placed in final position on the bedding material, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations.

Embedment material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement.

3.3.3 Backfill: Backfill material and compaction requirements shall conform to either Type I, Type II or Type III as shown on Figure 02206-2. The type of backfill to be used at specific locations shall be as shown on the plans. One year's maintenance will be required on all backfill.

3.3.4 Backfilling Through Rock: Backfilling through rock shall be performed as specified in the paragraph Backfill above, except that the Pipe Zone is increased to provide eighteen (18) inches of cover over the pipe. When approved by the Engineer the remainder of the backfill may be excavated rock provided the excavated rock has been broken up so that earth and rock will thoroughly mix and not result in voids around the larger pieces of rock. Any excess rock remaining after the trench has been backfilled shall be removed or wasted as directed by the Engineer.

3.3.5 Backfilling Under Pavement: Backfilling under pavement shall be performed as Backfill Type I or Flowable Fill to a level of two (2) feet from the bottom of the pavement. The remainder of the trench shall be backfilled with selected material, sufficiently damp to be properly compacted in layers not exceeding six (6) inches in depth, compaction shall be performed with mechanical tampers and continued until a relative density of 100 percent of standard density, in conformance with ASTM D698, is attained. Type I backfill shall also be utilized on all proposed streets and shall be used to the limits of the R-O-W.

3.3.6 Backfilling Under Gravel Streets: Where the trench crosses or lies in existing gravel surfaced streets, the backfill shall be compacted as provided in the paragraph "Backfilling Under Pavement".

3.4 Settlement: The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within one year after final completion of the contract under which the work was performed.

The Contractor shall make, or cause to be made, all repairs or replacement made necessary by settlement, within 48 hours after notice from the Engineer.

3.5 Borrow: General: If there is insufficient material from the excavations to build the embankments and fills required, the Contractor shall borrow the additional fill material required. The Engineer will designate the area from which the borrow material is to be secured and the depth to which the cut will be permitted.

3.6 Tamping: Whenever embankments are placed adjacent to structures or at locations where it is not practical to use a roller, the embankment materials shall be tamped by the use of mechanical rammers or tampers. Each layer shall be compacted to a density equal to or greater than that obtained under the above rolling procedure for the type of compaction designated. Each successive lift shall contain only that amount of material which will insure proper compaction, but in no instance shall any layer be greater than six (6) inches of compacted depth. When the quantity of work is small, a hand tamper may be used with the permission of the Engineer.

SECTION 02221 - EXCAVATABLE FLOWABLE FILL

1. DESCRIPTION

This work shall consist of a flowable mortar fill material in sewer, water and utility trenches under the pavement at locations as shown on the plans or as specified. The work shall be done in accordance with this specification.

2. MATERIALS

All materials shall meet requirements for the respective items in the Standard Specifications with the following exceptions.

a Cement shall be Type I.

b. Fly Ash shall meet requirements of ASTM C 618, Class C, and shall come from a source approved by the engineer.

c. Fine Aggregate for flowable mortar shall be natural sand consisting of mineral aggregate particles. The gradation of this materials shall be as follows:

Sieve Size	% Passing
3/4	100
200	0 - 10

It is intended that the sand be a fine sand that will stay in suspension in the mortar to the extent required for proper flow. Generally, mortar or plaster sand works well for this purpose. The sand intended for use shall be submitted to the central laboratory before the work begins. The Engineer reserves the right to reject the intended sand if a flowable mortar cannot be produced using the specified proportions. The contractor will not be responsible for certified aggregate testing. The Engineer will provide inspection that he deems appropriate, normally source approval followed by visual inspection.

d. Mix Design. The mix design for flowable mortar is as follows:

Quantity of Dry Materials per Cubic Yard

Cement	75 pounds
Fly Ash	300 pounds
Fine Aggregate	2600 pounds

These quantities of dry materials, with approximately 70 gallons of water will yield approximately one cubic yard of flowable mortar of the proper consistency. It is intended that the mix design produce a 50 to 75 PSI strength at 28 days. Set accelerator will be required when flowable fill is placed at temperature below 85°F to obtain the necessary support required for traffic and subsequent work at the end of the specified 72-hour period.

3. PROPORTIONING AND MIXING EQUIPMENT

Sufficient mixing capacity or mixers shall be provided to permit the intended pour to be placed without interruption.

4. PLACEMENT OF MORTAR

Flowable mortar shall be placed the full depth into the area that covers two feet beyond either side of the pavement by any reasonable means. The fill shall be brought up uniformly to an elevation 12 inches above the top of the pipe or two feet below the bottom of proposed pavement, whichever is higher. Placement of mortar shall then cease and the fill protected from traffic for a period of 72 hours.

5. LIMITATION OF OPERATIONS

a. Mortar shall not be placed on frozen ground.

b. Mortar batching, mixing, and placing may be started, if weather conditions are favorable. The cold weather operation shall conform to the same conditions as specified in the Standard Specifications for Concrete Work.

c. Each filling stage shall be as continuous an operation as is practicable.

6. MEASUREMENT AND PAYMENT

All materials, labor, equipment, tools and incidentals shall be paid for at the unit price bid per linear foot of trench filled regardless of trench depth and/or pipe sizes unless indicated otherwise by plans or contract.

SECTION 02400 - DRAINAGE

1. DEWATERING

1.1 General: Water encountered during trenching or excavating operations shall be removed or lowered by means of the following dewatering systems which will permit preparation of a satisfactory pipe bed or structural subgrade, free from water.

1.2 Well Points and Pumps: This dewatering system requires the installation of well points and pumps, connecting pipelines and continuous operation in order to permit preparation of a satisfactory pipe bed or structural subgrade.

1.3 Cased Wells and Pumps: This dewatering system requires the use of individually cased wells and pumps, connecting pipelines and continuous operation in order to permit preparation of a satisfactory pipe bed or structural subgrade.

1.4 Discharge: Water from dewatering operations shall be discharged into the drainage ditches adjacent to the sites.

1.5 Permits: The contractor shall be responsible to obtain all permits required for dewatering.

SECTION 02485 - SEEDING, SPRIGGING AND SODDING

1. GENERAL

This work shall consist of the furnishing and planting of seed, sprigs, and/or sod at locations in reasonable conformity with those shown on the Plans or designated by the Engineer and in accordance with these Specifications. The work shall include the preparation of the ground for the planting, fertilizing and mulching, and watering as specified.

2. MATERIALS

2.1 Seeds. The Contractor shall provide grass seed of the variety and at the rates as required to produce the live seed rates shown below or as specified on the Plans. The vendor's certified statement for each species of grass and grass mixture stating each variety, percentage by weight, and percentages of purity, germination, and weed seed shall be furnished. Live seed for each grass species is the product of the percentage of purity and the percentage of germination.

The seed shall be new-crop seed complying with and labeled in accordance with U.S. Department of Agriculture "Rules and Regulations under the Federal Seed Act" in effect at date of purchase of seed. All seed shall be furnished in standard containers. Seed which has become moldy, wet, or otherwise damaged in transit or storage shall not be accepted.

A certificate shall be furnished to the Engineer showing the date that the seed was treated. The treated seed shall be planted within twenty-four (24) months after treatment and any treated Buffalo grass seed held by the Contractor or supplied beyond this period shall not be used.

The seed shall be stored in a cool dry place until seeding time. Seed application rate of 8 pounds per 1,000 square feet/K-31 Fescue.

2.2 Sprigs. Sprigs shall be of the grass species specified on the Plans, and shall be healthy, living stems and roots freshly harvested without adhering soil or weeds and obtained from heavy, vigorous growing and mowed turf. After loosening sprigs from the soil, they shall be immediately gathered in piles or windrows and kept moist until planted.

2.3 Sod. Sod shall be of the species and of the size as specified on the Plans. Sod shall be strongly rooted, free of weeds and undesirable grasses, not less than 2 years old, and free of disease. Turf shall be mowed to approximately 2 inches, the sod freshly cut and obtained from areas having similar climatic conditions as the project site. The sod shall have a thickness of 2 to 3 inches, and shall be kept moist until planted.

2.4 Fertilizer. Fertilizer shall be proportioned as specified on the Plans or shown below and shall be of commercial grade, uniform in composition, free-flowing and suitable for application with approved equipment, delivered to the site in bags or other convenient containers, each fully labeled, conforming to the applicable State Fertilizer Laws, and bearing the same trade name or trade mark, analysis and warranty of the producer. Fertilizer shall be applied at the rate of .5 pounds of actual nitrogen, 1.0 pounds of actual phosphorus, and .5 pounds of actual potassium per 1,000 square feet.

2.5 Mulching.

(1) Hay Mulch - Prairie hay mulch shall normally be used. The hay shall not contain an excessive quantity of noxious weed seeds. The mulch shall be a sharp grade prairie hay, sedan grass hay or broom sedge or any other type of native hay or grass. Straw shall be 8 inches minimum; 50% shall be 10 inches in length or longer.

(2) Asphalt Mulch - Asphalt mulch shall be of a consistency for application by distributing machines and shall be Emulsified Asphalt type SS-1 of the type and grade as approved by the Engineer.

(3) Wood Cellulose Fiber Mulch - Wood fiber mulch shall consist of specially prepared wood cellulose fibers having no growth or germination inhibiting factors, dyed green, and as manufactured by Weyerhaeuser Company, or approved equal. The wood cellulose fiber shall have the characteristic of dispersing rapidly in water to form a homogeneous slurry and remaining in such state while being agitated in hydraulic-slurry equipment.

Wood cellulose fiber mulch shall be shipped packaged or otherwise weighed at a maximum air dry moisture content of 14 percent.

2.6 Water. Water shall not contain substances in the amounts considered harmful for the normal growth of vegetation. The Contractor shall supply water and watering equipment as required for the establishment and maintenance of grassed areas.

3. SITE PREPARATION

3.1 Project Coordination. After the construction has been completed, (except as provided below), the site has been brought to final grades as shown on the Plans, and other plantings have been accomplished, the Contractor shall prepare the areas to be grassed as specified. When so directed or permitted by the Engineer, portions of the

construction site may be grassed at different periods of time provided that the planting occurs in proper seasons as specified. Any grassed areas damaged by subsequent operations of the Contractor shall be replanted as directed by the Engineer at no additional cost to the Owner.

3.2 Tillage. The areas required to be grassed shall be prepared for planting by cultivation, removal of all objectionable material, and filling of gullies or depressions. The soil preparation shall be accomplished by disking, harrowing and firming. (Plowing will also be required if so indicated on the Plans.) The minimum depth of soil preparation shall be three (3) inches. Existing weed stubble, small weeds and grass that can be disked shall be cut by the disk and partially incorporated into the soil. Several diskings and harrowings over some areas may be required to provide a satisfactory seedbed. Areas too steep or otherwise inaccessible for disking shall be prepared by hand methods. The minimum depth of preparation of the seedbed where hand methods must be employed shall be two (2) inches. Disking, harrowing and raking shall be done longitudinally on slope areas.

The soil preparation on all slope areas shall be performed with disks and harrows unless demonstration shows such methods impracticable and that hand methods must be used.

During the process of soil preparation, extreme care shall be exercised to avoid injury to all trees that have been planted or designated by the Engineer to be saved.

The Engineer may designate local areas of desirable native perennial grasses to be omitted during the soil preparation. Areas of annual grasses such as cheat, crab grass, triple-awn, etc., shall be destroyed by thorough disking prior to seeding.

3.3 Application of Fertilizer. Fertilizer shall be distributed uniformly at rates shown in Section 2.4 and over the area to be planted, and shall be incorporated into the soil to a depth of at least 2 inches by disking, harrowing or other methods approved by the Engineer. Distribution by means of an approved seed drill or hydro seeder equipped to sow seed and distribute fertilizer at the same time will be acceptable unless otherwise noted on the Plans.

Additional soil conditioners shall be mixed into the soil by disking, harrowing, etc., when specified on the Plans, or as directed by the Engineer and furnished by the Owner.

4. SEEDING

4.1 Time of Seeding. The two general seeding seasons shall be (1) Spring Seeding Season, February 15 to April 20, and (2) Fall Seeding Season, August 15 to September 30. The permissible seeding periods for various seeds may be extended a few days in special cases when mulching is specified to follow the drilling of seeds and fertilizer.

