

**Addendum  
No. 1**

Pre-Bid Meeting Date: June 3, 2020

Addendum Date: June 4, 2020

Project: Carrie Downie E.S. – Water Main Replacement

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The work herein shall be considered part of the bid documents for the referenced project and carried out in accordance with the following supplemental instructions issued in accordance with the Contract Documents without change in Contract Sum or Contract Time. Acknowledge receipt of addendum on the bid form as indicated.

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**Pre-Bid Meeting Minutes:**

1. Introductions:
  - a. Colonial School District, Supervisor of Facilities and Special Projects – Ted Lambert
  - b. Colonial School District, Operations Secretary – Lisa Amoroso
  - c. Studio JAED Project Manager – Brian Zigmond ([zigmondb@studiojaed.com](mailto:zigmondb@studiojaed.com)) 302-832-1652
2. Studio JAED Assistant Project Manager – Bob Blyman ([blymanb@studiojaed.com](mailto:blymanb@studiojaed.com))
3. Attached pre-bid attendance list for reference.
4. Review of Bidding Timeline and Updated Requirements:
  - a. Bid opening is to take place on **Thursday, June 18, 2020 at 2:00 PM.**
  - b. PER THE STATE OF DELAWARE REVISED BIDDING GUIDELINES, ALL BIDS WILL BE SUBMITTED ELECTRONICALLY AND VIA UNITED STATES POSTAL SERVICE MAIL FOR THIS PROJECT DUE TO THE ONGOING COVID-19 DISTANCING CRITERIA. **IN PERSON BID SUBMISSIONS WILL NOT BE ACCEPTED.**
  - c. **ALL BIDS SHALL BE E-MAILED TO EMILY RYAN ([eryan@dataservice.org](mailto:eryan@dataservice.org)) AT THE DATA SERVICE CENTER BY THE TIME AND DATE STATED ABOVE. HARD COPIES SHALL BE MAILED SEPARATELY TO BRIAN ZIGMOND AT STUDIO JAED (ADDRESS PROVIDED BELOW) AND DO NOT NEED TO BE RECEIVED BY THE BID SUBMISSION DATE AND TIME. **IF THE E-MAILED BID IS NOT RECEIVED PRIOR TO THE BID SUBMISSION DATE AND TIME IT WILL BE REJECTED.****  
MAILING ADDRESS FOR HARD COPIES OF BIDS:  
STUDIO JAED  
2500 WRANGLE HILL RD  
SUITE 110  
BEAR, DE 19701  
ATTN: BRIAN ZIGMOND
  - d. THE BID OPENING WILL BE CONDUCTED VIA ONLINE CONFERENCING. THE INFORMATION FOR THIS CONFERENCE WILL BE DISTRIBUTED TO ALL PLANHOLDERS.

5. Bidders are to submit questions in writing by email to both Brian Zigmund and at the e-mail addresses noted above. Responses will be issued by addendum.
  - a. Bidder questions will be accepted until 5:00 PM on June 12, 2020.
6. All drawings must be purchased through RCI. All information / addenda will be released through RCI for this bid.
  - a. IT IS THE CONTRACTOR'S RESPONSIBILITY TO CONTACT RCI PRIOR TO THE BID DATE TO ENSURE THAT THEY HAVE RECEIVED ALL ADDENDA FOR THE PROJECT.
7. The project includes a \$10,000 allowance for unforeseen conditions which is to be included in contractor's base bid price and is to be used at the owner's discretion as project progresses. The allowance is not intended for any portion of work indicated in the bid documents. Any balance remaining in the allowance is to be returned to owner by credit change order at project conclusion.
8. Bid Form and Required Documents:
  - a. Bidders may not alter the bid form.
  - b. If bid form is reissued during the bidding process, the latest bid form is to be submitted.
  - c. Bidders are not to leave any blank lines on the bid form. Fill out bid form completely.
  - d. Review of Subcontractor List
    - i. Bidders must list 2<sup>nd</sup> and 3<sup>rd</sup> Tier Subcontractors beneath each section in compliance with DE Title 29, Chapter 69, Section 6962(d)(10)b of the Delaware Code. Bidders are encouraged to thoroughly review the requirements therein prior to submission of the bid.
  - e. Bidders are to individually acknowledge receipt of each numbered addendum received on the bid form. Bidders must list themselves for any listed subcontractors scope of work if they intend to do the scope of work with their own work force. Bidders must follow the guidelines listed in Title 29 regarding listing of 3<sup>rd</sup> Tier subcontractors.
  - f. Drug affidavits are required for bidders
  - g. Bidders are to include a copy of Delaware business license with bid form.
  - h. A bid bond is required. Bidders are to use the state bid bond form, a copy of which is found in the project manual.
9. After-hours work may only be undertaken in strict coordination with the Owner.
10. The Owner has reviewed previous HAZMAT / AHERA reports for the site and no material is currently identified as hazardous.
11. The contractor is responsible for obtaining all building permits. No drawings have been submitted to the City at this time. Signed and sealed drawings will be provided to the successful contractor for this purpose.
12. Parking – As noted, parking on the site will be designated by the Owner. Lay-down areas must be coordinated with the Owner in all cases.

13. Security – The Owner requires photographic badges for all work on-site.
14. No photographs may be taken on the site when students are present without the expressed approval of Colonial School District.
15. Site cleaning and maintenance: Site it expected to be cleaned daily to keep the site clean of debris and waste. The site and building must be returned to the original state regarding cleanliness and safety upon completion of the project, including all paving, facades/glass, and grass areas.
16. Schedule: The contract work on-site is expected to take place and be completed prior to the start of the Fall 2020 school year. **Date of substantial completion and occupancy is August 14, 2020.**
17. Temporary sanitary facilities shall be provided by the contractor per the project documents. Final location to be determined in coordination with the Owner.
18. Background Checks – Background checks are required for all on-site personnel for this project.
19. With the current COVID-19 recommendations, no indoor site visits will be allowed.
20. Apprenticeship training program certificate is not required for this project. That requirement for State bids was not in effect when this project was issued for advertisement.

**Changes to Specifications:**

Section 00 41 13 – Bid Form: Bid form has been reissued to correct indent spacing on the subcontractor list.

**Changes to Drawings:**

C-101 and C-102: Revised drawings to clarify pipe routing and installation requirements.

**General Information:**

1. This bid has been advertised in compliance with the State of Delaware Title 29 bidding requirements and those identified by the Office of Management and Budget / Division of Facilities Management.
2. The successful bid will be awarded in compliance with State of Delaware Title 29 bidding requirements. Please see *Instructions to Bidders - 00 21 13*.
3. Added THE MUNICIPAL SERVICE COMMISSION of the City of New Castle – *WATER SYSTEM TECHNICAL SPECIFICATIONS* as referred to in drawing C-101 for reference. See attachment.
4. The water meter and backflow preventer make/model are shown on the drawings and are to be provided by the contractor for the project.
5. For work on the 273 right-of-way, the City of New Castle will provide the DelDOT permit for the work. There is enough width in the area of construction to not require a full closing of a lane, so work is expected to take place during daytime hours.

**Pre-Bid Attendees:**

Ted Lambert – Colonial School District  
Lisa Amoroso – Colonial School District  
Brian Zigmond – Studio JAED  
Bob Blyman – Studio JAED  
Jon Sabatino – GPI  
Brian Morgan – GPI  
Carlos Lameira – Joao & Bradley  
Jose Waybright – East Coast Plumbing & HVAC  
Joe Cochran – Joseph A. Cochran & Sons  
Stanley Griffiths – Worth and Company  
John Everhart – Merit Construction Engineers  
Andrew Baker – Schlosser and Associates  
Larry Vai – Proworks  
Susan Trentham – JJID  
David Talley – Carrow Construction  
Shaun Rogers – Reybold  
Edwin Williams – Corrado American  
Patrick Doherty – Brandywine Construction  
Dan Hanna – A-Del

**Pre-Bid Meeting Minutes:** Please see above. These are now integral to the bidding documents.

END



**Water Main Replacement  
Carrie Downie ES  
1201 Delaware Street  
New Castle, DE 19720**

**BID FORM**

I/We acknowledge Addendums numbered \_\_\_\_\_ and the price(s) submitted include any cost/schedule impact they may have.

This bid shall remain valid and cannot be withdrawn for thirty (30) days from the date of opening of bids (60 days for School Districts and Department of Education), and the undersigned shall abide by the Bid Security forfeiture provisions. Bid Security is attached to this Bid.

The Owner shall have the right to reject any or all bids, and to waive any informality or irregularity in any bid received.

This bid is based upon work being accomplished by the Sub-Contractors named on the list attached to this bid.

Should I/We be awarded this contract, I/We pledge to achieve substantial completion of all the work within \_\_\_\_\_calendar days of the Notice to Proceed.

The undersigned represents and warrants that he has complied and shall comply with all requirements of local, state, and national laws; that no legal requirement has been or shall be violated in making or accepting this bid, in awarding the contract to him or in the prosecution of the work required; that the bid is legal and firm; that he has not, directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken action in restraint of free competitive bidding.

Upon receipt of written notice of the acceptance of this Bid, the Bidder shall, within twenty (20) calendar days, execute the agreement in the required form and deliver the Contract Bonds, and Insurance Certificates, required by the Contract Documents.