The Engineer reserves the right to delay the drilling or seeding of any seeds or to vary the permissible seeding seasons listed above due to weather or soil conditions or for other causes.

4.2 Seed Application. Seeds shall be uniformly distributed with acceptable drills, hydraulic-slurry, or other equipment approved by the Engineer. Broadcasting with a standard grass seeder will be required on areas where it is impossible to operate a drill and this method may also be required for certain small seeds.

When a standard drill with fertilizer attachment is used, certain mixed seeds may be placed in the seed box and the fertilizer placed in the fertilizer compartment. Both may be applied during one (1) operation, unless notes on the Plans require separate applications. Fertilizer may be drilled into the soil or applied by hydraulic-slurry. Broadcasting fertilizers is permissible on rough, rocky slopes where drills cannot operate.

All drills shall be fully adjustable so that they will deliver the seeds and fertilizer at the rates specified on the Plans or ordered by the Engineer. Drills that are in poor repair or that do not deliver the seeds and fertilizer uniformly in each drill furrow, shall not be used. Drills shall be adjustable so that the seeds can be planted and covered a maximum depth of 1/2 inch.

Most of the seeds should be drilled about one-half (1/2) inch deep in a well- prepared and firm seedbed. When the fertilizing and seeding operations start on an area, that area shall be completed as soon as possible. No seeding shall be done during windy weather or when the ground is wet or otherwise non-tillable. The grass seed shall then be covered, using a flexible toothed weeder or other suitable equipment. As soon as this covering operation has been completed, the seeded area shall be rolled again with the Culti-packer, the Culti-packer being run over the area only once parallel with the contours of the ground.

Kentucky bluegrass, Bermuda grass and seeds of similar size shall not be mixed with the coarse types of seeds. The finer seeds may be planted with certain drills by removing the seed tubes or they may be broadcast with hand seeders. Broadcast seeding shall be done when the weather is reasonably calm so that the seed will lodge on the prepared seed bed areas.

4.3 Mulching.

(1) Applying Hay Mulch - Hay mulch shall be the required mulching material, unless specified otherwise on the Plans or directed by the Engineer. After seeding operations are complete the mulch shall be spaced uniformly by hand, manure spreader, or other suitable equipment. The mulch shall be anchored to the soil by a V-type

wheel land packer, a disk harrow set to cut slightly, or other suitable equipment which will secure the mulch firmly into the ground 2 inches or more to form a soil-binding mulch and prevent loss or bunching by wind. Spacing between disks shall not exceed 8 inches. Apply hay mulch at the rate of 2 tons per acre or 90 lbs. per 1000 sq. ft.

(2) Applying Asphalt Mulch - Asphalt mulch shall be used only on very sandy soils and shall not be used unless specified on the Plans or directed by the Engineer. Emulsified asphalt may be diluted with additional water, when permitted by the Engineer, and applied with approved distributing equipment. The asphalt shall be applied to all areas regardless of slope and the rate of application shall provide a bituminous residual of not less than 0.12 gallons per square yard after loss of water.

(3) Applying Wood Cellulose Fiber Mulch - Wood cellulose fiber mulch may be used in lieu of hay mulch, when the Contractor elects to use a hydro seeder and the method is approved by the Engineer. Wood cellulose fiber mulch shall be applied at the minimum rate of 2000 pounds per acre, unless specified otherwise.

4.4 Watering. The Contractor shall water the seeded areas as required to assure an acceptable stand of grass.

5. SPRIGGING AND SODDING.

5.1 Time of Planting. Cool weather grasses such as bluegrass, fescue, etc. and including Buffalo grass shall be planted in either the spring or fall seasons with periods limited to March 1 to June 15 and September 1 to November 30, except that the spring season can be extended to June 30 for Buffalo grass.

Warm weather grass such as Bermuda grass, etc. shall be planted between April 1 and August 15, except that sprigs shall be planted between April 15 and June 15.

5.2 Planting. The areas to be sodded or sprigged shall be watered prior to planting when the ground is excessively dry.

(1) Sprigging - Grass sprigs of the variety and spaced as shown on the Plans shall be established by setting root divisions in furrows two (2) inches deep, parallel to the contours, and the roots placed so that they lie end to end in the furrow. The roots shall be covered approximately one (1) inch deep, thoroughly watered and firmed. The furrows shall be left partly open to facilitate additional watering and to hold any mulch applied on slope areas.

Firming shall be done with an approved type roller, so that the top of the sprigs will be slightly below the surrounding surface after the firming process is completed.

(2) Sodding - Grass sod shall be established by means of setting plugs or strips of sod in the soil. The Plans will show the size of plugs and/or the width of strips required and the required spacing of plugs or strips. Excavation shall be made for each plug or strip so that after tamping, the sod will be flush with the final grade. All plugs or strips shall be firmly tamped and thoroughly watered. After placing, all sods shall be firmed by use of an approved roller, a tamper or other approved methods. On steep slopes the sod may be firmed by compacting with hand shovels. The firming process shall remove all air pockets and shall pack the sod roots firmly into the prepared soil.

On steep slopes, staking of plugs or strips may be required as shown on the Plans or as directed by the Engineer. Stakes shall be of lath or similar materials and shall be driven six (6) inches into the ground, leaving approximately one-half (1/2) inch of the top above the sod line.

5.3 Watering.

(1) Sprigged Areas - Sprigged areas shall be kept thoroughly watered for twenty (20) days. Immediately following, the Contractor shall cultivate all areas between the sprigs with hand tools, to kill all weed growth and leave the soil loose and friable. At the time of cultivating, areas that do not have a satisfactory stand of grass shall be replanted as directed by the Engineer.

(2) Sodded Areas - The Contractor shall water all sods immediately after placing. All sodded areas shall be kept thoroughly watered by the Contractor for twenty (20) days after laying and as often as required thereafter until completion of other items of work in the Contract.

6. PROTECTION AND MAINTENANCE.

The grassed area shall be protected against traffic or other use immediately after planting. The Contractor shall be responsible for the proper care of the grassed area until all work on the entire contract has been completed and accepted, or a minimum period of 30 days, whichever is the longest duration. The Contractor will be relieved from watering grassed areas accepted by the Engineer and the Owner.

All planted areas shall be growing when accepted. Areas not showing a stand of grass or evidence of growth shall be replanted in accordance with these specifications. All costs in connection with replanting grassed areas shall be borne by the Contractor until an acceptable stand of grass is obtained, with no additional cost to the Owner.

SECTION 02601 - MANHOLES AND CLEANOUTS

1. GENERAL

Manholes and cleanouts shall be constructed at the location to the size and with the type as shown on the plans and in accordance with the drawings. The invert channels shall be smooth and semi-circular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels shall be formed directly in the concrete of the manhole base, or shall be constructed by laying a full section of sewer pipe through the manhole and cutting out the top half after the surrounding concrete has hardened. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than l inch per foot nor more than 2 inches per foot. Free drop inside the manholes (inside drop) shall not exceed 2 feet measured from the invert of the inlet pipe to the top of the floor of the manholes outside the channels. Outside drop manholes shall be constructed whenever the free drop would otherwise be greater than 2 feet and as shown on the plans.

Manholes shall be constructed to be watertight and shall be vacuum tested per Section 02626.

2. MATERIALS

2.1 Concrete: Section 03010 except as noted herein.

2.2 Quick Set Hydraulic Cements: Thoro "Waterplug", Quikrete "Waterstop" or equal.

2.3 PreCast Reinforced Concrete Manholes: Precast Reinforced Concrete manholes shall conform to the latest revision of ASTM C478 except for the following modifications:

(1) Cement, Section 5 shall be revised to read: Cement used in construction of precast reinforced concrete manholes shall conform to the requirements of the Standard Specifications for Portland Cement (ASTM Designation: C150).

(2) Thickness of precast sections shall be at least one-twelfth of the internal shell diameter plus one inch, or 5 inches total, whichever is greater. The minimum internal diameter of manholes shall be 4 feet.

(3) Precast reinforced concrete manholes shall not be constructed downstream of a force main, except when two (2) or more standard cast-in-place manholes separate the precast manhole and the force main. Precast manholes may be used on the receiving manhole forcemains. If the manhole is provided with an interior coating per specification Section 09902.

(4) Joints between precast reinforced concrete sections shall provide for the use of mastics (2 wraps) or rubber gaskets (natural or synthetic) to prevent leakage of infiltration.

(5) Precast sections shall be adequately reinforced with steel to withstand erection and temperature stresses.

(6) The Contractor must submit certified test results showing that a random number of precast sections have been sampled and tested in accordance with ASTM C497 prior to moving precast sections to the job site.

All costs to complete the preceding tests are to be at no additional cost to the Owner.

(7) Exterior coating shall be 1 coat of Tnemec 46-450 Heavy Tnemecol or equal.

(8) Each precast manhole section delivered to the site shall have the date of manufacture and the manhole number included on the section when delivered.

(9) Manholes on sanitary sewer main 12” and larger shall include an interior coating per specification Section 09902.

2.4 Sand For Mortar: Concrete sand (fine aggregate) sieved through 8 mesh screen.

2.5 Mortar: Eight sacks of Type I cement per cubic yard. Use of hydrated lime shall not be allowed.

2.6 Gaskets:

(1) Mastic: Fed. Spec. SS-S-210; K. T. Snyder "RamNek" or ConSeal CS-102.

(2) Rubber: Neoprene or other synethic, 40 plus or minus 5 hardness when measured by ASTM D2240, Type A durometer.

2.7 Castings: ASTM A48-83, Class 35B. Frames and covers as shown on the plans. All weights as given are approximate and average. Variation will not exceed the specified weights by more than 4 percent. Castings are to be manufactured true to pattern and with satisfactory fit of component parts. Castings shall be free of defects. Dimensions as detailed on plans shall not deviate by +/- 1/16" per foot. Castings shall be furnished with machined horizontal bearing surfaces.

2.8 Delivery: Precast concrete section shall not be delivered to the job until representative concrete control cylinders have attained a strength of at least 80 percent of the specified minimum. The date of manufacture and manhole number shall be indicated on each manhole section upon delivery.

2.9 Inspection: Precast concrete sections shall be inspected when delivered and all cracked or otherwise visibly defective units rejected.

2.10 Quality of Materials. The manufacturer of precast manhole sections shall submit tests from a certified lab detailing quality of aggregates and the mix design, which shall be in accordance with ASTM C478 or the specifications as herein stated.

3. CONSTRUCTION METHODS.

3.1 Cast-In-Place Manholes: **Cast-In-Place Manholes will not be allowed on this project without prior written approval by the Engineer**. Forms used in the construction of cast in place circular concrete manholes shall be inspected and approved by the Engineer prior to use. The forms shall be made of metal and fabricated in sections which will permit easy installation and removal without damage to complete manhole. The forms shall be constructed such that the walls will have a thickness of 8 inches without any form marks on the interior or exterior exceeding 1/4 inch. The upper portion of the form shall be constructed such that the finished manhole will taper from 48-inch diameter to 26-inch diameter in a minimum distance of 30 inches and a maximum distance of 48 inches.

The concrete base shall be poured monolithically with the rest of the manhole as approved by the Engineer. Concrete used in the construction of cast-in-place manholes shall be Class I Mix Concrete with a maximum permissible slump of 4 inches. Concrete shall be placed and compacted in the forms in 2-foot layers in such a manner that will prevent segregation. Forms shall not be removed from the walls of the manhole until the concrete has set up sufficiently to prevent damage to the walls by the form removal operation.

Backfilling will not be permitted until a period of l2 hours has expired after the application of field applied exterior coatings.

Manhole locations which require pipe inlets through cast-in-place circular manhole walls will be constructed by cutting an opening in the manhole wall at the proper location after the forms have been removed. The pipe will than be installed in the opening using the correct alignment and grouted in place. The space between the pipe and manhole shall be completely filled with grout. All plugging or grouting shall be done with a quick set hydraulic cement as specified in Section 02601-1.

3.2 Frames and Covers: Frames shall be set so that the top of the frames will be flush with all paved surfaces.

3.3 Precast Reinforced Concrete Manholes: Thickness of precast sections shall be at least one-twelfth of the internal shell diameter plus one inch, or 5 inches total, whichever is greater. The minimum internal diameter of manholes shall be 4 feet.

All precast sections shall be adequately reinforced to withstand erection and temperature stresses as well as other applied loads.

Joints between precast sections shall provide for the use of mastics or rubber gaskets (natural or synthetic) to prevent leakage or infiltration.

Prior to moving precast sections to the job site, the Contractor shall submit certified test results showing a random number of precast sections have been sampled, tested for compressive strength and absorption and are in compliance with ASTM-C497.

3.4 Sewer Connections to Manholes. Sewer Connections to manholes shall be correctly aligned and connected to the manhole with an approved gasket. Where manholes are to be constructed on an existing pipe, the following shall apply: Pipe connections at manhole walls shall be grouted in place with hydraulic cement. Pipes having smooth exterior surfaces, unable to make a watertight bond with manhole walls, shall be installed with a rubber water stop at manhole penetrations. The space between the pipe and manhole shall be completely filled with an approved quick-set hydraulic cement.

All sewers extending from manholes shall be supported by a crushed rock encasement for a distance of 3 feet minimum from the face of the outside wall, for VCP concrete shall extend to a joint. Pipe penetrations that do not utilize an approved gasket precast in the manhole wall shall have the pipe supported a minimum of 3' from the face of the outside wall with Class I concrete.

3.5 Manholes Adjustment Stacks: Elevation of the manhole service entry shall be set so that the top of the frames will be flush with all paved surfaces, all other locations will be set as shown in the plans. Vertical stacks shall be constructed of 3 inch and 6 inch Keyed Steel Reinforced Concrete Adjustment Rings (S.R.C.A.R.), complying with ASTM-C150 and ASTM-C478. When more than one S.R.C.A.R. is required, only one 3 inch ring shall be allowed and it shall be placed at the bottom of the stack. The manhole entry frame and the adjustment rings shall be properly sealed using two rings of mastic (Fed. spec. SS-S210) spaced approximately 2 inches apart. The manhole entry frame shall be 'capped' with a ring of Type 1 concrete complying with ASTM-C150. The cap should extend from a maximum of (1") one inch below the top of the frame, to a point beyond the bottom of the frame joint. The surface of the cap shall be hand rubbed to provide a smooth, even texture and appearance. When it is necessary to adjust a reinforced concrete manhole with a corbel section upward more than (12") twelve inches or downward, remove the stack and the corbel section completely, then build-up or lower the barrel to the proper height to facilitate reassembly of the corbel and stack to the required elevation. The barrel may be built-up of lowered by adding and/or removing 4 foot diameter precast barrel sections. These sections can be produced in 6” increments to fulfill the elevation requirements. To meet additional elevation requirements use vertical stacks as described above. Manhole details are shown on the plans.

4. STUBS AND CAPS

All stubs out of manholes shall terminate with plain end pipe capped by a gasketed cap made for the pipe being installed. Caps shall not be glued or cemented to the stub.

Stubs shall be a minimum of 5' in length, to the sizes shown in the plans. The contractor shall prevent any concrete from being within 1 foot of the end of the stub.

SECTION 02605 - SANITARY SEWER CONSTRUCTION

1. GENERAL

The work covered by this section consists in furnishing all labor, equipment, and materials, and performing all operations for the construction of gravity sanitary sewers, complete, in accordance with this section of the specifications and the detailed plans. Any section of the sewer that is found defective in material, alignment, grade, or joints, or any section that allows surface infiltration in any form, shall be corrected by the Contractor to the satisfaction of the Engineer at no additional cost to the Owner before final acceptance.

2. TRENCHING AND BACKFILLING

Excavation, trenching and backfilling shall conform to the work as outlined in the Section 02206, of these specifications. All trenching and backfilling shall be Type I or Type III unless otherwise shown on the plans.

3. CONNECTIONS WITH EXISTING PIPELINES

Where connections are made between new work and existing sewers, such connections shall be made in a thorough and workmanlike manner and to the satisfaction of the Engineer. Each connection shall be made in such a manner that adjacent sewers are kept in operation as authorized by the Owner. Before any construction involving a connection to the existing sanitary sewer collection system, the existing system must be isolated from any construction activity. A mechanical plug(s) shall be used. Pneumatic or inflatable plugs are not acceptable. This shall be done with the knowledge of the Owner of the system, who shall be notified 24 hours prior to any intrusion into the existing system. The plug(s) shall stay in position until the new construction is accepted by the Owner, unless otherwise instructed by the Owner. Where existing lines pass through new manholes and are above the bottom of the manhole the contractor must provide pipe support to ensure continuous service. Suitable facilities shall be provided for proper dewatering and drainage. Disposal of all water removed from the dewatered lines and excavation shall not be to a sanitary sewer.

4. MATERIALS

4.1 Concrete: Concrete shall be Class I, except where shown otherwise, and shall be in accordance with the Section 03010 entitled "Concrete Work". Concrete in manhole bases and pipe encasement or cradle shall not be required to have air entrainment.

4.2 Gravity Sewer Pipe (Rigid): Pipe may be of any of the following materials unless otherwise shown on the plans, proposal, or specified. The Contractor shall furnish certified records of the tests for each type of pipe to be used in the work. Tests and certifications shall be provided by the Contractor and made by a reliable commercial laboratory. These items shall be submitted to the Engineer for approval prior to ordering and shipment of pipe.

(1) Ductile-Iron Pipe For Sanitary Sewer: Ductile iron pipe shall conform to ANSI A21.51 or AWWA C151 and shall be thickness Class 52 unless otherwise noted on the plans. Joints shall be either push-on joints or mechanical joints manufactured in accordance with Federal Specification WW-P-421c. All exterior surfaces of ductile iron pipe shall be coated with a bituminous coating approximately one mil thick. The inside of ductile iron pipe shall be lined with a chemically inert liner such as "Protecto 401" as manufactured by United States Pipe and Foundry Co., "Polybond" as manufactured by American Cast Iron Pipe Co., or an approved equal.

4.3 Gravity Sewer Pipe (Flexible): Sewer pipe may be any of the following types of material, unless indicated otherwise on the plans, in the proposal, or in the specifications.

Trenching and backfill conditions are important integral parts of a flexible conduit system, therefore all parts will be considered for acceptance or rejection and for performance and maintenance of the sewer pipe in place. Particular attention should be given to the Section entitled "Excavation, Trenching and Backfilling for Utilities".

The minimum material thickness for each type and size of pipe shall be as required by the Engineer. All pipe not meeting the flexibility tolerances of the Engineer, will not be accepted. The stiffness factor will be used for determination of each pipe's flexibility. The stiffness factor is a product of the moment of inertia of the pipe cross-section and the modulus of elasticity of the pipe material. When requested by the Engineer, the Contractor shall provide certified test results by the pipe manufacturer for the pipe to be used.

A deflection test shall be performed by the Contractor at the Contractor's expense on all flexible pipe after it has been laid and backfilled. The pipe shall be tested by pulling a mandrel through the pipe. The maximum allowable deflection shall not exceed 5.0% of the pipe's internal diameter.

(1) Polyvinyl Chloride (PVC) Pipe. Pipe and fittings shall meet and/or exceed all of the requirements of the latest revision of ASTM Specification D-3034 and conform to Standard Ratio (SDR) 35. Pipe lengths shall have terminals fabricated for the approved joint system and such length to permit ease of handling and installation without damage to the pipe sections. Joints shall be slip joint with a rubber (Neoprene) gasket to form a tight compression seal. Fittings and or adapters shall be as approved by the Engineer. The pipe shall be protected against ultra-violet light degradation. Each pipe length shall be identified with the manufacturer's name, pipe designation, and date of manufacture.

(2) Polyvinyl Chloride (PVC) Pipe, Schedule 40. All pipe and fittings less than 8 inch in diameter shall be Schedule 40 PVC pipe, meeting all of the requirements of the latest revision of ASTM D1785. Joints shall be elastomeric seals meeting the latest revision of ASTM D3212 or solvent welded joints. Caps shall not be solvent welded. Only gasketed caps will be allowed.

5. GRAVITY SEWER CONSTRUCTION

5.1 Water Mains Paralleling and Crossing Sewer Lines. When potable water pipes and sanitary sewers are laid parallel to each other, the horizontal distance between them shall be not less than 10 feet. The laying of water pipes and sanitary sewers shall be in separate trenches with undisturbed earth between them.

When a water line and a sanitary sewer cross and the sewer is two feet or more (clear space) below the water pipe, no extra protection or special requirements are needed. At all other crossings, the sewer shall be constructed of an approved pipe material with gasketed joints. One full length pipe section shall be centered at the waterline crossing.

Sewer construction within a 100 foot radius of a public water well for potable consumption or within 10 feet of a private water well will not be allowed. This requirement also applies to house connections located within a 100 foot radius of a public well for potable consumption.

5.2 Pipe Storage and Laying The pipe shall be stored at the site to avoid any damage to the pipe, pipe coatings, and joint system. When the pipe is laid out along the trench, the same precautions shall be taken to prevent damage to the pipe or joint systems.

The interior of all pipe shall be thoroughly cleaned of all foreign matter before being lowered into the trench, and shall be kept clean during the laying operation by means of plugs, pigs, swabs or other approved methods.

Each section of pipe shall be laid to line and grade proceeding upgrade with the spigot ends pointing in the direction of flow. The trench bed shall support the full length of pipe, except for joint recesses, over the bottom quadrant of the pipe circumference unless shown otherwise in the details. Where shown on the plans, specified, or when directed by the Engineer the pipe shall be supported on special bedding material, concrete cradle, or concrete encasement.

Any pipe that has its grade or joints disturbed after laying, shall be taken up and relaid by the Contractor at no additional cost to the Owner. Trenches shall be kept free from water until the pipe sections are joined, and pipe shall not be laid when the condition of the trench or the weather is unsuitable for such work. At times when work is not in progress, open ends of pipe and fittings shall be securely and satisfactorily closed so that no trench water, earth, or other substance will enter the pipe.

All sections of the pipe shall be set to form a close concentric joint with the preceding pipe. Joints shall be made with the pipe in place in the trench unless approved otherwise in writing by the Engineer. All pipe and joint systems shall be installed in accordance with the manufacturer's recommendations except for variations due to special adapters, with all types as approved by the Engineer. Care shall be taken to lubricate joint systems to avoid damage or prevent twisting of rubber gaskets out of position. Pipe having smooth exterior surfaces, unable to make a watertight bond with manhole walls, shall be installed with a rubber water stop at all manhole penetrations as recommended by the pipe manufacturer and as directed by the Engineer.

5.3 Wye Branches The wye branches on sewer laterals for house connections shall be four (4) inches in diameter unless otherwise specified, and shall be set on the downgrade of every lot, or at such intervals as may be directed by the Engineer. All wye branches shall have a proper socket on the outer end, and when not immediately used shall be plugged as directed by the Engineer.

5.4 Boring and Steel Encasement Steel casing of sewer pipes shall be installed by boring methods as specified by the plans. Steel casing for bored construction shall be steel pipe conforming to ASTM Designation A 139 with a minimum diameter as shown on the plans. Steel shall be Grade B under railroads and Grade A on all other uses. Steel pipe shall have welded joints in accordance with AWWA C 206 and shall have minimum wall thickness as indicated on the following table.

	Minimum Wall Thickness In Inches	
Dia. of Casing--inches	Under Railroads	All Other Uses
16	0.281	0.188
18	0.312	0.250
20	0.344	0.250
22	0.375	0.250
24	0.406	0.281
26	0.438	0.281
28	0.469	0.312
30	0.469	0.312
32	0.500	0.312
34	0.531	0.312
36	0.531	0.344
42	0.563	0.375

Excavation shall be completed by approved methods applicable to the materials encountered. The sewer in the area to be bored shall be completed before the construction of adjacent portions of the same sewer so minor adjustments can be made in the adjacent sewer to compensate for slight discrepancies in alignment or grade which may occur in the boring process. Boring operations shall be performed by experienced crews using a rotary type boring machine designed especially for this purpose. The casing shall be jacketed as the boring proceeds. Boring without simultaneous jacking of the casing or pipe will not be permitted.