I am / We are an Individual / a Partnership / a Corporation

By \_\_\_\_\_ Trading as \_\_\_\_\_  
(Individual's / General Partner's / Corporate Name)  
\_\_\_\_\_  
(State of Corporation)

Business Address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Witness:** \_\_\_\_\_ **By:** \_\_\_\_\_  
(SEAL) ( Authorized Signature )  
\_\_\_\_\_  
( Title )  
**Date:** \_\_\_\_\_

**ATTACHMENTS**

- Sub-Contractor List
- Non-Collusion Statement
- Affidavit(s) of Employee Drug Testing Program
- Bid Security
- (Others as Required by Project Manuals)

**Water Main Replacement  
Carrie Downie ES  
1201 Delaware Street  
New Castle, DE 19720**

**BID FORM**

**SUBCONTRACTOR LIST**

In accordance with Title 29, Chapter 69, Section 6962(d)(10)b of the Delaware Code, the following subcontractor listing must accompany any bid submittal. The bidder must list **in each category** the full name and address (City & State) of the sub-contractor that the bidder will be using to perform the work and provide material for that subcontractor category. Should the bidder's listed subcontractor intend to provide any of their subcontractor category of work through a third-tier contractor, the bidder shall list that third-tier contractor's full name and address (City & State). **If the bidder intends to perform any category of work itself, it must list its full name and address.** For clarification, if the bidder intends to perform the work themselves, the bidder **may not** insert "not applicable", "N/A", "self" or anything other than its own full name and address (City & State). To do so shall cause the bid to be rejected. In addition, the failure to produce a completed subcontractor list with the bid submittal shall cause the bid to be rejected. If you have more than three (3) third-tier contractors to report in any subcontractor category, print out additional page(s) containing the appropriate category, complete the rest of your list of third-tier contractors for that category, notate the addition in parentheses as (CONTINUATION) next to the subcontractor category and an asterisk (\*) next to any additional third-tier contractors, and submit it with your bid.

<u><b>Subcontractor Category</b></u>	<u><b>Subcontractor</b></u>	<u><b>Address (City &amp; State)</b></u>	<u><b>Subcontractors tax-payer ID # or Delaware Business license #</b></u>
1. Sitework	_____	_____	_____
A.	_____	_____	_____
B.	_____	_____	_____
C.	_____	_____	_____
2. Plumbing	_____	_____	_____
A.	_____	_____	_____
B.	_____	_____	_____
C.	_____	_____	_____

**Water Main Replacement  
Carrie Downie ES  
1201 Delaware Street  
New Castle, DE 19720**

**BID FORM (Continued)**

3. Carpentry

A.

B.

C.

_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

**Water Main Replacement  
Carrie Downie ES  
1201 Delaware Street  
New Castle, DE 19720**

**AFFIDAVIT  
OF  
CONTRACTOR QUALIFICATIONS**

We hereby certify that we will abide by the contractor's qualifications outlined in the construction bid specifications for the duration of the contract term.

In accordance with Title 29, Chapter 69, Section 6962(d)(10)b.3 of the Delaware Code, after a contract has been awarded the successful bidder shall not substitute another subcontractor whose name was submitted on the Subcontractor Form except for the reasons in the statute and not without written consent from the awarding agency. Failure to utilize the subcontractors on the list will subject the successful bidder to penalties as outlined in the General Requirements Section 5.2 of the contract.

**Contractor Name:** \_\_\_\_\_

**Contractor Address:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Authorized Representative (typed or printed):** \_\_\_\_\_

**Authorized Representative (signature):** \_\_\_\_\_

**Title:** \_\_\_\_\_

Sworn to and Subscribed before me this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_.

My Commission expires \_\_\_\_\_. NOTARY PUBLIC \_\_\_\_\_.

**THIS PAGE MUST BE SIGNED AND NOTARIZED FOR YOUR BID TO BE CONSIDERED.**

**Water Main Replacement  
Carrie Downie ES  
1201 Delaware Street  
New Castle, DE 19720**

**BID FORM**  
**NON-COLLUSION STATEMENT**

This is to certify that the undersigned bidder has neither directly nor indirectly, entered into any agreement, participated in any collusion or otherwise taken any action in restraint of free competitive bidding in connection with this proposal submitted this date to the Office of Management and Budget, Division of Facilities Management.

All the terms and conditions of this bid package have been thoroughly examined and are understood.

**NAME OF BIDDER:** \_\_\_\_\_

**AUTHORIZED REPRESENTATIVE  
(TYPED):** \_\_\_\_\_

**AUTHORIZED REPRESENTATIVE  
(SIGNATURE):** \_\_\_\_\_

**TITLE:** \_\_\_\_\_

**ADDRESS OF BIDDER:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**E-MAIL:** \_\_\_\_\_

**PHONE NUMBER:** \_\_\_\_\_

Sworn to and Subscribed before me this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_.

My Commission expires \_\_\_\_\_. NOTARY PUBLIC \_\_\_\_\_.

**THIS PAGE MUST BE SIGNED AND NOTARIZED FOR YOUR BID TO BE CONSIDERED.**

**Water Main Replacement  
Carrie Downie ES  
1201 Delaware Street  
New Castle, DE 19720**

**AFFIDAVIT  
OF  
EMPLOYEE DRUG TESTING PROGRAM**

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors implement a program of mandatory drug testing for Employees who work on Large Public Works Contracts funded all or in part with public funds.

We hereby certify that we have in place or will implement during the entire term of the contract a Mandatory Drug Testing Program for our employees on the jobsite, including subcontractors that complies with this regulation:

**Contractor/Subcontractor Name:** \_\_\_\_\_

**Contractor/Subcontractor Address:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Authorized Representative (typed or printed):** \_\_\_\_\_

**Authorized Representative (signature):** \_\_\_\_\_

**Title:** \_\_\_\_\_

Sworn to and Subscribed before me this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_.

My Commission expires \_\_\_\_\_. NOTARY PUBLIC \_\_\_\_\_.

**THIS PAGE MUST BE SIGNED AND NOTARIZED FOR YOUR BID TO BE CONSIDERED.**

**END OF SECTION**

# THE MUNICIPAL SERVICES COMMISSION

OF THE  
CITY OF NEW CASTLE, DELAWARE 19720-0208  
PHONE: 302-323-2330 FAX: 302-323-2337

## **Water Main and Water Service Construction in the City of New Castle Municipal Services Commission ( MSC )**

Water main construction in the City of New Castle involving extension of service is the responsibility of the developer who shall bear all costs associated with planning, design, installation, inspection and final approval.

MSC recommends a pre-design meeting with all City Agencies too review the scope of the work to be completed for the extension of service. Information the Owner/Developer should be prepared to offer to the MSC during the pre-design meeting should include the type of occupancy, water flow calculations including request for allocation, and time table for construction.

The MSC reserves the option to have our consulting engineer review proposals for water main extension. The cost of this review process will be the responsibility of the developer / contractor.

Water main construction must be in accordance with the latest version of the MSC Water System Technical Specifications and be approved by the MSC.

The water service installation must meet all requirements of the latest version of 10 States Standards for clearances with respect to water mains and services, sewer mains and laterals, and storm water management facilities. Additionally, all Federal, State, and City Standards must be followed.

Please refer to the Section III – Submittals of the MSC Water System Technical Specifications for the required documents to be submitted for review.

An application for water service must be completed at the MSC Main Office located at 216 Chestnut Street, New Castle. Phone: 302-323-2330.

When all submittals and plans have been approved, the MSC will submit the necessary copies to the Delaware Office of Drinking Water and/or DelDOT for their review and approval. The Office of Drinking water will issue a “Certificate to Construct” for the project and a “Certificate to Operate” once the installation is complete. DelDOT will issue a utility construction permit if deemed necessary. Allowances for the additional time to review and approve should be considered in the overall project.

When all submittals and plans have been approved, the total cost of the water service installation including the estimated time to complete the project and the contractor information shall be submitted to the MSC for review. Upon review, the MSC will add time for on-site inspection of the extension of service. The total cost of the water service installation plus our estimated inspection time shall be submitted to the office prior to any work being started.

The MSC requires a minimum of 48 hours notice prior to any work being started so we can coordinate to have an inspector on-site for the installation. Any work completed with out the presence of an MSC representative is subject to rejection for connection to the City Water System.

**WATER SYSTEM**  
**TECHNICAL SPECIFICATIONS**  
**FOR**  
**MUNICIPAL SERVICES COMMISSION**  
**OF**  
**THE CITY OF NEW CASTLE, DELAWARE**

**PREPARED BY:**

**URS CORPORATION**  
**1200 Philadelphia Pike**  
**Wilmington, Delaware 19809**

**REVISIONS BY:**

**MUNICIPAL SERVICES COMMISSION**  
**216 Chestnut Street**  
**New Castle, Delaware 19720**

**Revised: August 2006**

**In Effect: August 2006**

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## **Section I- Water Main and Water Service Construction Overview**

1. Water main construction in the City of New Castle involving extension of service is the responsibility of the developer who shall bear all costs associated with planning, design, installation and inspection.
2. MSC requires a pre-design meeting with all City Agencies to review the scope of the work to be completed for the extension of service. Information the Owner/Developer should be prepared to offer to the MSC during the pre-design meeting should include the type of occupancy, water flow calculations including request for allocation, and time table for construction.
3. The MSC reserves the option to have our consulting engineer review proposals for water main extension. The cost of this review will be the responsibility of the developer / contractor.
4. Water main construction must be in accordance with the latest version of the MSC Water System Technical Specifications and be approved by the MSC.
5. The water service installation must meet all requirements of the latest version of 10 States Standards for clearances with respect to water mains / services, sewer mains / laterals, and storm water management facilities. Additionally, all Federal, State, and City Standards must be followed.
6. Please refer to the Section III – Submittals for the required documents to be submitted for review.
7. An application for water service must be completed at the MSC Main Office located at 216 Chestnut Street, New Castle. Phone: 302-323-2330.
8. When all submittals and plans have been approved, the MSC will submit the necessary copies to the Delaware Office of Drinking Water and/or the DelDOT for their review and approval. The Office of Drinking Water will issue a “Certificate to Construct” for the project and a “Certificate to Operate” once the installation is complete. DelDOT will issue a utility construction permit if deemed necessary. Allowances for the additional time to review and approve should be considered in the overall project.
9. When all submittals and plans have been approved, the total cost of the water service installation including the estimated time to complete the project and the contractor information shall be submitted to the MSC for review. Upon review, the MSC will estimate time for on-site inspection of the extension of service. The total cost of the water service installation plus our estimated inspection time shall be submitted to the office prior to work commencing.
10. The MSC requires a minimum of 48 hours notice prior to work commencing so we can coordinate our inspector for on-site inspection of the installation. Any work completed with out the presence of an MSC representative is subject to rejection for connection to the City Water System.