The steel casing shall be cleaned of all debris after its installation is complete. The annular space between the steel casing and the sewer pipe shall be filled with sand from end seal to end seal after the sewer pipe has been permanently placed in the casing, tested and approved, in such a manner such as not to disturb the alignment or grade of the sewer pipe. Skids shall be installed on the sewer pipe as shown on the plans or directed by the Engineer. Skids shall be installed in accordance with Uni-Bell Standards on PVC pipe**.** Concrete end seals 8" in thickness shall be constructed on each end of the casing after the sewer pipe has been installed, tested, and approved. Concrete and construction requirements shall conform to the same requirements as specified for cast-in-place manholes.

5.5 Concrete Cradles and Encasement Where indicated on the plans or directed by the Engineer, the sewer pipe shall be supported by concrete cradle or concrete encasement in accordance with the details. During the concrete placing operations, the Contractor shall prevent the introduction of foreign matter into the trench or displacement of sewer pipe.

6. TESTS

The following tests shall be performed on all gravity sewer pipes.

6.1 Infiltration and Exfiltration: All 8-inch through 24-inch sanitary sewers constructed under this contract shall be air tested by the Contractor prior to acceptance by the Owner. The Contractor will be required to conduct vacuum tests on all manholes prior to acceptance (See Section 02626). The Contractor shall conduct exfiltration tests on sanitary sewers larger than 24-inch installed as part of this project prior to acceptance. Any defects indicated by the air testing, exfiltration testing and/or vacuum testing shall be corrected by the Contractor at no additional cost prior to acceptance of the work by the Owner.

Sewer lines shall be retested after repairs are made by the Contractor.

Air testing of sanitary sewer other than PVC sanitary sewers shall consist of measuring the amount of time required for air pressure to drop 1 psi from a starting pressure of approximately 4 psi in the length of sewer being tested between manholes. Elapsed time for a pressure drop of 1 psi shall be no less than that shown in the following table for the diameter of the pipe tested.

Low Pressure Air Test Requirements	
Pipe Diameter (inches)	Minimum Elapsed Time (minutes)
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5
21	10.0
24	11.5

Air Testing of PVC sewers shall meet the requirements for the Time-Pressure Drop Method as outlined in ASTM F1417.

Air Testing of PVC Sanitary Sewers shall consist of measuring the amount of time required for an air pressure drop of 0.5 psi from a starting pressure of 3.5 psi. The pipe shall be tested by adding air slowly to the test section of pipe until the pressure is raised to 4.0 psi. The pressure shall slowly be decreased to 3.5 psi before commencing with the test. Determine the time required to achieve a 0.5 psi drop, and compare this time with the allowable times for the 0.5 psi drop, as shown in Table 2 of ASTM F1417. The elapsed time shall be no less than that shown in Table 2 of ASTM F1417.

TABLE 2 Minimum Specified Time Required for a 0.5 psig Pressue Drop for Size and Length of Pipe Indicated

*Reference: ASTM F1417 Time/Pressure Drop Method Air Testing of PVC

				Specification Time for Length (L) Shown, min:s							
Pipe Diameter, in.	Minimum Time, min:s	Length for Minimum Time, ft.	Time for Longer Length, S	100 ft.	150 ft.	200 ft.	250 ft.	300 ft	350 ft	400 ft	450 ft
4	1:53	597	0.190 L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	0.427 L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	0.760 l	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235 L	9:55	13.05	17:27	21.40	28:11	30:32	34:54	39:16
24	11:20	99	6.837 L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653 L	14.25	21:38	28:51	36:04	43:16	50:30	57:42	64:54
30	14:10	80	10:683 L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12:926 L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15:384 L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23

6.2 Displacement of Sewers: Sewers shall be checked to determine whether any displacement of the pipe has occurred after the trench has been backfilled and compacted as specified. The test shall be as follows: A light shall be flashed between manholes, or, if the manholes have not as yet been constructed, between the locations of the manholes, by means of a flashlight or by reflecting sunlight with a mirror. If the illuminated interior of the pipe line shows poor alignment, displaced pipe, excessive deflection of pipe barrels or any other defects, the defects as designated by the Engineer shall be satisfactorily remedied by the Contractor. Sections of pipe barrels having deflections greater than 5% shall be corrected. Tests for deflection shall be conducted by the Contractor when and as directed by the Engineer at no additional cost to the Owner (See 4.3).

Any sewer lines having flow elevations which deviate by more than one inch from a straight line, as determined by the flow line of the two ends of the pipe of any one line between structures, compared with any point between, shall be reconstructed by the Contractor at his expense.

6.3 Television Inspection of Sewer Lines. All sanitary sewers eight-inch diameter and larger constructed under this contract will be televised by the owner prior to acceptance. Any defects discovered during televising will be corrected by the contractor at no additional cost to the owner. The contractor shall schedule construction operations so no wastewater and no construction debris will enter a proposed sewer line that has not been cleaned and televised. Any retelevising of the sanitary sewer as a result of correcting any defects in the sewer will be paid for by the contractor.

The contractor will be responsible for cleaning all sewer mains.

SECTION 02626 - VACUUM TESTING OF MANHOLES

1. GENERAL

Each manhole shall be vacuum tested for leaks prior to backfill. Tests, sealing, and acceptance shall be according to the procedures described in this section.

2. MATERIALS REQUIRED

(1) Air-tight pipe plugs for each pipe into the manhole, with brace posts.
(2) Test plate fitted to top opening of manhole.
(3) Air pump and base.
(4) Vacuum gauge: range zero to 20 inches Hg vacuum range.
(5) Non-shrink grout.

3. PROCEDURE

Prior to testing, all lifting holes and exterior joints shall be filled and pointed with an approved non-shrinking mortar well in advance of testing so it will have time to cure to its maximum strength. The completed manhole shall not be backfilled prior to testing. Manholes which have been backfilled shall be excavated and cleaned to expose the entire exterior prior to vacuum testing. When testing, all manholes shall be free of internal water and all external water shall be removed below the top of the base.

All pipes and other openings into the manhole shall be plugged. All plugs shall be securely braced to prevent the plugs from being drawn into the manhole. A plate with an inflatable rubber ring the size of the top of the manhole shall be installed by inflating the ring with air to pressure adequate to prevent leakage of air between the rubber ring and manhole wall. Air shall then be pumped out of the manhole through an opening in the plate until a vacuum is created inside of the manhole equal to 10 inches of mercury on an approved vacuum gauge. The removal of air shall then be stopped and the test time begun.

If more than 1 inch drop in vacuum occurs within the first 2 minutes of the test period the manhole has failed the test and shall be repaired or reconstructed, and retested. Following satisfactory test results, the manhole may be backfilled and coated (as required).

Existing Manholes that have pipe penetrations added as part of this project shall be vacuum tested at the discretion of the Field Engineer. The pipe penetration into the manhole spall remain exposed during the test. The test parameters shall be as mentioned previously in this section, with the exception that approval will not be based on actual vacuum test results, but on a visual inspection of the manhole during the vacuum test. The Contractor will be responsible for correcting only items such as damage caused by construction activities including the pipe penetrations through the manhole wall.

NOTE: Make sure the test plugs in the pipes are securely braced so that the vacuum will not displace them. If a general porosity leak is present the use of smoke will be helpful in locating the leaks. Caution: Do not allow anyone in the manhole during testing.

SECTION 02650 - HORIZONTAL DIRECTIONAL DRILLING, BORING AND JACKING

1. GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavation for approach trenches and pits
2. Horizontal Directional Drilling
3. Boring and Jacking
4. Casing Pipe

1.2 DEFINITIONS

A. AASHTO: American Association of State Highway and Transportation Officials
B. ANSI: American National Standards Institute
C. ASTM: American Society for Testing and Materials
D. AWWA: American Water Works Association
E. CCS: Copper Clad Steel
F. CI: Cast Iron
G. EPA: Environmental Protection Agency
H. HDPE: High Density Polyethylene
I. IPS: Iron Pipe Size
J. O&M: Operation and Maintenance
K. OSHA: Occupational Safety and Health Administration

1.3 COORDINATION

A. Contractor shall coordinate work with the City of Newton Public Works and utilities within construction area.

B. Contractor shall obtain all necessary permits required to install the pipe using trenchless methods and for the proper disposal of drilling materials (mud, screenings, water, etc.).

C. Contractor shall furnish all labor, materials, and equipment required to install the pipe using the trenchless methods of installation, all in accordance with the requirements of the Contract Documents. The pipe size, type and length shall be as specified herein or as shown on the drawings. Work shall include and not be limited to proper installation, testing, grouting, restoration of underground utilities and environmental protection and restoration.

D. Contractor shall be sufficiently trained and knowledgeable of the construction technique required by the use of these trenchless methods. Contractor shall furnish all directional drilling and boring equipment, qualified laborers and equipment operators necessary to complete the required work in accordance with the project manual and associated drawings.

E. Contractor shall obtain all additional easements or right of way required to perform the trenchless pipe installation.

F. The length of the drill or bore shown on the drawings is the minimum required length of the installation. The Contractor may, at his option and at no expense to the Owner or Engineer, increase the length of the drill or bore during construction with approval from the Engineer.

G. Gravity lines shall not be drilled unless otherwise approved in writing by the Engineer.

1.4 SUBMITTALS

A. Submittals shall be made by the Contractor in accordance with the procedures set forth in Division 01.

B. Contractor shall provide with their installation schedule, the manufacturer's catalog cuts, technical data, and/or shop drawings for the following system components (shop drawings shall be drawn to a scale sufficiently large to show all pertinent aspects of the item and its method of connection to the work):

1. Pipe (Carrier and/or Casing)
2. Fittings, sleeves and couplings
3. Pipe restraints and welds
4. Casing Spacers and End Seals
5. Tracer wire
6. Detectable warning tape

C. Shop Drawings:

1. Submit technical data for equipment, method of installation, and proposed sequence of construction.
2. Include information pertaining to pits, dewatering, method of spoils removal, equipment size and capacity, equipment capabilities including installing pipe on radius, type of drill bit, drilling fluid, method of monitoring line and grade and detection of surface movement, name plate data for drilling equipment and mobile spoils removal unit.
3. Data supporting the directional drilling Contractor's qualifications and experience.

D. Submit permit for installations on public right of way and lands.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Contractor shall submit a plan for installation of piping and appurtenances including their location in relation to other services or pipes in same area, drawn to scale. Show size, location and elevation of the piping and appurtenances.

B. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with the requirements including proof of insurance, and other permit requirements for construction across or along railroads, highways, local or county roads, or drainage ways.

2. Comply with the requirements for NPDES permitting, including best management practices for storm water discharges from the construction site.

3. Comply with requirements of utility company supplying water. Includes tapping of water mains and backflow prevention.

4. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.

5. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

6. Comply with local, state, and federal requirements for proper disposal of drilling materials (mud, screenings, water, etc.).

B. All applicable permits and applications must be in place prior to beginning construction. Contractor shall perform the work in accordance the permit requirements.

C. All trenchless pipe installation operations shall be performed by a qualified Contractor with at least three (3) years of experience involving work of a similar nature to the work required for this project.

D. All work shall be performed in the presence of the Engineer or the Resident Project Representative.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery, Storage and Handling shall be in accordance with Section 2603.

B. Conduct operations so as not to interfere with, interrupt, damage, destroy, or endanger the integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

C. Maintain access to existing items/areas indicated to remain. Modify pipe installation to maintain access to existing facilities.

2. PRODUCTS

2.1 GENERAL

A. Trenchless methods of pipe installation may be used in lieu of traditional trenching methods as approved by the Engineer.

B. Should the Contractor choose to utilize trenchless installation methods in lieu of traditional trenching, no additional payment will be made unless otherwise specified or approved in writing by the Engineer.

2.2 HORIZONTAL DIRECTIONAL DRILLING (HDD)

A. Performance / Design Criteria:

1. HDD construction methods shall comply with the latest revisions of ASTM F1962-11. Pipe used for HDD construction must meet project.

2. Tracer wire, where required, shall meet the requirements as outlined in Section 2603.

B. Drilling Fluid:

1. Liquid bentonite clay slurry; totally inert with no environmental risk.

2. Polymers to produce high yield bentonite can be added with approval by the Engineer.

C. Equipment:

1. Drilling Rig: Directional drilling rig shall consist of a hydraulically powered system to rotate and push hollow drilling pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill head. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the installation.

a. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations.

b. Hydraulic system shall be free of leaks.

c. Rig shall have a system to monitor and record maximum pullback pressure during pullback operations.

d. There shall be a system to detect electrical current from drill string and an audible alarm that automatically sounds when an electrical current is detected.

2. Drill Head: The drill head shall be steerable by changing its rotation and shall provide necessary cutting surfaces and drilling fluid jets.

3. Motors: Motors shall be of adequate power to turn the required drilling tools.

D. Drilling Fluid (Mud) System:

1. Mixing System: A self-contained, closed, drilling fluid mixing system shall be of sufficient size to thoroughly mix and deliver drilling fluid. The drilling fluid reservoir tank shall be a minimum of 1,000 gallons and the mixing system shall continually agitate the drilling fluid during operations.

2. Drilling Fluid: Drilling fluid shall be composed of potable water, bentonite clay and appropriate additives. Water shall be from an authorized source with pH of 8.5 to 10. Water with a lower pH or with excessive calcium shall be treated with the appropriate amount of sodium carbonate or approved equal. No additional material may be used in drilling fluid without prior approval by the Engineer. The bentonite mixture shall have the minimum viscosities as measured by a Marsh funnel in accordance with ASTM A139.

Table 1

Soil Type	Viscosity Requirement
Rocky Clay	60 Seconds
Hard Clay	40 Seconds
Soft Clay	45 Seconds
Sandy Clay	90 Seconds
Stable Sand	80 Seconds
Loose Sand	110 Seconds
Wet Sand	110 Seconds

E. Tracking:

1. The system shall be capable of tracking at all depths of up to fifty feet in any soil condition, including hard rock and shale.

2. The Contractor shall supply all components and materials to install, operate and maintain the guidance system.

2.3 BORING AND JACKING

A. Auger Boring

1. Contractor shall use a steel encasement pipe (of approximate diameter of the pipe to be installed).

2. The auger shall be equipped with a cutter head to perform the excavation. Auger used shall be sized to convey the excavated material to the work pit.

B. Jacking:

1. Contractor shall use heavy duty jacks to complete the installation.

2. Jacking head and bracing between the jacks shall apply uniform pressure around the pipe.

3. Guides and support shall be used to direct the pipe to the proper line and grade as shown on the drawings.

2.4 STEEL CASING

A. Steel pipe casing shall conform to the latest revision of ASTM A53 for Grade B and ASTM A139 for Grade A having a minimum diameter as shown on the drawings.

B. Steel pipe shall be Grade B under railroads and Grade A on all other uses.

C. Steel pipe shall have a minimum wall thickness as shown in the following table:

Table 2

Diameter of Casing - Inches	Minimum Wall Thickness In Inches	
	Under Railroads	All Other Uses
Less than 12	0.250	0.188
12	0.250	0.188
14	0.312	0.188
16	0.312	0.188
18	0.312	0.250
20	0.375	0.250
22	0.375	0.250
24	0.437	0.281
26	0.437	0.281
28	0.437	0.312
30	0.500	0.312
32	0.500	0.312
34	0.500	0.312
36	0.562	0.344
38	0.562	0.344
40	0.562	0.344
42	0.562	0.344
44 through 48	0.625	0.344

2.5 PIPE

A. Pipe shall be as specified in Section 2603.

3. EXECUTION

3.1 EXAMINATION

A. Proper alignment and elevations shall be maintained throughout the directional drilling or boring operation.

B. Pipe shall be installed to meet or exceed the requirements of ASTM and AWWA approved installation methods.

C. Testing of the pipe shall be in accordance with the testing requirements as outlined in Section 2603.

3.2 PREPARATION

A. The entire drill path shall be accurately surveyed by the Contractor with entry and exit pit stakes placed in the appropriate locations within the areas indicated on the drawings.

B. If using the magnetic guidance system, the drill path shall be surveyed by the Contractor for any surface geomagnetic variations.

C. Contractor shall locate all utilities before performing Work.

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

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

3.3 DEWATERING

A. Intercept and divert surface drainage, precipitation, and groundwater away from excavation through use of dikes, curb walls, ditches, pipes, sumps or other means.

B. Develop and maintain substantially dry subgrade during drilling and pipe installation.

C. Comply with all local, state and federal requirements for discharging water to watercourse, preventing stream degradation, and erosion and sediment control.

3.4 EXCAVATION

A. Excavate approach trenches and pits as site conditions require. Minimize number of access pits.

B. Restore areas after completion of drilling and carrier pipe installation.

3.5 DIRECTIONAL DRILLING

A. Entrance and exit pits shall be located to avoid conflicts with the public utilities, and other agencies.

B. Provide sump areas to contain drilling fluids.

C. Pipe sections shall be joined together per the manufacturer's specifications. When required, tracer wire shall be attached to the pulling eye and the crown of the pipe with tape at 24 inch increments along the pipe and a minimum of two full wraps around the pipe. Contractor shall test tracer wire for continuity for each section before acceptance.

D. Guide drill remotely from ground surface to maintain alignment by monitoring signals transmitted from drill bit.

1. Monitor depth, pitch, and position.

2. Adjust drill head orientation to maintain correct alignment.

E. Inject drilling fluid into bore to stabilize hole, remove cuttings, and lubricate drill bit and pipe.

1. The drilling slurry shall be in a homogenous/flowable state serving as an agent to carry the loose cuttings to the surface through the annulus of the bore hole.

2. The volume of bentonite mud required for each pull back shall be calculated based on soil conditions, largest diameter of the pipe system component, capacity of the bentonite mud pump and the speed of pullback as recommended by the bentonite drilling fluid manufacturer.

3. Bentonite slurry is to be contained at the entry or exit side of the drill pits or holding tanks.

4. Slurry may be recycled for reuse in the opening operation or shall be hauled by the Contractor to an approved disposal/dump site for proper disposal.

5. The Contractor and Resident Project Representative shall document all drilling fluid products being used, the pumping pressure, rate of pumping and details relative to drilling fluid circulation at the end points of the drill.

6. The right of way and surrounding areas should be examined regularly for inadvertent returns. If inadvertent returns are discovered, they could be contained or cleaned up in accordance with federal, state or local regulations. These areas shall be monitored for continuing problems.

F. Continuously monitor drilling fluid pumping rate, pressure, viscosity, and density while drilling pilot bore, back reaming, and installing pipe to ensure adequate removal of soil cuttings and stabilization of bore.

1. Provide relief holes when required to relieve excess pressure.

2. Minimize heaving during pullback.

G. Calibrate and verify the accuracy of the electronic monitor in presence of the Engineer or Resident Project Representative before proceeding with other drilling. When required accuracy is not met, adjust equipment or provide new equipment capable of meeting required accuracy.

H. Readings shall be recorded after advancement of each successive drill pipe (no more than 10 feet). Access to all recorded readings and plan/profile information shall be made available to the Engineer or the Resident Project Representative at all times. At no time shall the deflection radius of the drill pipe exceed the deflection limits of the carrier pipe.

I. Drill pilot hole with vertical and horizontal alignment with no deviations greater than 5% of depth over the length of the drill unless previously agreed to by the Engineer.

1. In the event that the pilot does deviate from the drill path more than 5%, the Contractor shall notify the Engineer. The Contractor may be required to pull back and re-drill from the location along the drill path before the deviation.

2. In the event of a drilling fluid fracture, inadvertent returns, or returns lost during drilling operations, the Contractor shall cease drilling and wait at least 30 minutes, inject drilling fluid with a viscosity exceeding 120 seconds as measured by a Marsh funnel and wait another 30 minutes. If mud fracture continues, Contractor shall notify the Engineer for alternate methods.

J. The pilot bore shall be approved by the Engineer or Resident Project Representative prior to commencement of the reaming phase. The diameter of the bore hole shall be increased to accommodate the pull-back operation of the required carrier pipe. The Contractor shall select the proper reamer with the final hole opening being a maximum of 1.5 times larger than the outside diameter of the pipe to be installed.

K. Protect and support pipe so it moves freely and is not damaged during installation. Contractor shall provide pipe rollers, slings or other appurtenances to assist in supporting the pipe during installation.

3.6 BORING AND JACKING

A. As the boring progresses, it shall be concurrently supported with a welded continuous, permanent, new steel pipe casing conforming to ASTM A139 and having a minimum diameter as shown on the drawings.

B. Once the jacking operation has commenced, it shall be continued uninterrupted until the conduit has been installed to the specified limits.

C. Borings and encasement shall be constructed so they will drain and shall be bored in a single direction. The pipe shall be pulled or pushed into the casing on premanufactured casing spacers as manufactured by RACI, CCI Pipeline Systems, Cascade or approved equal or wood skids as shown in the details and approved by the Engineer. The entire void area between the casing and the pipe shall be filled with jetted sand. The ends of the encasement pipe shall be sealed with flexible, synthetic rubber end seals with 304 stainless steel bands.

D. All voids or abandoned holes caused by boring or jacking are to be filled by pressure grouting when deemed necessary by the Engineer representative. The grout material shall be a sand cement slurry with a minimum of two sacks of cement per cubic yard and a minimum of water to assure satisfactory placement.

3.7 OBSTRUCTIONS AND UNEXPECTED UTILITIES

A. When obstructions or unexpected utilities are encountered during the boring or directional drilling process, the Contractor shall notify the Engineer immediately. Do not proceed around obstruction without Engineer's approval.

B. For conditions requiring deviation in horizontal or vertical alignment, the Contractor shall submit a proposed alignment to Engineer for approval before resuming work.

3.8 LINE AND GRADE TOLERANCES

A. The installed pipe and/or casing shall not deviate from the line and grade as shown on the drawings.

B. Horizontal Tolerance:

1. Pipe shall not deviate horizontally from what is shown on the drawings unless approved by the Engineer.

C. Vertical Tolerance:

1. Pipe shall not deviate vertically from what is shown on the drawings unless approved by the Engineer.

3.9 DISPOSAL OF SPOILS

A. Remove, transport and legally dispose of drilling spoils.

1. Do not discharge drilling spoils in sanitary sewers, storm sewers, or other drainage systems.

2. When drilling in suspected contaminated soil, test drilling fluid for contamination before disposal.

3. Spoils shall be disposed of on sites provided by the Contractor. Disposal sites must be approved by KDHE.

4. Any material dumped in waters of the United States or wetlands is subject to U.S. Corps of Engineers permitting regulations.

B. Slurry Removal for Horizontal Directional Drilling

1. Contractor is responsible for removal and proper disposal of all slurry in accordance with the local, state and federal requirements.

2. Contractor shall contain excess drilling fluids at entry and exit points until recycled or removed from site. Provide recovery system to remove drilling spoils from access pits.

3. When drilling fluid leaks to surface, immediately contain leak and barricade area from vehicular and pedestrian travel before resuming drilling operations.

4. Complete cleanup of drilling fluid at end of each work day.

3.10 CLEANING

A. Upon completion of drilling and pipe installation, remove drilling spoils, debris, and unacceptable material from approach trenches and pits. Clean up excess slurry from ground.

B. Restore approach trenches and pits to original condition.

END OF SECTION

DIVISION 3 - CONCRETE

SECTION 03010 - CONCRETE WORK

1. GENERAL

Concrete shall consist of cement, coarse aggregate, fine aggregate, approved admixtures, and water; proportioned and mixed to produce a workable mixture suitable for specific conditions of placement as noted in the following specifications.

All concrete used in the work shall be air-entrained unless otherwise permitted by these specifications or approved by the Engineer.

All reinforcing steel as detailed on the drawings shall be installed and fastened by ties or supports prior to placing any concrete.