**Section II- GENERAL CONDITIONS**

**A. Standards**

1. All water systems, public and private, which connect to or will connect to the New Castle Municipal Services Commission (MSC) systems or networks must conform to these and the referenced specifications. All designs for water systems shall conform to the following standards:
  - a) MSC Water System Technical Specifications, Latest Version
  - b) American Water Works Association, Latest Version
  - c) Great Lakes Upper Mississippi River Board of State Public Health & Environmental Managers (10 State Standards), Latest Version
  - d) Delaware Office of Drinking Water, Latest Version
  - e) MSC Cross-Connection Control Manual, Latest Version
  - f) International Plumbing Code, Latest Version
  - g) Delaware State Fire Prevention Regulations, Latest Version
2. Submission of calculations, including those for domestic and fire flows, as a basis of design may be required by the MSC.

**B. Prints and Designs**

1. The developer shall provide submittals for approval by the MSC.
2. All prints and design calculations submitted by the MSC will include underground piping, interior plumbing, and fire suppression systems.
3. The MSC shall obtain any utility construction permits and certificate to construct/certificate to operate as required by local and state agencies. The Contractor shall obtain building or other permits as required by local or state agencies.

**C. Insurance**

1. The Contractor shall maintain insurance during the job and provide an insurance certificate to MSC in accordance with the following:

<u>Type of Policy</u>	<u>Limits of Liability</u>
a) Standard Workers Compensation Employer's Liability	Statutory \$500,000
b) General Liability Combined Single Limit (Bodily Injury and Property Damage)	\$1,000,000 Each Occurrence and Aggregate
c) Automobile Liability Combined Single Limit (Bodily Injury and Property Damage)	\$1,000,000 Each Occurrence

#### **D. Required Guarantees**

1. Financial security required by this Article shall be in the form of cash only.
2. All agreements for required guarantees shall be executed by the applicant and shall be approved by the MSC.
3. The balance of any unused financial security will be returned upon acceptance of work by the MSC.

#### **E. Improvements Guarantee**

1. The applicant shall deposit with the MSC financial security in an amount sufficient to cover the cost of all water system improvements including but not limited to water mains, valves, hydrants and other water supply facilities.
2. When requested by the applicant, in order to facilitate financing, the MSC shall furnish the applicant with a letter indicating approval of the final plans contingent upon the applicant obtaining a satisfactory financial security. The final plans shall not be approved for construction until the financial improvements agreement is executed. The letter of contingent approval shall expire and be deemed to be revoked if the financial security agreement is not executed within ninety (90) days unless a written extension is granted by the MSC. Request for such extension by the applicant shall be in writing.
3. The said financial security shall provide for, and secure to the public, the completion of all water system improvements for which such security is being posted within one (1) year of the date of approval by the MSC for completion of such improvements. The amount of financial security to be posted for the completion of the required improvements shall be equal to one hundred twenty five (125) percent of the cost of completion, including engineering and inspection costs, estimated as of ninety (90) days following the date scheduled for completion by the applicant.
4. The MSC may adjust the amount of the financial security annually by comparing the actual cost of the improvements which have been completed and the estimated cost for the completion of the remaining improvements as of the expiration of the ninetieth day (90) after either the original date scheduled for completion or a rescheduled date of completion. Subsequent to said adjustment, the MSC may require the applicant to post additional security in order to assure that the financial security equals one hundred twenty five (125) percent.
5. The amount of financial security required shall be based upon an estimate of the cost of completion of the required improvements, submitted by the applicant and prepared by a professional engineer licensed as such by the State of Delaware and certified by such engineer to be a fair and reasonable estimate of such cost. The MSC, may refuse to accept such estimate for good cause shown. If the applicant and the MSC are unable to agree upon an estimate, then the estimate shall be

recalculated and recertified by another professional engineer licensed as such by the State of Delaware and chosen mutually by the MSC and the applicant. The estimate certified by the third engineer shall be presumed fair and reasonable, and shall be the final estimate. In the event that a third engineer is so chosen, fees for the services of said engineer shall be paid equally by the MSC and the applicant.

6. If the party posting the financial security requires more than one (1) year from the date of posting of the financial security to complete the required improvements, the amount of financial security shall be increased by an additional ten (10) percent for each one (1) year period beyond the first anniversary date from posting of financial security or to an amount not exceeding one hundred twenty five (125) percent of the cost of completing the required improvements as reestablished on or about the expiration date of the preceding one (1) year period by using the above procedure.
7. In the case where development is projected over a period of a year, the MSC may authorize submission of final plans by section or stage of development, subject to such requirements or guarantees for improvements within the future sections or stages of development as the MSC may authorize submission of final plans by section or stage of development, subject to such requirements or guarantees for improvements within the future sections or stages of development as the MSC finds essential for the protection of any finally approved section of the development.
8. As the work of installing the required improvements proceeds, the party posting the financial security may require the MSC to release or authorize to be released, from time to time, such portions of the financial security necessary for payment to the contractor or contractors performing the work. Any such requests shall be in writing addressed to the MSC and the MSC shall have fifteen days from receipt of such request within which to verify the improvements have been completed in accordance with the approved plans. Upon such verification the MSC shall authorize release by the bonding company or lending institution of an amount as estimated to represent the value of the improvements completed. If the MSC fails to act within said fifteen (15) day period, the MSC shall be deemed to have approved the release of funds as requested.

#### **F. Release From Improvements Guarantee**

1. When the applicant has completed all the necessary and appropriate improvements, They shall notify the MSC, in writing, by certified or registered mail, of completion of the aforesaid improvements.
2. The MSC shall notify the applicant, in writing by certified mail, of the action of the MSC with regard to approval, non-approval, or rejection of the improvements.
3. If any portion of the said improvements shall not be approved or shall be rejected by the MSC, the applicant shall proceed to complete those improvements and, upon completion, the same procedure of notification as outlined here above shall be followed.

4. Ten (10) percent of the improvements guarantee shall be held back by the MSC until the developer has posted a performance and maintenance guarantee, as specified in Section II, G.
5. Any violations of Federal, State, County, City or MSC regulations must be resolved before release of funds.

#### **G. Performance and Maintenance Guarantee**

1. The applicant shall be responsible for maintenance of all water system improvements until such improvements are offered for dedication and are accepted by the MSC.
2. Where the MSC accepts dedication of all or some of the required improvements following completion, the MSC shall require the posting of financial security to secure the integrity of the improvements and the functioning of the improvements in accordance with the design and specifications as depicted on the final plans.
3. The security required shall be in the form required by Section II, F shall be for a term of eighteen (18) months from the date of the acceptance of dedication, and shall be in an amount equal to fifteen (15) percent of the actual costs of installation of the improvements so dedicated.

#### **H. INSPECTION**

1. The MSC will inspect the Work for compliance with the approved design plans and these specifications. During construction, the MSC or its' designated representative will make inspections as deemed necessary. The total responsibility for compliance with design plans and specifications for conformance rests with the Applicant. The cost of the inspections of the water system by the MSC will be paid to MSC by the Applicant prior to work commencing.
2. Inspection will be required for all water main construction up to the first valve immediately inside the building. A minimum of 48 hours notice will be required for all inspections. It will be the responsibility of the contractor to notify the MSC or its' designated inspector of their construction schedule.
3. No water main construction will be accepted or use made of the MSC's water system without the MSC's inspection and approval.
4. The failure of the MSC to enforce any provisions of these Specifications shall not be deemed a waiver of its' right to do so.

### **Section III- SUBMITTALS**

#### **A. SUBMITTAL PROCEDURES**

1. Sequentially number the transmittal forms. Resubmittals are to have the original number with an alphabetic suffix.
2. Identify Project, Contractor, Subcontractor or supplier; pertinent Drawing sheet and detail number(s), and specification Section number, as appropriate.
3. Apply Contractor's "approved" stamp, signed or initialed certifying that review, verification of Products required, field dimensions, adjacent Construction Work, and coordination of information, is in accordance with the requirements of the Work and Contract Documents.
4. Schedule submittals to expedite the Project. Coordinate the submission of all related items and deliver to the MSC.
5. Identify variations from Contract Documents, Product or system limitations which may be detrimental to successful performance of the completed Work shall be identified also.
6. Provide space for Contractor and MSC review stamps.
7. Revise and resubmit submittals as required, identify all changes made since previous submittal.
8. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

#### **B. PROPOSED PRODUCTS LIST**

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

#### **C. DESIGN PLANS**

1. Submit two complete copies of the design plans for the overall project to the MSC.

#### **D. WATER MAIN PLANS**

1. Submit 5 complete sets of water main plans to the MSC, two for the MSC; two for our consulting engineer, and one for the city building department.
2. 24in X 36in water main plans illustrating:
  - a) coordination of all utilities
  - b) complete profiles for water system with conflict resolution
  - c) station locations for the proposed water system
  - d) complete lines and grades for the project

3. After examination by the MSC, the Contractor, if required shall make such corrections to the drawings and shall furnish the MSC with five corrected copies. Regardless of corrections made or approval given to such drawings by the MSC, the Contractor will be responsible for the accuracy of such drawings and for their conformity to the plans and specifications. Only drawings bearing the approval stamp of the MSC shall be used for ordering materials and construction. If requested by MSC, the Contractor shall furnish additional copies.

#### **E. CUT SHEETS**

1. Submit 5 complete sets of cut sheets to the MSC; two for the MSC, two for our consulting engineer, and one for the city building department.
2. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this Project.
3. Cut sheets shall include, but are not limited to:
  - a) Hydrants
  - b) Valves and fittings
  - c) Pipe
  - d) Precast concrete products
  - e) Cast-in-place concrete
  - f) Castings
  - g) Signs

#### **F. SAMPLES**

1. Submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
2. Include identification on each sample, with full Project information.
3. Submit the number or samples specified in individual specification Sections.
4. Reviewed samples which may be used in the Work are indicated in individual specification Sections.

#### **G. MANUFACTURER'S INSTRUCTIONS**

1. When specified in individual specification Sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for Product Data.
2. Identify conflicts between manufacturers' instructions and Contract Documents.

## **H. MANUFACTURER'S CERTIFICATES**

1. When specified in individual specification Sections, submit manufacturers' certification for calibration and accuracy to MSC for review, in quantities specified for Product Data.
2. Indicate material or Product conforms to or exceeds specified requirements. Submit supporting reference date, affidavits, and certifications as appropriate.
3. Certificates may be recent or previous test results on material or Product, but must be acceptable to MSC.

## **I. WRITTEN SAFETY PLAN**

1. Contractor shall submit a written safety plan prior to construction. The contractor shall certify that the safety plan meets all local, state, federal, OSHA, and other applicable requirements to be followed during construction of the Work.
2. The contractor must designate a responsible safety plan administrator who will dictate, inspect, and enforce the Written Safety Plan.

## **J. PROJECT SCHEDULE**

1. A written Project Schedule shall be submitted to the MSC for review and coordination of on-site inspection. This schedule should include the start date and details for each sequential step of the installation process including flushing and testing of the main.

## **Section IV- WORKMANSHIP AND SAFETY**

### **A. WORKMANSHIP**

1. All workmanship and materials throughout shall be of the highest quality.

### **B. SAFETY**

1. In accordance with generally accepted construction practices, the Contractor shall be solely and completely responsible for conditions of the job site, including safety of all persons and property affected directly or indirectly by his operations during the performance of the work. This requirement will apply continuously 24 hours per day until acceptance of the work by the MSC and shall not be limited to normal working hours.
2. The duty of the MSC to conduct construction review of the Contractor's performance is not intended to include review of the adequacy of the Contractor's safety measures in or near the construction site.
3. All safety laws, rules, ordinances or regulations adopted or that may be enacted hereinafter by State, Federal, Local or Municipal Authority shall govern all construction and operation of facilities under these specifications or contracts. Each and every provision of law, rule, ordinance, regulation or clause required by law as related to safety to be inserted in these specifications or contract shall be deemed to be inserted herein and the specifications or contracts shall be read and enforced as though it were included herein.

## Section V- QUALITY CONTROL

### **A. QUALITY ASSURANCE/CONTROL OF INSTALLATION**

1. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
2. Comply fully with manufacturers' instructions, including each step in sequence.
3. Should manufacturers' instructions conflict with Contract Documents, request clarification from MSC before proceeding.
4. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
5. Perform work by persons qualified to produce workmanship of specified quality.
6. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

### **B. REFERENCES**

1. Conform to the latest edition of referenced standards in effect at the time the project design Agreement is approved by the MSC.
2. Obtain copies of standards when required by Contract Documents.
3. Should specified reference standards conflict with Contract Documents, request clarification from MSC before proceeding.
4. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

### **C. FIELD SAMPLES**

1. Install field samples at the site as required by individual specifications Sections for review.
2. Acceptable samples represent a quality level for the Work.
3. Where field sample is specified in individual Sections to be removed, clear area after field sample has been accepted by MSC.

#### **D. MOCK-UP**

1. Assemble and erect specified items, with specified attachment and anchorage devices, flashings, seals, and finishes.
2. Where mock-up is specified in individual Sections to be removed, clear area after mock-up has been accepted by MSC.

#### **E. TESTING LABORATORY SERVICES**

1. Contractor will employ services of an independent firm to perform testing. Contractor shall pay for services as part of bid price.
2. The independent firm will perform inspections, tests, and other services specified in individual specification Sections and as required by the MSC.
3. Reports will be submitted by the independent firm to the MSC, in duplicate indicating observations and results of tests and indicating compliance or noncompliance with Contract Documents.
4. Retesting required because of nonconformance to specified requirements shall be performed by the same independent firm or a firm selected by the MSC. Payment for retesting will be charged to the Contractor.

#### **F. MANUFACTURERS' FIELD SERVICES AND REPORTS**

1. Submit qualifications of observer to MSC 30 days in advance of required observations. Observer subject to approval of MSC.
2. When specified in individual specification Sections, require material or Product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance of equipment as applicable, and to initiate instructions when necessary.
3. Individuals to report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
4. Submit report in duplicate within 30 days of observation to MSC for review.

## **Section VI- MATERIAL AND EQUIPMENT**

### **A. PRODUCTS**

1. Products: Means new material, plant materials, components, equipment, fixtures, and systems forming the work. Does not include machinery and equipment used for preparation, fabrication, conveying and installation of the work. Products may also include existing materials or components required for reuse.
2. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

### **B. TRANSPORTATION AND HANDLING**

1. Transport and handle products in accordance with supplier's or manufacturer's instructions.
2. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.
3. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

### **C. STORAGE AND PROTECTION**

1. Store and protect products in accordance with supplier's or manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate controlled enclosures. Store plant materials to prevent excessive drying and exposure to harsh environmental conditions.
2. Provide off-site storage and protection when site does not permit on-site storage or protection.
3. Cover products subject to deterioration with appropriate covering to prevent damage.
4. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
5. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage. Store plant materials to prevent damage to roots, limbs or foliage.
6. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.

#### **D. PRODUCT OPTIONS**

1. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.
2. Products Specified by Naming One or More Manufacturers: Products of manufacturers named and meeting specifications. No options or substitutions will be allowed.
3. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

#### **E. SUBSTITUTIONS**

1. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.
2. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
3. A request constitutes a representation that the Contractor:
  - a) Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
  - b) Will provide the same warranty for the Substitution as for the specified product.
  - c) Will coordinate installation and make changes to other work which may be required for the work to be complete.
4. Substitutions will not be considered when they are indicated or implied on product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
5. Substitution Submittal Procedure:
  - a) Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
  - b) Submit cuts, product data, and certified test results attesting to the proposed product equivalence.
  - c) The MSC will notify Contractor, in writing, of decision to accept or reject request within fifteen (15) days of receipt of the request for substitution.

## **Section VII- CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS**

### **A. SECTION INCLUDES**

1. Temporary Utilities: Electricity, lighting, heat, water, and sanitary facilities.
2. Temporary Controls: Barriers, enclosures and fencing, protection of the Work, and water control.
3. Construction Facilities: Access roads and progress cleaning.

### **B. TEMPORARY ELECTRICITY**

1. Provide power service required from Utility source.
2. Provide temporary electric feeder for electrical service.

### **C. TEMPORARY LIGHTING**

1. Provide and maintain lighting for construction operations.

### **D. TEMPORARY HEAT**

1. Provide heat devices and heat as required to maintain specified conditions for construction operations.

### **E. TEMPORARY WATER SERVICE**

1. Provide, maintain and pay for suitable quality water service required for construction operations. Refer to the MSC Tariff, Section 22B, Temporary Water Service.
2. Provide separate metering and reimburse MSC for cost of water used.
3. All water services will be provided on a temporary basis for filling, hydrostatically testing, disinfecting, and flushing new water mains and fire systems. New systems will be kept isolated from existing systems until all testing requirements have been successfully completed. A reduced pressure principle backflow prevention device shall be used in accordance with AWWA Standard C651-92, Section 4.8.

### **F. BARRIERS**

1. Provide barriers to protect existing facilities and adjacent properties from damage due to construction operations.
2. Provide protection for plant life designated to remain. Replace damaged plant life.
3. Protect non-owned vehicular traffic, stored materials, site and structures from damage.

## **G. WATER CONTROL**

1. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
2. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

## **H. PROTECTION OF INSTALLED WORK**

1. Protect installed Work and provide special protection where specified in individual specification Sections.
2. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.
3. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
4. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
5. Prohibit traffic from landscaped areas.

## **I. ACCESS ROADS**

1. Construct and maintain temporary roads accessing public thoroughfares to serve construction area.
2. Extend and relocate as Work progress requires. Provide detours necessary for unimpeded traffic flow.
3. Provide and maintain access to fire hydrants, free of obstructions.
4. Provide means of removing mud from vehicle wheels before entering streets.

## **J. PARKING**

1. Arrange for temporary parking areas to accommodate construction personnel.
2. When site space is not adequate, provide additional off-site parking.

## **K. PROGRESS CLEANING**

1. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
2. Remove waste materials, debris, and rubbish from site and dispose of off-site.

## **L. REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS**

1. Remove temporary above grade or buried utilities, equipment, facilities, and materials prior to the final inspection.
2. Clean and repair damage caused by installation or use of temporary work.
3. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

## Section VIII- CONTRACT CLOSEOUT

### **A. CLOSEOUT PROCEDURES**

1. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for MSC final inspection.
2. Provide submittals to MSC that are required by governing or other authorities.

### **B. FINAL CLEANING**

1. Execute final cleaning prior to final inspection.
2. Clean site; rake clean landscaped surfaces.
3. Remove waste and surplus materials, rubbish, and construction facilities from the site.

### **C. PROJECT RECORD DOCUMENT**

1. Maintain on site, one set of the following record documents; record actual revisions to the work:
  - b) Contract Drawings.
  - c) Specifications.
  - d) Addenda.
  - e) Change Orders and other Modifications to the Contract.
  - f) Reviewed product data, and samples.
2. Store Record Documents separate from documents used for construction.
3. Record information concurrent with construction progress.
4. Specifications: Legibly mark and record at each Product section a description of the actual Products installed, including the following:
  5. Manufacturer's or supplier's name and product model and number or description.
  6. Product substitutions or alternates utilized.
  7. Changes made by Addenda and Modifications.

8. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
  - a) Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  - b) Field changes of dimension and detail.
  - c) Details not on original Contract Drawings.