2. MATERIALS

2.1 Portland Cement:

(1) General - Portland Cement shall conform to the requirements of ASTM Designation C150 and shall be Type II. When approved by the Engineer in writing, Type I or Type III cements may be used in lieu of Type II. Use of special cements containing interground admixtures will not be permitted without approval by the Engineer.

(2) Packaged Cement - Where packaged cement is to be used in the work, it shall be stored in a suitable moisture-proof enclosure with each shipment properly marked and segregated. Bags of cement in which, for any reason, the cement has become partially set, or which contains lumps of caked cement, shall be rejected.

(3) Bulk Cement - Bulk cement may be used in the work when approved by the Engineer. Methods of transporting, handling and storage shall also be subject to approval.

(4) Tests - The Contractor shall furnish certified test reports showing that the cement being supplied complies with these specifications.

2.2 Aggregates: - The use of pit run or naturally mixed aggregates will not be permitted. Fine and coarse aggregates shall be separately furnished and stored.

The mixing of different kinds of aggregates from different sources or alternating batches of different aggregates in one stockpile will not be permitted. In no case shall aggregates containing lumps of frozen or partially cemented materials be used. Aggregates proposed for use in the work shall meet the following requirements.

(1) Deleterious Substances - Deleterious substances in aggregates shall not exceed the following percentages by weight when tested under the designated ASTM method.

	Coarse	Fine	Test
Material Passing No. 200 Sieve	1.0	3.00	C117
Shale	0.5	0.5	C123
Soft Friable Pieces	0.5	0.5	C142
Sticks (wet)	0.10	0.10	
Coal	0.25	0.25	C123
Clay Lumps (wet, on No. 4 Sieve)	1.5	0.25	C142

No one of the above percentages shall be exceeded when taken separately. In addition, any combination of shale, soft friable pieces, sticks, coal or clay lumps shall not exceed 1.5 percent.

(2) Coarse Aggregate - Coarse aggregate shall be hard, durable, clean uncoated pieces of crushed rock or gravel. Coarse aggregate will be well graded within the following limits (ASTM Size #67) when tested under ASTM Standard C136.

Sieve Size	1	3/4	3/8	4	8
% Retained	0	0-10	45-80	90-100	95-100

(3) Fine Aggregate - Fine aggregate shall consist of clean, hard, durable, uncoated siliceous or calcareous particles well graded within the following limits.

Sieve Size	3/8	4	8	16	30	50	100
% Retained	0	0-5	0-20	15-50	40-75	70-90	90-99

The Fineness Modulus (F.M.) of the fine aggregate furnished shall be not less than 2.5 nor more than 3.4 when determined by using a sieve series consisting of the No. 4, 8, 16, 30, 50 and 100 sizes. After acceptance of a gradation for use in the work the F.M. shall not vary more than $\pm$ 0.2.

(4) Stockpiles - Aggregates shall be stockpiled by building up free-draining horizontal layers not greater than 4 feet in thickness. Aggregates that have become mixed with earth or foreign material shall not be used. If the water content in coarse aggregate is below that which the aggregate will absorb, such aggregate shall be wet down at least 12 hours in advance of the time the mix is to be batched.

(5) Aggregate Tests

(a) General - All aggregates proposed by the Contractor for use in the work shall be certified by an approved Testing Laboratory as complying with the above requirements covering deleterious materials and gradation. In addition, unless waived by the Engineer, certified tests also shall be provided in accordance with Paragraphs (b) thru (e) below. All costs of testing shall be borne by the Contractor.

(b) Soundness - Coarse aggregate for concrete when tested for soundness with magnesium sulphate in accordance with ASTM Standard C88 shall have a total loss not greater than 18% by weight.

(c) Abrasion - The percentage of wear of the coarse aggregates by the Los Angeles Abrasion Test, ASTM C131, shall be less than 40%.

(d) Absorption - Coarse aggregate for concrete shall have an absorption limit of 4% or less, as determined by ASTM C127.

(e) Mortar Strength - Fine aggregates shall be of such quality that when made into a mortar and tested in accordance with ASTM C87 the mortar shall develop a compressive strengths at 7 and 28 days of not less than 100 percent of that developed by the control mortar specified in C87.

2.3 Admixtures:

(1) General - Admixtures are defined by these specifications as a material, other than portland cement, aggregate or water, added to concrete to modify its properties. The following admixtures shall be used when required and may be used when permitted.

(2) Air Entraining Agent (AEA) - An approved air entraining agent shall be used to produce 5 to 8% air entrainment in the concrete as placed. The AEA shall be a neutralized solution of vinsol resin meeting the requirements of ASTM C260.

(3) Calcium Chloride - When approved by the Engineer, calcium chloride meeting the requirements of ASTM D-98 may be used as an accelerator in an amount not exceeding two (2) percent of the weight of cement. No calcium chloride, or admixtures containing calcium chloride, shall be used where aluminum conduit, couplings or accessories are embedded in the concrete.

(4) Water Reducing Admixtures - At the option of the Contractor, subject to approval of the Engineer, a water reducing admixture (WRA) may be used. Water -reducing, set-controlling admixtures shall be of the basic chemical composition described as "hydroxylated carboxylic acid" or "hydroxylated polymers" and shall meet the requirements of ASTM C494, Type A or Type D. Before approval, the compatibility of the proposed admixture, with the other materials to be used in the concrete mixture, shall be established by test. Where a WRA has been approved for use, and design mix test results demonstrate adequate strength, the Cement Factor may be reduced by 0.5 bag below that specified in Paragraph 3.1, "Proportioning".

(5) Tests - The Contractor shall furnish three (3) copies of certified test results showing that the admixtures proposed for use comply with these specifications.

2.4 Water: Water used in concrete shall be clean, clear, and free from injurious amounts of sewage, oil, acid, strong alkalis or vegetable matter. If the water is of questionable quality, it shall be tested by a comparative mortar strength test in accordance with ASTM C87.

2.5 Metal Reinforcement: Metal reinforcement shall be Grade 60 billet steel in accordance with ASTM A615. The size, length and shape shall be shown and detailed on the drawings.

2.6 Epoxy-Coated Metal Reinforcement. Where shown on the plans, metal reinforcement shall be epoxy-coated in accordance with the requirements of the latest revision of ASTM D3963.

3. PROPORTIONING

3.1 Mix Design: Concrete mixes to be used in the work shall be proportioned in accordance with the requirements of Table 1. All materials shall be proportioned by weight considering one sack of cement as 94 pounds and one gallon of water as 8.33 pounds.

Table 1

	Minimum				
	28-Day Strength		Minimum	Maximum	
Concrete	(PSI)		Cement Factor	W/C Ratio	Slump*
Class*	Compressive	Flexural	Bags/C.Y.	Gal./Bag	(in.)
Class I	4000	500	6.5	5.5	1 to 3
Class II	3000	425	5.75	6.0	1 to 3
Class III (sand mix)	3500		8.0	5.75	1 to 3

*The Class of concrete to be used in the various parts of the work shall be as specified herein or as noted on the drawings. Where no specific class has been designated, Class I concrete shall be used.

**No concrete with slump in excess of 3-inches shall be used in the work without approval of the Engineer.

The Contractor shall design and submit for approval three (3) copies of the proposed design mix for each of the classes of concrete specified for the work. Included with the submittal shall be copies of test reports showing the 7 and 28 day strengths (Flexural and Compressive) for each proposed mix. The proposed design mixes shall be based on the specific materials and the maximum slump to be used in the work. All costs of mix design and testing shall be borne by the Contractor.

3.2 Aggregate Content: The total volume of aggregate used in each cubic yard of concrete shall be the maximum consistent with the requirements of workability.

For Class I and II concretes, the composition of the total aggregate (Fine and Coarse) shall be such that not more than 70% or less than 40% will pass the #4 sieve. The exact proportions of fine and coarse aggregate may be varied within the above limits by the Engineer to produce a concrete mixture more suitable for the work at hand.

For Class III concrete l00% fine aggregate shall be used. Sidewalks and driveways shall be 100% fine aggregate (sand mix) except where an approved mix using coarse aggregate is used due to special construction methods. In such cases, not more than 70% or less than 30% shall pass the #4 sieve.

3.3 Variations in Mix Proportions: The initial concrete mixes used on the work for the various classes of concrete shall be in accordance with the proportions used in the approved design mixes. In the event that these mixes do not produce concretes with the required strength, workability, or air content the Engineer may order changes in the mix proportions to obtain the specified requirements, and the changes so ordered, including additional cement, will be made at no additional cost to the Owner.

3.4 Control: The Contractor shall provide all equipment necessary to determine and positively control the actual amounts of all materials, including admixtures, entering into the concrete. Batching and weighing devices for aggregates and cement shall be accurate within 0.5 percent, and for water and admixtures within 1.0 percent.

4. FORMS

Forms shall be steel or wood as approved by the Engineer and shall conform to the shape, lines, grade and dimensions of the concrete as detailed on the drawings. Lumber used in forms for exposed surfaces shall be dressed to a uniform thickness and free from knots and blemishes. Joints in the forms shall be all horizontal or vertical where the finished surface is to be exposed. Forms shall have nails withdrawn and surfaces to be in contact with concrete thoroughly cleaned and oiled prior to each use. Form oil shall be non-staining and shall be applied to the forms before reinforcement is placed. Forms shall be sufficiently tight to prevent leakage of mortar and properly braced to maintain the desired shape, line and grade.

The removal of forms shall not be started until the concrete has attained the necessary strength to support its own weight and any construction loads. Forms shall not be removed before the expiration of 30 hours from any construction. Forms supported by false work shall not be removed until the concrete has attained its design strength. Where forms are removed less than seven days after placement of the concrete, provisions shall be made to insure curing as specified in this Section under, "Curing of Concrete".

5. REINFORCEMENT

Prior to positioning, reinforcing steel shall be cleaned of all loose mill scale and rust or coatings which might prevent or reduce bond. Reinforcement shall be positioned accurately and secured against any displacement by using annealed iron wire ties or suitable clips and be supported by suitable metal supports, spacers or hangers. All reinforcing shall be in place and securely fastened before placing any concrete. The contractor shall submit shop drawings, bar lists and bending diagrams to the Engineer for approval prior to ordering any reinforcement.

6. EPOXY-COATED REINFORCEMENT

6.1 Handling. In order to protect the coated reinforcement from damage, the contractor shall use padded or nonmetallic slings and padded straps. Bundled bars shall be handled in a manner which will prevent excessive sagging of bars which will damage the coating. The bundled bars shall not be dropped or dragged and must be stored on wooden cribbing. If, in the opinion of the engineer, the coated bars have been extensively damaged, the material will be rejected. The contractor may propose for the approval of the engineer, alternate precautionary measures.

6.2 Fabrication and Placement. The bars shall be fabricated and placed as shown on the plans and as specified. All bending should be done around nylon coated pins or wooden mandrels. The rate of bending may have to be reduced for some bar sizes to minimize cracking or disbonding of the coating. Any visible evidence of cracking or disbonding of the coating in the bent area of bars bent in accordance with the plan requirements may be patched with approval of the engineer, except that a hairline crack, 0.003 inch or less, at the base of the deformation will not be cause for rejection nor will patching of these cracks be required. All patching shall be done promptly after bending. Bars shall not be shipped until patching material has lost all tackiness.

Plastic-coated tie wires approved by the engineer shall be used in the assembly of the coated bars in the structure to protect them from physical damage.

6.3 Patching. Patching material shall be applied to all sheared ends and contact areas for hangers or couplers. Patching materials shall be applied to all damaged areas at the points of occurrence, such as the initial application, fabrication, destination or installation points with the following exception. Damaged areas of coating not more than 0.2 inch across at the widest point of exposed area of bare steel and occurring no more than six in any lineal foot of coated bar need not be repaired.

Areas to be patched shall be clean and free of surface contaminants. They shall be promptly treated in accordance with the resin manufacturer's recommendations and before detrimental oxidation occurs.