#### **D. MAINTENANCE DATA**

1. Submit two sets prior to final inspection, bound 8-1/2 x 11 inch text pages in binders with durable covers.
2. Prepare binder covers with printed title "Maintenance Instructions", title of project.
3. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
4. Contents: Prepare a Table of Contents.
5. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and suppliers.
6. Part 2: Maintenance instructions.
7. Part 3: Project documents and certificates, including the following:
  - a) Product data.
  - b) Manufacturers' Certificates illustrating accuracy and certification.
  - c) Photocopies of warranties.
  - d) Revised plans showing as built information for the project to include  
4- 24in x 36in paper copies and 1 digital copies formatted for Auto Cad.
8. Submit one copy of completed volumes in final form 15 days prior to final inspection. This copy will be returned with MSC comments. Revise content of documents as required prior to final submittal.
9. Submit final volumes revised ten days prior to final inspection.

## **E. WARRANTIES**

1. Provide duplicate notarized copies.
2. Execute and assemble documents from Subcontractors, suppliers, and manufacturers.
3. Assemble in binder with durable cover.
4. Submit prior to date of start of warranty period.
5. Provide starting and ending dates of warranty period.

## Section IX- SITE CLEARING

### **A. SECTION INCLUDES**

1. Remove surface debris.
2. Remove paving, curbs, and/or other surface rock as required to complete the work.
3. Remove trees and shrubs.
4. Remove root system of trees and shrubs.

### **B. REGULATORY REQUIREMENTS**

1. Coordinate clearing Work with utility companies.
2. Conform to applicable codes for disposal of debris.

### **C. PRODUCTS**

#### 1. MATERIALS

- a) Tree Dressing for Wounds: Antiseptic and waterproof, asphalt base.

### **D. EXECUTION**

#### 1. PREPARATION

- a) Verify that existing plant life and features designated to remain are tagged or identified.

### **E. PROTECTION**

1. Protect utilities that remain, from damage.
2. Protect trees, plant growth, and features designated to remain as final landscaping.
3. Protect bench marks (and existing structures) from damage or displacement.

### **F. CLEARING**

1. Clear areas required for access to site and execution of Work.
2. Remove paving and curbs as required to finish the work.
3. Remove trees and shrubs, stumps, root systems and surface rock.
4. Clear undergrowth and deadwood without disturbing subsoil.

## **G. REMOVAL**

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

## Section X- ROCK REMOVAL

### **A. WORK INCLUDED**

1. Removal of discovered rock during excavation.
2. Use of explosives to assist rock removal.
3. Minimum clearances around utilities.

### **B. RELATED WORK**

1. Excavation
2. Backfilling
3. Trenching

### **C. REFERENCES**

1. NFPA 495 - Code for the Manufacture, Transportation, Storage, and Use of Explosive Materials.

### **D. QUALITY ASSURANCE**

1. Seismic Survey Firm: Company specializing in seismic surveys with five years documented experience.
2. Explosives Firm: Company specializing in explosives for disintegration of subsurface rock with five years documented experience.

### **E. REGULATORY REQUIREMENTS**

1. Conform to state, DNREC and DelDOT codes for explosive disintegration of rock.
2. Obtain permits from authorities having jurisdiction before explosives are brought to site or drilling is started.

### **F. SUBMITTALS**

1. Submit two (2) copies of blaster's license to the MSC.
2. Provide a descriptive procedure of either mechanical or blasting methods to the MSC for review. Indicate all safety measures to be in effect during blasting operations.
3. Provide daily blasting reports to the MSC.

## **G. MATERIALS**

1. Rock (Definition): Solid mineral material with a volume in excess of 1/2 cu yd or rock that cannot be removed by a hydraulic excavator with a minimum manufacturer's operating weight of 41,000 pounds, 118 flywheel horsepower at 1800 rpm (Caterpillar E200 B EL equivalent or larger) and minimum 3 foot wide heavy duty bucket with rock teeth.
2. Explosives: Type recommended by explosives firm following seismic survey and required by authorities having jurisdiction.
3. Delay Devices: Type recommended by explosives firm.
4. Blasting Mat Materials: Type recommended by explosives firm.

## **H. EXECUTION**

### **1. INSPECTION**

- a) Verify site conditions and note irregularities affecting work of this Section.

## **I. ROCK REMOVAL - MECHANICAL METHOD**

1. Excavate for and remove rock by the mechanical method.
2. Cut away rock at excavation bottom to form a level bearing surface.
3. Remove shaled layers to provide sound and un-shattered base for footings.
4. In utility trenches, excavate to maintain 18" inches of clearance around the circumference of the pipe or to a width shown on the Contract Drawings if specified.
5. Remove excavated material from site.
6. Correct unauthorized rock removal in accordance with backfilling and compaction requirements of Section 14.

## **J. ROCK REMOVAL - EXPLOSIVES METHODS**

1. If rock is uncovered requiring the explosives method for rock disintegration, notify the MSC.
2. Advise owners of adjacent buildings or structures in writing prior to setting up seismographs. Describe blasting and seismic operations.
3. Obtain a seismic survey prior to rock excavation to determine maximum charges that can be used at different locations in area of excavation without damaging adjacent properties.

4. Provide seismographic monitoring during progress of blasting operations.
5. Disintegrate rock and remove from excavation.
6. Cut away rock at excavation bottom to form level bearing.
7. Remove shaled layers to provide sound and un-shattered base for footings.
8. Remove excavated material from site.
9. Correct unauthorized rock removal or over-break in accordance with backfilling and compaction requirements of Section 14.

**K. FIELD QUALITY CONTROL**

1. Provide for visual inspection of bearing surfaces and cavities formed by the removal process.
2. Provide a minimum of 18 inches clearance around the bottom and 24 inches of clearance on each side of the pipe for maintenance purposes.

## **Section XI- EXCAVATION**

### **A. FIELD MEASUREMENTS**

1. Verify that survey benchmark and intended elevations for the Work are as indicated.

### **B. PRODUCTS**

1. Not Used

### **C. EXECUTION**

1. Preparation
2. Identify required lines, levels, contours, and datum.

### **D. EXCAVATION**

1. Underpin adjacent structures which may be damaged by excavation work, including utilities and pipe chases.
2. Excavate subsoil required to accommodate pipes, building foundations, slabs-on-grade, paving and site structures as shown on the Drawings.
3. Comply with all Federal, State and local codes, permits and regulations.
4. Excavation cut not to interfere with normal 45 degree bearing splay of foundations or any other adjacent structures or utilities.
5. Grade top perimeter of excavation to prevent surface water from draining into excavation.
6. Hand trim excavation. Remove loose matter.
7. Remove lumped subsoil.
8. Notify MSC of unexpected subsurface conditions or utility damage.
9. All excavations must be kept free of water below the subgrade of the work while work is in progress. Water removed from excavations shall be disposed of in such a manner as to not cause injury to public health, private property, street surfaces, embankments, or any portion of the work completed or in progress.
10. Correct areas over-excavated by error.
11. Stockpile excavated material in area designated on-site and remove excess material not being reused from site.

12. Support excavations with sheathing, shoring and bracing or with a "trench box" as required to comply with Federal and State laws and codes.
13. Install adequate excavation supports to prevent ground movement or settlement to adjacent structures, pipelines or utilities. Damage due to settlement because of failure to provide support or through fault of the Contractor in any other manner, shall be repaired at the Contractor's expense.
14. Withdraw supports unless otherwise directed by MSC.

#### **E. BEDDING**

1. Stone bedding shall be required when unsuitable soil conditions are encountered.

#### **F. FIELD QUALITY CONTROL**

1. Provide for visual inspection of bearing surfaces.

#### **G. PROTECTION**

1. Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.
2. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

## Section XII- TRENCHING

### **A. SECTION INCLUDES**

1. Excavation of trenches for utilities and pipes.
2. Compacted bedding.
3. Backfilling and compaction.

### **B. REFERENCES**

1. ANSI/ASTM D698 - Test methods for moisture - Density Relations of Soils and Soil-aggregate Mixtures using 5.5 pound rammer and 12 inch drop. (Standard Proctor Density).
2. AWWA C600-99 - Standard for installation of Ductile-Iron Water Mains and their Appurtenances.

### **C. FIELD MEASUREMENTS**

1. Verify the survey benchmark and intended elevations for the work are as shown on Project Drawings.

### **D. PRODUCTS**

#### **1. FILL MATERIALS**

- a) Type C or clean, unfrozen excavated subsoil as described in Section 01000.

### **E. BED MATERIALS**

1. Type B as described in Section 14.

### **F. COVER MATERIALS**

1. Topsoil: In accordance with DelDOT standard specifications Sections 732.

### **G. EXAMINATION**

1. Verify fill material to be reused, is acceptable.

### **H. PREPARATION**

1. Identify required lines, levels, contours and datum.
2. Maintain and protect existing utilities and piping which pass through the work area allowing for proper clearance.

- a) There shall be a minimum of 4' clearance from other utilities on each side of MSC water mains with the exception of sanitary and storm water utilities which shall have a minimum of ten feet clearance parallel from MSC water mains.
  - b) There shall be a minimum of 18" clearance top and bottom from other utilities crossing MSC water mains.
3. Cut out soft areas of sub-grade not capable of in-situ compaction. Backfill with Type B fill and compact to density equal to or greater than requirements for subsequent backfill material.
  4. The trench bottom shall be true and even to provide support for the full length of the pipe barrel, except that a slight depression may be provided to allow the withdrawal of pipe slings or other lifting equipment without damaging the pipe. Areas over excavated by error shall be backfilled with Type B fill and compacted to density equal to or greater than requirements for subsequent backfill material.

## **I. EXCAVATION**

1. Excavate subsoil required for piping.
2. Cut trenches sufficiently wide to enable installation of utilities and allow inspection. Refer to AWWA C600-99, Section 4.2, Table 1.
3. Water main trenches for 4 inch through 16 inch pipe shall not exceed 60 inches of depth while maintaining a minimum top of pipe invert of 42 inches. Deviation from this operating range requires approval from the MSC.
4. Water service trenches for ¾ inch through 2 inch pipe shall be 42 inches deep.
5. Excavation shall not interfere with normal 45 degree bearing splay of foundations.
6. Hand trim excavation. Remove loose matter.
7. Remove lumped subsoil, boulders, and rock from the trench.
8. Correct areas over-excavated by error.
9. All excavations must be kept free of water below the sub-grade of the work while work is in progress. Water removed from excavations shall be disposed of in such a manner as to not cause injury to public health, private property, street surfaces, embankments or any portion of the work completed or in progress in accordance with federal, state, and local requirements.
10. Saw cut any paving prior to trench excavation.

## **J. BEDDING**

1. Stone bedding shall be required when unsuitable soil conditions are encountered.
2. Support pipe during placement and compaction of bedding fill.

## **K. BACKFILLING**

1. Backfill trenches to contours and elevations with unfrozen materials.
2. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy sub-grade surfaces.
3. Fill: Place and compact material in continuous layers to facilitate review by the MSC inspector or inspecting engineer.
4. Employ a placement method that does not disturb structures, utilities, etc.
5. Maintain optimum moisture control of backfill materials and place material in a manner in which to attain required compaction density of 95%.
6. Remove surplus backfill materials from site.
7. Leave fill material stockpile areas completely free of excess fill materials.

## **L. TOLERANCES**

1. Top surface of backfilling: Plus or minus one inch from required elevations.

## **M. PROTECTION OF FINISHED WORK**

1. Protect finished work.

## Section XIII- PIPING, VALVING AND COMPONENTS

### **A. WORK INCLUDED**

1. Furnish and install water mains, valves, service laterals, meter curb stops and miscellaneous appurtenances as indicated on the drawings.

### **B. REFERENCE STANDARDS**

1. Conform to the following reference standards where applicable:
  - a) Ductile Iron Pipe: ANSI A21.51, Class 52
  - b) Gate Valves: AWWA C509 - Resilient Wedge Valves
  - c) Copper Tubing: ASTM B 88, Type K & Type L

### **C. QUALITY ASSURANCE**

1. Materials and installation shall conform to manufacturer's specifications and instructions.

### **D. MANUFACTURERS**

1. Where manufacturers' products are specified, it is for the purpose of establishing a standard of quality and construction.
2. Equivalent products of other manufacturers may be substituted with prior approval from the MSC.

### **E. DUCTILE CAST IRON PIPE (DCIP) AND FITTINGS**

1. Ductile cast iron pipe shall conform to ANSI A21.51 and shall have an ANSI Class 52 thickness unless otherwise specified. Ductile Iron Pipe shall be 4 inch, 6 inch, 8 inch, 12 inch, 16 inch, or as approved by the MSC.
2. All buried pipe shall receive an outside bituminous seal coat and cement interior lining. Above ground or exposed piping will be uncoated and suitable for painting.
3. Above ground or exposed ductile cast iron pipe shall be flanged in accordance with ANSI A21.10. Buried ductile cast iron pipe shall have push-on joints such as "Tyton" joint ends as manufactured by U.S. Pipe or approved equal, or mechanical joints. Rubber gaskets shall conform to C-111 and ANSI A21.11 for mechanical and push-on joints.
4. Ductile cast iron fittings shall conform with the "Standard Specifications for Ductile Cast Iron Pipe and Special Castings" for Class D fittings, mechanical joint (C-153) and push-on joint (C-110).

5. Tapping sleeves shall be Mueller Model H-615 Mechanical Joint Tapping Sleeve or approved equal. Tapping sleeve and valve assemblies shall be supported by concrete blocks and bricks and plumbed level with the existing pipe. The pipe to be tapped and all components of the tapping sleeve assembly shall be disinfected per AWWA Standard C651 for Cutting Into or Repairing Pipe.
6. All Mechanical Joints will be assembled using Ford Uni-Flange Series 1400 Wedge Action Retainer Glands or EBBA Iron Mega Lug Series 1100 Mechanical Joint Retainer glands.
7. Where necessary push-on joints will be assembled using EBBA Iron Mega Lug Series 1700 Restraint Harness.
8. No pipe joints shall be encased in concrete or covered with concrete during the construction of thrust restraint buttresses.
9. Thrust restraint of ductile cast iron pipe joints and fittings shall use ASTM A-307 galvanized 3/4in steel threaded rod, nuts, and washers.
10. Refer to the Trenching details in Section 12 of these Specifications for pipe bury depth, other utility clearance, and trench width of water main and service connections.

#### **F. COPPER PIPE**

1. This specification designates general requirements for copper process piping and copper water service laterals.
  - a) Above ground copper pipe shall be Type "L" hard conforming to ASTM B-88.
  - b) Underground copper piping shall be Type "K" soft conforming to ASTM B-88.
  - c) Copper fittings shall be flared type only or as approved by the MSC.

#### **G. GATE VALVES**

1. Gate valves shall be furnished and installed where indicated on the drawings. Each gate valve shall conform to AWWA C509 for resilient wedge gate valves. The cast iron gate valves shall be epoxy coated inside and out. The valve stem shall be constructed of manganese bronze and sealing shall be accomplished by dual o-rings allowing replacement of o-ring seals while the valve is open and under pressure. Buried valves shall be equipped with a two inch square operating nut. Valves shall be open left Mueller Model A2360-20 or approved by MSC.
2. Gate valves shall be provided so that inconvenience and sanitary hazards will be minimized during repairs. Gate valves shall be located where practical with in or adjacent to street property lines and out of the roadway when possible.

3. Gate valves shall be supported on solid concrete blocks and plumbed level with existing pipe.
4. The operating nut on buried valves shall not be more than 4' below finished grade. An MSC approved valve stem extension with accessory guide ring shall be used to raise the operating nut to the required height. The stem extension shall be pinned to the existing valve stem operating nut.
5. All domestic meter bypass valves shall be provided with tamper resistant valve lockout covers. These devices will have provisions for a MSC provided pad lock and be blue in color. Tampering with devices which are secured in place shall have penalties including estimated consumption and billing.

#### **H. FIRE HYDRANTS**

1. Fire hydrants must comply with AWWA Standard C502 with a 5 1/4" valve, open right, 1-3/16" operating nut, 6" mechanical joint inlet, (2) 2-1/2" nozzles (GA7-298), (1) 4-1/2" nozzle (GA5-512) and will be served by a 6-inch pipe with a 6-inch valve incorporated in the connection as close to the main as possible. The drain valve shall close when the main valve is open. All hydrants must be buried a minimum of 3'-6". The hydrant shall be restrained as shown in the details, and shall be a Mueller Centurion Model A423.
2. Fire hydrants shall be installed every 500' or at locations shown and such elevations as MSC may direct. They shall be set on a bed of Type B Stone extending full width of trench from center of hydrant to end of trench, and from bottom of trench to a point six inches above drip opening. All gravel shall be of such size as will remain on 3/4-inch sieve and pass a two-inch sieve. They shall be supported on blocking and shall be protected against trench sides or end.
3. Non-Historical District Fire Hydrant Setting - the hydrant steamer cap shall be located 2'-6" from the face of the curb and set so the Bury Line on the barrel will be at finish grade.
4. Historical District Fire Hydrant Setting - the hydrant steamer cap shall be located 1' from the face of the curb and set so the Bury Line on the barrel will be at finish grade.

#### **I. FIRE SUPPRESSION SYSTEMS**

1. All Fire Suppression Systems connected to the MSC Potable water system must meet the standards defined in section 15- Pressure Testing, Chlorination and Bacteria Testing.
2. Fire Suppression Systems meeting potable water system standards may be connected to the MSC water supply utilizing detector checks defined in Section 13K.

3. Fire Suppression Systems that do not meet potable water system standards may be connected to the MSC water supply utilizing reduced pressure backflow preventors as defined in Section 13K.
4. Stand Alone Fire Suppression Systems are permitted when they are an approved type that will prevent any cross connection with the MSC potable water system.

#### **J. VALVE BOXES**

1. All buried valves shall be furnished with a suitable cast iron valve box and valve box cover. Valve boxes shall be two-piece screw type installed over the bonnet and operating nut and of sufficient length to reach the surface of the ground, but not to extend above the ground surface. Valve box covers shall be marked "water". They shall be Mueller or approved by MSC.

#### **K. METERS AND SERVICE LINES**

1. All Water meters shall be tested and certified in accordance with AWWA Standard C700-95 Section B.6 and C702-92 Section A.5 or as required by the MSC. A certificate of accuracy shall be furnished to the MSC.
2. Meters 1" and smaller:
  - a) The minimum service line size shall be 3/4" in size.
  - b) The curb stop shall be installed at the property line of the customer and the utility right-of-way. A 3' service line pigtail will be provided on the customer side of the curb stop.
  - c) The meter well and setting shall be installed at the property line of the customer and the utility right-of-way. A 3' service line pigtail will be provided on the customer side of the meter setting.
  - d) MSC will set meters 1" and smaller in settings after disinfection and bacteria testing have been completed on all newly installed components.
  - e) The contractor shall use the following materials for installation of the service and setting:
    1. Corporation Stop - Mueller Model H 15000
    2. Flared Fittings Only
    3. 3/4" Type K Copper
    4. Curb Stop - Mueller Model H 15204
    5. Curb Box - Mueller Model 93D Buffalo Type
    6. Rectangle Meter Pit - PennCell Plastics - PE - 20HD for 3/4" non road rated service.
    7. Rectangle Meter Pit- PennCell Plastics - PE - 30 HD non road rated for 1" service.

8. Copper Meter Yokes Pit - Mueller H-14104-2 12" or 18" rise with a spring loaded check valve
  9. Copper Meter Yokes Basement - Mueller H-1412
  10. WATTS Series No. 7 Residential Dual Check Valve
  11. Meter - Badger Model 25 (5/8" x 3/4") or Model 70 (1") "Recordall" Bronze Disc Meter with Itron integral ert or as approved by the MSC. All meter readings shall be in gallons.
3. Refer to Typical Service Connection Detail for additional information.
4. Meters 1 1/2" and larger:
- a) Settings larger than 1" shall be installed in accordance with drawings approved by MSC and be supplied by the customer or developer.
  - b) MSC will inspect the setting installation prior to installing meters larger than 1".
  - c) The Contractor shall use the following materials for piping and settings in the meter pit.
  - d) Service Pipe - Schedule 40 standard red brass for services up to 2" diameter. DCIP pipe, class 52, for services 3" diameter and larger.
  - e) Valves and Fittings - Cast bronze for services up to 2" diameter. Cast iron for services 3" diameter and larger.
  - f) Disc Meter - Badger "Recordall" Disc Meter with Itron integral ert or Itron pit ert as approved by the MSC. Disc Meters shall be Model M 120 (1 1/2") or M 170 (2"). All meter readings shall be in gallons. The contractor shall forward the Meters Certification information to MSC.
  - g) Compound Meter- Badger "Recordall" Compound Meter with Itron integral ert or Itron pit ert as approved by the MSC. Meters shall be 2", 3", 4" or 6" compound. All meter readings shall be in gallons. The contractor shall forward the Meters Certification information to the MSC.