7. MIXING

7.1 Job-Mixed Concrete: The equipment used for mixing concrete on the project site shall be capable of combining the aggregates, cement and water into a thoroughly mixed and uniform mass, and of discharging the mixture without segregation. The concrete shall be mixed in quantities required for immediate use. Concrete shall not be used which has developed its initial set or that has not been placed within one-half (1/2) hour after the water has been added. Retempering concrete by adding water or by any other means will not be permitted.

The concrete shall be mixed not less than sixty seconds. When a double compartment mixer is used, the minimum mixing time in the first compartment shall be thirty seconds and the total mixing time, including transfer time, shall not be less than sixty-five seconds.

Concrete may be mixed by a paving mixer into which the materials, including the water, can be precisely and regularly proportioned, and which will produce a concrete of uniform consistency, uniform color, and thoroughly and uniformly mixed. The paving mixer shall be equipped with a batch meter and an automatic locking timing device. The water tank shall be equipped with a scale graduated in gallons and fractions thereof. The water measuring device shall be capable of accurate measurement to within one percent of the required amount. The paving mixer shall be equipped with a boom and bucket, fully power controlled, which shall be so operated that the batches may be uniformly distributed on the subgrade.

7.2 Ready-Mixed Concrete: Ready-Mixed (Transit-mixed) concrete may be used in lieu of concrete mixed at the project site. When used, transit-mixed concrete shall comply with the applicable provisions of Division 150, Equipment and Division 400, Portland Cement Concrete of the Standard Specifications for State Road and Bridge Construction, 1990 Edition, Kansas Department of Transportation, except that testing will be in accordance with the requirements of "Control Tests" in this Section.

8. PLACING CONCRETE

8.1 General: Before beginning placement of concrete, hardened concrete and foreign materials shall be removed from the inner surface of the conveying equipment. Before depositing concrete, all debris shall be removed from the space to be occupied by the concrete; forms, if constructed of lumber, shall be thoroughly wetted (except in freezing weather) or oiled. Reinforcement shall be secured thoroughly in position and approval by the Engineer obtained before concrete is placed.

8.2 Removal of Water: Water shall be removed from the space to be occupied by the concrete before concrete is deposited, unless otherwise directed by the Engineer. Any flow of water into an excavation shall be diverted through proper side drains to a sump, or be removed by other approved methods which will avoid washing the freshly deposited concrete. If directed by the Engineer, water vent pipes and drains shall be filled by grouting, or other approved means, after the concrete has thoroughly hardened.

8.3 Handling: Concrete shall be handled from the mixer, or in the case of ready-mixed concrete from the transporting vehicle, to the place of final deposit as rapidly as practicable by methods which shall prevent the separation or loss of the ingredients. Under no circumstances shall partially hardened concrete be deposited in the work. Concrete shall be deposited in the forms as nearly as practicable in its final position to

avoid rehandling. It shall be deposited as to maintain, until the completion of the unit, an approximately horizontal plastic surface. Forms for walls or thin sections of considerable height shall be provided with openings or other devices that will permit the concrete to be placed in a manner that will prevent segregation and accumulations of hardened concrete on forms or metal reinforcement above the level of concrete. Regardless of the type of transporting vehicle, concrete shall have the quality required when deposited in the forms.

8.4 Chuting: When concrete is conveyed by chutes, the equipment shall be of such size and design as to insure a continuous flow in the chute. Chutes shall be of metal or metal lined and the different portions shall have approximately the same slope. The slope shall not be less than one vertical to two horizontal and shall be such as to prevent segregation of the ingredients. The discharge end of the chute shall be provided with a baffle plate to prevent segregation. If the distance of the discharge end of chute above surface of the concrete is more than 3 times the thickness of the layer being deposited, but not more than 5 feet above surface of concrete, a spout shall be used and the lower end maintained as near the surface of deposit as practicable. When the operation is intermittent, the chute shall discharge into a hopper. The chute shall be thoroughly cleaned before and after each run and all debris and cleaning water shall be discharged outside the forms.

8.5 Compacting: During and immediately after depositing, concrete shall be compacted thoroughly by means of suitable tools. In general, concrete shall be compacted by mechanical vibration. Number and type of vibrators shall be subject to the approval of the Engineer.

For thin walls or inaccessible portions of forms where spading, rodding, or forking is impracticable, concrete shall be worked into place by vibrating or tapping forms lightly opposite the freshly deposited concrete. Concrete shall be worked thoroughly around reinforcement, and around embedded fixtures, and into corners of forms.

Accumulations of water on surface of concrete, during placement and compacting, due to water gain, segregation or other causes shall be prevented as far as possible by adjustments in the mixture. Provisions shall be made for removal of such water as may accumulate so that, under no circumstances, will fresh concrete be placed in such accumulations.

8.6 Depositing Continuously: Concrete shall be deposited continuously or in layers of such thickness that no fresh concrete will be deposited on concrete which has hardened sufficiently to cause formation of seams and planes of weakness within the section. If a section cannot be placed continuously, construction joints shall be located at points as provided for in the drawings or approved by the Engineer.

8.7 Depositing in Cold Weather: Concrete when deposited shall have a temperature of not less than 50° F. nor more than 100° F. The Contractor shall submit for the approval of the Engineer the methods he proposes to use for protecting the concrete from freezing temperatures during the first 72 hours where Type I or II Portland cement is used, or 24 hours where Type III (high early strength) Portland cement is used.

Before placing concrete, forms or subgrade shall be free from frost and ice. Methods of heating materials shall be approved by the Engineer. Salts, chemicals or other foreign materials shall not be mixed with the concrete for the purpose of preventing freezing. Calcium Chloride may be used as an accelerator when specifically approved by the Engineer.

8.8 Bonding: Before depositing fresh concrete on or against concrete which has hardened, forms shall be retightened. The surface of the hardened concrete shall be roughened, in a manner that will not leave loosened particles of aggregate or damaged concrete at the surface, cleaned thoroughly of foreign matter and saturated with water. To provide adequate mortar at the juncture of the hardened and newly deposited concrete, the cleaned and saturated surfaces, including vertical and inclined surfaces, shall be first covered thoroughly with a coating of mortar or neat cement grout, against which new concrete shall be placed before the grout has attained its initial set.

8.9 Wet Pour Method: When approved by the Engineer, the Contractor may place a wet pour if he cannot prevent the flow of water into the area as defined in 8.2. At the time a wet pour is made the water level shall be static and below the concrete form surface elevation, unless approved otherwise by the Engineer. A wet pour shall be placed by the tremie method or by pump after the reinforcing and forms are determined to be acceptable by the Engineer. A tremie shall consist of a watertight tube having a diameter of not less than 10 inches with a hopper at the top. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the discharge end, always keeping it in the deposited concrete.

Concrete pump discharge tubes and tremie tubes used to deposit concrete in water shall be equipped with a device that will prevent water from entering the tube while charging the tube with concrete. Such tubes shall be supported so as to permit free movement of the discharge end over the entire top surface of the work and to permit rapid lowering, when necessary to control or stop the flow of concrete. The tubes shall be filled by a method that will prevent washing of the concrete. The discharge end shall be completely submerged in concrete at all times and the tube shall contain sufficient concrete to prevent any water entry. The flow shall be continuous until the work is completed and the resulting concrete seal shall be monolithic and homogeneous. The wet pour shall be placed in one continuous pour until the form is filled to the plan elevation and all water and unsound concrete has been removed.

When requested by the Engineer the method selected by the Contractor to place the concrete shall be submitted for approval along with sufficient details and data to review the procedure. Concrete for a wet pour shall be the same class of concrete as specified on the plans with a minimum of 10% additional cement and a slump not to exceed six (6) inches.

9. CURING OF CONCRETE

All concrete surfaces shall be protected to insure that loss of moisture from the surface is held to a minimum for a period of at least seven (7) days following initial set. Where Type III (high early strength) Portland cement is used, the period shall be not less than three (3) days. Concrete damaged by improper curing shall be subject to removal and replacement as directed. The method of curing, regardless of type, will not relieve the Contractor of his responsibility to provide concrete having required strength and surface finish. Unless otherwise specified for a specific item of work, the prevention of the loss of moisture from the concrete surface shall be accomplished by one of the following alternate methods:

a. Surface maintained continuously wet by sprinkling or inundation;
b. Covering with burlap mats kept continuously wet;
c. Covering surfaces with white or translucent polyethelene sheeting not less than .004 inch in thickness. Splices shall be made with a minimum lap of 4 inches and sealed with adhesive tape approved by the Engineer;
d. Application of a membrane curing compound such as Protex Industries "Triple Seal"; Carter-Waters' "Chlorcure"; or an equal product approved by the Engineer. Application shall be at a rate of not more than 200 square feet of surface per gallon of compound;
e. Forms left in place during the specified curing period shall be sprinkled and maintained moist as required to prevent rapid drying of the concrete;
f. Other methods of curing as may be approved by the Engineer.

10. CONTROL TESTS

All concrete and concrete materials used in the work shall be tested as directed by the Engineer. The Contractor shall provide material for all samples and test specimens required.

So long as the Contractor's work progresses in an orderly and reasonable manner the costs of field sample preparation and testing of all specimens will be borne by the Owner. Should the Contractor use methods or procedures that require unreasonable or excessive field testing to determine whether specification requirements are being met, or if field testing is performed with continued negative results that indicate the

Contractor's methods or procedures are not adequate to provide the specified results, the Engineer shall notify the Contractor in writing that the costs of all additional testing beyond specific limits, which shall be set out in the written notice for the particular area or material in question, shall be the responsibility of the Contractor. Such costs will then be deducted from the monies due the Contractor for the work performed.

Control tests which will be conducted on a continuing basis include:

10.1 Slump Test: (ASTM-C143) as directed during concrete placement.

10.2 Yield Test: (ASTM-C138) as directed during concrete placement, generally once each day during concrete placement.

10.3 Compressive Strength: (ASTM-C39) two (2) test specimens for each 50 cubic yards or less of each class of concrete placed during one days operation to be tested at 7 and 28 days. Test specimens to be prepared in accordance with ASTM-C3l.

10.4 Flexural Strength: (ASTM-C78) as directed during concrete placement, generally two (2) test specimens for each days placement of more than 50 CY. Test specimens to be prepared in accordance with ASTM-C31.

10.5 Air Entrainment: (ASTM-C231) as directed during concrete placement, generally at least once each day during concrete placement.

11. DEFECTIVE CONCRETE

11.1 Deficient Strength: Where the results of strength tests indicate concrete which fails to conform to these specifications, additional test specimens shall be taken, in accordance with ASTM C42, from the questioned areas, as directed by the Engineer. If the strength indicated by these core samples meets the specification requirements the concrete will be accepted. In the event that the core tests fail to meet the specifications, all concrete represented by the deficient test specimen shall be removed and replaced by the Contractor at no additional cost to the Owner. The cost of all coring and testing, including satisfactory patching of core holes, shall be borne by the Contractor.

11.2 Defective Area: Areas of concrete which are defective for reasons other than strength (i.e. Honeycombs, finish irregularities, misalignment of forms, etc.) shall be repaired by methods approved by the Engineer. When in the opinion of the Engineer satisfactory repairs cannot be made the defective concrete shall be removed and replaced by the Contractor at no additional cost to the Owner.

12. CONSTRUCTION

12.1 General: The Contractor shall ensure all pipe, pipe sleeves, reinforcing and other embedments are properly set and placed prior to any concrete pours. Concrete items shall be constructed to the detailed thickness and to the lines and grade as shown on the plans. Concrete shall be placed over moistened and unfrozen subgrade and when the ambient temperature is 40°F or greater and rising. The subgrade shall be void of excessive moisture. The concrete shall be reinforced with the type of reinforcement indicated and the reinforcement shall be secured and tied in place prior to depositing any concrete.

12.2 Expansion Joints: Asphalt Expansion Joints shall be composed of asphalt, vegetable fibres, and mineral fillers, formed under heat and pressure between two asphalt-saturated felt liners. Asphalt Expansion Joints shall conform to AASHTO M33 or ASTM D994, shall be 1/2" thick and weigh approximately 3 pounds per square foot, unless shown otherwise on the plans.