#### **L. Cross Connection Control**

1. Refer to MSC Cross Connection Control Manual for MSC requirements. Backflow Prevention Devices shall be inspected annually or as required by the MSC and certified by a License Inspector. A written report shall be furnished to the MSC on the anniversary date of installation.
2. **Double Check Valve Assemblies (DCVA and DCVDC)** - All DCVA and DCVDC shall conform to AWWA C510 and shall be approved by the MSC.
  - a) All DCVA assemblies will be Ames Model 2000SS (2 1/2" to 12") or Watts Model 709 (3/4" to 10") or Watts Model No. 7 (1/2" to 1 1/4") or approved by MSC. All inspector test ports shall be plugged with the appropriate size brass fittings.

- b) All Double Check Valve Detector Checks (DCVDC) will be Ames Model 3000SS (2 ½" to 12") or Watts Model 709 DCDA (3" to 10"). The detector bypass assembly shall be schedule 40 standard red brass with fittings and valves. Refer to K2 for approved detector check meters. All inspector test ports shall be plugged with the appropriate size brass fittings.
3. **Reduced Pressure Zone Assemblies (RPZA and RPZDC)** – All RPZA and RPZDC shall conform to AWWA C511 and shall be approved by the MSC.
4. All RPZA assemblies will be Ames Model 4000SS (2 ½" to 6") or Watts Model 909 (3/4" to 10") or approved by MSC. All inspectors test ports shall be plugged with the appropriate size brass fittings.
5. All Reduced Pressure Zone Detector Check (RPZDC) will be Ames Model 5000SS (2 ½" to 12") or Watts Model 909 RPDA (3" to 10"). The detector bypass assembly shall be schedule 40 standard red brass with fittings and valves. Refer to section K2 for approved detector check meters. All inspector test ports shall be plugged with the appropriate size brass fittings.

#### **M. METER PITS**

1. Meter pits shall be approved by the MSC. Meter pits shall be furnished and installed where indicated on the drawing.
2. Positive drainage of meter pits shall be the responsibility of the owner at all times. The owner shall select one of the following methods, or a pre approved equal, to provide removal of water. Should the method selected by the owner not provide positive drainage at all times, then a pre-approved alternative method shall be provided by the owner. Should the owner not accept responsibility of positive drainage for the meter pit, a de-watering charge will be assessed by the MSC for each occurrence it endures.
3. Verify that ground water elevation is below the bottom of the meter pit at all times and that subsoil will provide drainage. Provide (2) 3" diameter holes through the bottom of the sump.
4. Provide gravity drain pipe with check valve to storm sewer or drainage swale.
5. Provide 120 volt submersible sump pump with automatic float control. 120 volt power supply shall have a ground fault protection device. Pump outlet shall have a check valve and discharge to a storm sewer or drainage swale.

#### **N. PRESSURE PIPE AND VALVE INSTALLATION**

1. The Contractor shall verify the dimensions of all valves, fittings, equipment, etc., so that all of the pipe work performed will fit together properly and conform to the general arrangement shown on the Drawings. All pipe valves, fittings, and related accessories shall be carefully examined for defects before installing and no

defective pieces shall be installed. All pieces shall be thoroughly cleaned before they are installed and shall be kept clean and dry.

2. Adjoining pipe, valves and/or equipment to be joined by flanges shall be blocked and shimmed to true elevation with bolt holes in perfect alignment before bolts are inserted and tightened. Bolts shall be tightened uniformly. Drawing skewed joints into gaskets between flanged connections, fittings shall be non-asbestos composition and shall be coated with thread lubricant prior to making up joints. Flange bolts, nuts and washers shall, unless otherwise shown on the drawings, be of mild steel with good, sound, well-fitted threads; the nuts shall be cold-punched, hexagonal, trimmed, and chamfered. Heads, nuts and threads shall be United States standard sizes. Bolts shall be of such length as to project one-quarter inch beyond the nut when the flanged joint with gasket is assembled.
3. During construction, the Contractor shall keep all ends of pipes or conduits, and all equipment connections, closed with caps, plugs, or wooden flange covers, so as to prevent entrance of dirt, building materials, or other foreign matter.

#### **O. BUTTRESSES AT FITTINGS**

1. Buttresses shall be used in all pressure lines at all valves, bends, tees, hydrants, and at reducers or other fittings where changes in direction or pipe size occur. The buttresses shall be as shown on the Drawings.
2. Forms and supports used for buttresses shall be removed after a minimum of 24 hours prior to backfilling.

#### **P. SERVICE CONNECTIONS**

1. Whenever practical, water service lines shall be installed by boring, tunneling or jacking into place rather than by open cut excavation. This method is desired to the fullest practical extent to limit interference with flow of traffic and inconvenience necessary, otherwise by open cut construction and repaving operations. A 3/4 copper cap shall be installed at the end of each service pipe.

## **Section XIV- BACKFILLING**

### **A. SECTION INCLUDES**

1. Site structure backfilling to sub-grade elevations.
2. Site filling and backfilling.
3. Fill under slabs-on-grade and paving.
4. Consolidation and compaction.
5. Fill for over-excavation.

### **B. RELATED SECTIONS**

1. None

### **C. REFERENCES**

1. ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures, Using 5.5 lb. (2.49 kg) Rammer and 12 inch (304.8 mm) Drop. (Standard Proctor).
2. ANSI/ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
3. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb. (4.54 kg) Rammer and 18 inch (457 mm) Drop. (Modified Proctor).
4. ANSI/ASTM D2922 - Test Methods for Density of Soil and Soil Aggregate in place by Nuclear Methods.
5. AASHTO T88 - Modified; T89, Modified; T90 Modified; and T99, Method C Modified.

### **D. FILL MATERIALS**

1. Type A - DE CR1, Crusher Run Meeting Section 821.03 of Delaware Department of Transportation Standard Specifications, July 1985.
2. Type B - SP-57, Delaware No. 57 Stone Meeting Section 813 of Delaware Department of Transportation Standard Specifications, July 1985.
3. Type C - Select Borrow Backfill Meeting the requirements of Section 209.03C of the Delaware Department of Transportation Standards and Specifications, July 1985.

4. Type F – Common Borrow Backfill Meeting the requirements of Section 209.02 of the Delaware Department of Transportation, Standards and Specifications, July 1985.
5. Concrete: Concrete with a compressive strength of 3000 psi or as approved by the MSC.
6. Subsoil: Existing site subsoil free of stones larger than 1”, debris, or clay.

#### **E. EXECUTION**

1. EXAMINATION: Verify fill materials to be reused are acceptable.

#### **F. PREPARATION**

1. Generally, compact sub-grade to density requirements for subsequent backfill materials.
2. Cut out soft areas of sub-grade not capable of in-situ compaction. Backfill with Type B fill material and consolidate to density equal to or greater than requirements for subsequent backfill material.
3. Prior to placement of aggregate base course material at paved areas, compact subsoil to 95 percent of its maximum dry density in accordance with ANSI/ASTM D698.

#### **G. BACKFILLING**

1. Backfill areas to contours and elevations with unfrozen materials.
2. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy sub-grade surfaces.
3. Employ a placement method that does not disturb or damage foundation perimeter drainage, foundation damp proofing, protective covers or utilities in trenches.
4. Maintain optimum moisture content of backfill materials to attain compaction density of 95% Standard Proctor (ANSI/ASTM D698).
5. Backfill against supported structures or utilities.
6. Backfill simultaneously on each side of unsupported structures or utilities.
7. Slope grade away from building minimum two inches in 10 feet, unless noted otherwise.
8. Make grade changes gradual. Blend slope into level areas.
9. Remove surplus backfill materials from site.

10. Leave fill material stockpile areas completely free of excess fill materials.

#### **H. TOLERANCES**

1. Top Surface of Backfilling: plus or minus one inch from required elevations.

#### **I. FIELD QUALITY CONTROL**

1. Compaction testing will be performed in accordance with ANSI/ASTM D1556, ANSI/ASTM D1557 ANSI/ASTM D2992, ANSI/ASTM D698 and with Section 01400.
2. Frequency of Tests: Provide one test on every 50 cubic yards of backfill. MSC may call for additional compaction tests on any backfilled material. If the results show the work does not meet specified requirements, the test shall be at the Contractor's expense.
3. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.

#### **J. PROTECTION OF FINISHED WORK**

1. Protect finished Work.

## Section XV- PRESSURE TESTING

### **A. TESTING OF PRESSURE PIPES**

#### 1. Test Restrictions

- a) Test pressure shall not be less than 1.5 times the working pressure at the highest point along the test section and shall not be less than 150 psi.
- b) Test pressure shall not exceed pipe or thrust-resistant design pressures.
- c) The hydrostatic test shall be for a 2 hour duration or as designated by the MSC.
- d) Test pressure shall not vary by more than  $\pm 5$  psi (35 MPa or 0.35 bar) for the duration of the test.
- e) Valves shall not be operated in either direction at differential pressure exceeding the rated valve working pressure. Use of a test pressure greater than the rated valve pressure can result in trapped test pressure between the gates of a double-disc gate valve. For tests at these pressures, the test setup should include provision, independent of the valve, to reduce the line pressure to the rated valve pressure on completion of the test. The valve can then be opened enough to equalize the trapped pressure with the line pressure, or fully opened if desired.