12.3 Waterstop: Waterstop shall be extruded P.V.C. material with multiple ribs and center bulb for construction joints. It shall be 4-7/16" wide and 3/16" thick (min.). P.V.C. waterstop for expansion joints shall be 3/16" thick (min) and be designed for 1/2" expansion (min). The waterstops shall be Labyrinth Model B3 as manufactured by Water Seals, Inc., Chicago, Illinois, phone 1-312-332-6765 or approved equal.

12.4 Joint Sealer: After the specified curing period, the faces of all joints to be sealed shall be thoroughly cleaned, using compressed air, sweeping, brooming or other methods approved by the Engineer. The faces of the joint shall be dry after being thoroughly cleaned, and filled with joint sealing compound using a nozzle designed to completely fill the joint.

Joints shall be filled to within the top surface, but in no case shall they be overfilled. Upon completion of the joint sealing operations, all excess material and foreign material shall be removed from the concrete surface.

Joint Sealant to be polysulfide base which cures to a flexible seal with good bonding characteristics or as shown otherwise in the plans.

12.5 Finishing of Related Unformed Surface: Surfaces to receive concrete Class III (grout) or equipment foundations shall have a rake finish or broom finish. Equipment or structure foundations, floor slabs and steps not to receive concrete Class III (grout) shall receive a troweled finish. Slabs to receive a coating shall have a finish as recommended by coating manufacturer.

Sidewalks shall receive a light broomed finish.

12.6 Finishing of Formed Surfaces: All surfaces exposed to view which have been in contact with the forms shall receive a smooth rubbed finish in accordance with Section 10.3.1 of ACI 301-72 after the surfaces have been prepared as specified in Chapter 9 of ACI 301-72. All air bubbles shall be filled with a bonding grout and rubbed down with sacks before final rubbing as specified above. This shall include all exposed edges and surfaces of walls.

DIVISION 9 – FINISHES

SECTION 09902 – SANITARY SEWER MANHOLE COATINGS

1.1 SECTION INCLUDES

A. Requirements for surface preparation and coating applications to manhole inside surfaces.

B. Requirements for the installation of manhole chimney seals to prevent inflow and infiltration in the chimney section of all proposed manholes.

1.2 REFERENCES

A. ASTM - The published standards of the American Society for Testing and Materials, West Conshohocken, PA.

B. NACE - The published standards of National Association of Corrosion Engineers (NACE International), Houston, TX.

C. SSPC - The published standards of the Steel Structures Painting Council, Pittsburgh, PA.

1.3 SUBMITTALS

A. The following items shall be submitted:

1. Technical data sheet on each product used, including ASTM test results indicating the product conforms to and is suitable for its intended use per these specifications.

2. Material Safety Data Sheets (MSDS) for each product used.

3. Project specific guidelines and recommendations.

4. Qualification of Applicator:

a. Manufacturer verification that Applicator has been trained and approved in the handling, mixing and application of the products to be used.

b. Certification by the protective coating manufacturer that the equipment to be used for applying the products has been approved and Applicator personnel have been trained and certified for proper use of the equipment.

c. Five (5) recent references of Applicator indicating successful application of the coating system for manhole interior coatings.

d. Proof of any necessary federal, state or local permits or licenses necessary for the project.

5. Design details for any additional ancillary systems and equipment to be used in site and surface preparation, application and testing.

1.4 QUALITY ASSURANCE

A. Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM, NACE and SSPC standards and the protective coating manufacturer's recommendations.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Materials are to be kept dry, protected from weather and stored under cover.

B. Protective coating materials are to be stored in accordance with manufacturer's instructions.

C. Protective coating materials are to be handled according to their material safety data sheets.

1.6 SITE CONDITIONS

A. Applicator shall conform with all local, state and federal regulations including those set forth by OSHA, RCRA and the EPA and any other applicable authorities.

B. The applicator shall meet all confined space requirements prior to entry into any manholes.

1.7 WARRANTY

A. Applicator shall warrant all work against defects in materials and workmanship for a period of one (1) year, unless otherwise noted, from the date of final acceptance of the project. Applicator shall, within 14 days after receipt of written notice thereof, repair defects in materials or workmanship which may develop during said one (1) year period, and any damage to other work caused by such defects or the repairing of same, at his own expense and without cost to the Owner.

PART 2 - PRODUCTS

2.1 EXISTING PRODUCTS

A. New concrete must cure 28 days prior to coating application.

B. Cementitious patching and repair materials should not be used unless their manufacturer provides information as to its suitability for topcoating with coating. Project specific submittals should be provided including application, cure time and surface preparation procedures which permit optimum bond strength with the coating.

C. Remove existing coatings prior to application of the new protective coating. Applicator is to maintain strict adherence to applicable NACE and SSPC recommendations with regard to proper surface preparation and compatibility with existing coatings.

D. Specified steel surfaces will be thoroughly inspected and, after blast preparation may be ultrasonically tested to detect thin spots in the shell where the structural integrity of the structure has deteriorated. After blast preparation these spots should be marked with epoxy spray paint or zinc primer.

E. Existing coatings should be removed or, where bonded well, thoroughly abraded to provide adequate surface profile for mechanical bond by the new protective coating. Applicator is to maintain strict adherence to the protective coatings manufacturer's recommendations with regard to proper surface preparation and compatibility with existing coatings.

2.2 MANUFACTURER

A. Raven Lining Systems, Inc., Tulsa, OK (800) 324-2810 or (918) 584-2810 or FAX (918) 582-4311.

B. Sauereisen, Pittsburg, PA, (412) 963-0303.

C. Tnemec Company, Inc., Kansas City, MO (800) 863-6321).

2.3 PROTECTIVE COATING MATERIAL

A. Raven Lining Systems' Raven 405 epoxy coating system.

B. Sauereisen SewerGard Epoxy Systems No. 210S

C. Tnemec Chembloc H2S Series 434

D. Manhole chimney seal No. F-88

2.4 PROTECTIVE COATING APPLICATION EQUIPMENT

A. Specifically designed, or approved for use by the protective coating manufacturer.

PART 3 - EXECUTION

3.1 ACCEPTABLE APPLICATORS

A. Protective coating must be applied by an approved Certified Applicator of the protective coating manufacturer and according to manufacturer specifications.

3.2 EXAMINATION

A. The applicator shall comply with local, state and federal regulatory and other applicable agencies with regard to environment, health and safety.

B. Any active flows shall be dammed, plugged or diverted as required to ensure that the liquid flow is maintained below the surfaces to be coated.

C. Installation of the protective coating shall not commence until the concrete substrate has properly cured and been prepared in accordance with these specifications.

D. Temperature of the surface to be coated should be maintained between the recommended surface temperature required for the products specified herein. Prior to and during application, care should be taken to avoid exposure of direct sunlight or other intense heat source to the structure being coated. Where varying surface temperatures do exist, care should be taken to apply the coating when the surface temperature is falling versus rising (i.e., late afternoon into evening as opposed to morning into afternoon).

3.3 SURFACE PREPARATION

A. Applicator shall inspect all surfaces specified to receive a protective coating prior to surface preparation. Applicator shall notify Owner of any noticeable disparity in the surfaces which may interfere with the proper preparation or application of the repair mortar and protective coating.

B. All concrete, brick, or mortar that is not sound or has been damaged by chemical exposure shall be removed to a sound surface.

C. All contaminants including: oils, grease, unsound or incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed.

D. Surface preparation method(s) should be based upon the conditions of the substrate and the requirements of the protective coating to be applied.

E. All surfaces shall be repaired as required by the protective coating system in the intended service condition.

F. Surfaces to receive protective coating shall be cleaned and abraded to produce a sound surface with adequate profile and porosity to provide a strong bond between the protective coating and the substrate. Generally, this can be achieved with a high pressure water cleaning using equipment capable of 5,000 psi at 4 gpm. Other methods such as high pressure water jetting (refer to NACE Standard No. 5/SSPC-SP12), abrasive blasting, shotblasting, grinding, scarifying or acid etching may also be used. Detergent water cleaning and hot water blasting may be necessary to remove oils, grease or other hydrocarbon residues from the concrete. Whichever method(s) are used, they shall be performed in a manner that provides a uniform, sound clean neutralized surface that is not excessively damaged.

G. A mild chlorine solution may be used to neutralize the surface to diminish microbiological bacteria growth prior to final rinse and coating.

H. Test prepared surfaces after cleaning but prior to application of the coating to determine if a specific pH or moisture content of the concrete is required according to manufacturer's recommendations.

I. All surfaces should be inspected during surface prep and before the manhole coating is applied.

J. Loose brick work and voids in mortar joints shall be regrouted with corrosion resistant mortar that is compatible with the coating.

K. Surfaces shall be free of weld splatter. All welds shall be continuous.

L. Steel contaminated with soluble salts (i.e., chlorides and sulfates) develops rust-back rapidly at intermediate and high humidities. Therefore, these salts shall be removed from the steel surface before blast cleaning. A number of tests for soluble salts have been examined by SSPC, ASTM, the National Shipbuilding Research Program, and the International Organization for Standardization.

M. All loose scale, large oil deposits, grease, cutting oils, dirt and other contaminants shall be removed prior to abrasive blasting by washing with detergent and potable water, followed by a thorough rinsing with potable water.

N. The steel surfaces to be coated shall be abrasive blast cleaned per SSPC-SP10 (near-white blast clean) with a sharp angular abrasive of suitable size to create 2-3 mil blast profile. Blast air shall be free of oil and water.

O. Abrasive blasting shall not be performed when the air or steel temperature is below 40 deg F, when the relative humidity exceeds 80%, or when the steel is less than 5 deg F warmer than the dewpoint. The Contractor will provide dehumidification, and/or temperature control as necessary to meet these conditions.

P. Blast cleaning shall be in accordance with SSPC-SP 5, White Metal Blast Cleaning for severe-duty immersion service of the coated areas. Cleaning for other surfaces shall be in accordance with SSPC-SP 10 (near-white blast clean). Anchor profile shall be 2.5-5.0 mil and relative to the coating thickness specified.

Q. Remove all blasting residues from the structure/vessel by means of vacuum cleaning plus, as appropriate, shovels, brooms, compressed air, vacuum cleaners and other dry extraction methods.

R. All surfaces should be inspected by the Inspector during and after preparation and before the protective coating is applied.

3.4 APPLICATION OF PROTECTIVE COATING

A. Application procedures shall conform to the recommendations of the protective coating manufacturer, including material handling, mixing, environmental controls during application, safety, and spray equipment.

B. The spray equipment shall be specifically designed to accurately ratio and apply the specified protective coating materials and shall be regularly maintained and in proper working order.

C. The coating will be applied to a minimum thicknesses of 80 mils.

D. If necessary, subsequent topcoating or additional coats of the protective coating should occur as soon as the basecoat becomes tack free, ideally within 12 hours but no later than 24 hours after the prior coat has been applied at 75 deg F unless additional prior coat surface preparation is performed. The protective coating manufacturer must be consulted for any additional-coat surface preparation guidelines if necessary.

3.5 TESTING AND INSPECTION

A. During application a wet film thickness gage, meeting ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used to ensure a monolithic coating and uniform thickness during application.

B. After the protective coating has set hard to the touch it shall be inspected with high-voltage holiday detection equipment. An induced holiday shall be made on to the coated concrete surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays at that particular area. The spark tester shall be initially set at 100 volts per 1 mil (25 microns) of film thickness applied but may be adjusted as

necessary to detect the induced holiday. All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional protective coating material can be hand applied to the repair area. All touch-up/repair procedures shall follow the protective coating manufacturer's recommendations.

C. Measurement of bond strength of the protective coating to the substrate can be made at regular intervals and along different sections of the structure (i.e.. crown of pipe, wall, invert -- every 200 ft). Bond strength can be measured in accordance with ASTM D4541. Any areas detected to have inadequate (less than 300 psi to concrete) bond strength shall be evaluated by the Project Engineer. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded area and repairs shall be made by Applicator in strict accordance with manufacturer's recommendations.

D. A final visual inspection shall be made by the Inspector and manufacturer's representative. Any deficiencies in the finished coating shall be marked and repaired according to the procedures set forth herein by Applicator.

E. The system may be put back into service seven (7) days after application after inspection occurs.

END OF SECTION