#### 2. Pressurization

- a) After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure as stated above at the point of testing. Each valved section of pipe shall be slowly filled with water, and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the MSC. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure. It is good practice to allow the system to stabilize at the test pressure before conducting the leakage test.

#### 3. Air Removal

- a) Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left and capped in place at the discretion of the MSC.

#### 4. Examination

- a) Any exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, hydrants, or joints that are discovered following the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until it is satisfactory to the MSC.

#### 5. Leakage Defined

- a) Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi (35 MPa or 0.35 bar) of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

#### 6. Allowable Leakage

- a) No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{133,200}$$

Where:

L	=	Allowable leakage, in gallons per hour
S	=	length of pipe, in feet
D	=	nominal diameter of the pipe, in inches
P	=	average test pressure during the leakage test, in pounds per square inch (150psi)

This formula is based on an allowable leakage of 11.65 gpd/mi/in. of nominal diameter at a pressure of 150 psi.

When hydrants are in the test section, the test shall be made against closed hydrant valves and open gate valves.

## Section XVI – DISINFECTION AND BACTERIOLOGICAL TESTS

### **A. DISINFECTION OF PIPING**

1. All piping, fittings, and related equipment including fire systems which carry potable water shall be disinfected, as herein specified before water is used for domestic consumption or fire suppression. One of the three (3) procedures outlined in the latest edition of AWWA Standard C651 used to accomplish disinfection. The MSC preferred method is continuous feed method.
  - a) The continuous feed method gives a 24 hour chlorine residual of not less than 10mg/L.
  - b) The slug method gives a 3 hour exposure of not less than 50 mg/l of free chlorine.
  - c) The tablet method gives an average chlorine dose of approximately 25 mg/L.
  - d) Water for hydrostatic testing and disinfection
  - e) Water for disinfection and hydrostatic testing shall be furnished by the Contractor from an approved source. The disposal of water used in hydrostatic testing and disinfection shall be the responsibility of the Contractor. Adequate provisions to thoroughly flush newly installed mains shall be the responsibility of the Contractor.

### **B. CONTINUOUS-FEED METHOD**

1. The continuous-feed method consists of placing calcium hypochlorite granules in the main during construction (optional), completely filling the main to remove all air pockets, flushing the completed main to remove particulates, and filling the main with potable water. The potable water shall be chlorinated so that after a 24-h holding period in the main there will be a free chlorine residual of not less than 10 mg/L.
2. Placing of calcium hypochlorite granules. At the option of the purchaser, calcium hypochlorite granules shall be placed in pipe sections as specified in Sec. 2A. The purpose of this procedure is to provide a strong chlorine concentration in the first flow of flushing water that flows down the main. In particular, this procedure is recommended when the type of pipe is such that this first flow of water will flow into annular spaces at pipe joints.
3. Preliminary flushing. Before being chlorinated, the main shall be filled to eliminate air pockets and shall be flushed to remove particulates. The flushing velocity in the main shall not be less than 2.5 ft/s unless the purchaser (or purchaser's representative) determines that conditions do not permit the required flow to be discharged to waste. Table 3 shows the rates of flow required to produce a velocity of 2.5 ft/s in commonly used sizes of pipe. Note that flushing is no substitute for preventive measures during construction. Certain

contaminants, such as caked deposits, resist flushing at any feasible velocity. For 24-in. or larger diameter mains, an acceptable alternative to flushing is to broom-sweep the main, carefully removing all sweeping prior to chlorinating the main.

**Table 1: Required flow and openings to flush pipelines (40 psi [276 kPa] residual pressure in water main)**

Pipe Diameter (inch)	Flow Required to Produce 2.5 ft/s (approx.) Velocity in Main. GPM	Size of Tap, in. No. of Taps on Pipet			No. of 2 ½ in Hydrant Outlet
		1	1 ½"	2	
4	100	1	-	-	1
6	200	-	1	-	1
8	400	-	2	1	1
10	600	-	3	2	1
12	900	-	-	3	2
16	1600	-	-	4	2

### C. PROCEDURE FOR CHLORINATING THE MAIN

1. Water supplied from a temporary, backflow-protected connection to the existing distribution system or other approved source of supply shall be made to flow at a constant, measured rate into the newly installed water main. In the absence of a meter, the rate may be approximated by methods such as placing a Pitot gauge in the discharge or measuring the time to fill a container of known volume.
2. At a point not more than 10ft downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 25 mg/L free chlorine. To ensure that this concentration is provided, measure the chlorine concentration at regular intervals in accordance with the procedures described in the current edition of Standard Methods for the Examination of Water and Wastewater or AWWA Manual M12, or using appropriate chlorine test kits. Table 4 gives the amount of chlorine required for each 100 ft of pipe of various diameters. Solutions of 1 percent chlorine may be prepared with sodium hypochlorite or calcium hypochlorite. The latter solution requires 1 lb of calcium hypochlorite in 8 gal of water.

**Table 2: Chlorine required to produce 25-mg/L concentration in 100 ft (30.5 m) of pipe- by diameter**

Pipe Diameter (inch)	100 percent Chlorine (lb)	1 percent Chlorine Solution (gal)
4	.013	.16
6	.030	.36
8	.054	.65
10	.085	1.02
12	.120	1.44
16	.217	2.60

3. Chlorine application shall not cease until the entire main is filled with heavily chlorinated water. The chlorinated water shall be retained in the main for at least 24 h, during which time all valves and hydrants in the treated section shall be operated to ensure disinfection of the appurtenances. At the end of this 24-h period, the treated water in all portions of the main shall have a residual of not less than 10 mg/L free chlorine.
4. Direct-feed chlorinators, which operate solely from gas pressure in the chlorine cylinder, shall not be used for the application of liquid chlorine. (The danger of using direct-feed chlorinators is that water pressure in the main can exceed gas pressure in the chlorine cylinder. This allows a backflow of water into the cylinder, resulting in severe cylinder corrosion and escape of chlorine gas.) The preferred equipment for applying liquid chlorine is a solution-feed, vacuum-operated chlorinator and a booster pump. The vacuum-operated chlorinator mixes the chlorine gas in solution water; the booster pump injects the chlorine-gas solution into the main to be disinfected. Hypochlorite solutions may be applied to the water main with a gasoline or electrically powered chemical-feed pump designed for feeding chlorine solutions. Feed lines shall be of such material and strength as to safely withstand the corrosion caused by the concentrated chlorine solutions and the maximum pressures that may be created by the pumps. All connections shall be checked for tightness before the solution is applied to the main.

#### **D. SLUG METHOD**

1. The slug method consists of placing calcium hypochlorite granules in the main during construction, completely filling the main to eliminate all air pockets, flushing the main to remove particulates, and slowly flowing through the main a slug of water dosed with chlorine to a concentration of 100 mg/L. The slow rate of flow ensures that all parts of the main and its appurtenances will be exposed to the highly chlorinated water for a period of not less than 3 hours.
2. Placing calcium hypochlorite granules. Same as Sec 3B.
3. Preliminary flushing. Same as Sec. 3C.
4. Chlorinating the main.
5. Same as Sec. 3D(1).
6. At a point not more than 10ft downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 100 mg/L free chlorine. To ensure that this concentration is achieved, the chlorine concentration should be measured at regular intervals. The chlorine shall be applied continuously and for a sufficient period to develop a solid column, or "slug," of chlorinated water that will expose all interior surfaces to a concentration of approximately 100 mg/L for at least 3 hours.

7. The free chlorine residual shall be measured in the slug as it moves through the main. If at any time it drops below 50 mg/L, the flow shall be stopped, chlorination equipment shall be relocated at the head of the slug, and, as flow is resumed, chlorine shall be applied to restore the free chlorine in the slug to not less than 100 mg/L.
8. As the chlorinated water flows past fittings and valves, related valves and hydrants shall be operated so as to disinfect appurtenances and pipe branches.

#### E. TABLET METHOD

1. The tablet method consists of placing calcium hypochlorite granules or tablets in the water main as it is being installed and then filling the main with potable water when installation is completed. This method may be used only if the pipes and appurtenances are kept clean and dry during construction.
2. Placing of calcium hypochlorite granules. During construction, calcium hypochlorite granules shall be placed at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500-ft intervals. The quantity of granules shall be as shown in Table 1. **Warning: This procedure must not be used on solvent-welded plastic or on screwed-joint steel pipe because of the danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite.**

**Table 3: Ounces of calcium hypochlorite granules to be placed at beginnings of main and at each 500-ft interval**

Pipe Diameter	Calcium Hypochlorite	
	Inch	oz
4	0.5	(14)
6	1.0	(28)
8	2.0	(57)
12	4.0	(113)
16 and larger	8.0	(227)

3. Placing of calcium hypochlorite tablets. During construction, 5-g calcium hypochlorite tablets shall be placed in each section of pipe. Also, one such tablet shall be placed in each hydrant, hydrant branch, and other appurtenance. The number of 5-g tablets required for each pipe section shall be  $0.0012 \text{ dL}$  rounded to the next highest integer, where d is the inside pipe diameter, in inches, and L is the length of the pipe section, in feet. Table 2 shows the number of tablets required for commonly used sizes of pipe. The tablets shall be attached by a food-grade adhesive.<sup>1</sup> There shall be no adhesive on the tablet except on the broadside

<sup>1</sup> Examples of food-grade adhesives are GE RTV 108, Permatex Form-A-Gasket No. 2 and Permatex Clear RTV Silicone Adhesive Sealant, which are manufactured by Loctite Corporation, Kansas City, KS 66115. These products have both been approved by the US Drug Administration (USDA) for uses that may

attached to the surface of the pipe. Attach all the tablets inside and at the top of the main, with approximately equal numbers of tablets at each end of a given pipe length. If the tablets are attached before the pipe section is placed in the trench, their position shall be marked on the section so it can be readily determined that the pipe is installed with the tablets at the top.

**Table 4: Number of 5-g Calcium Hypochlorite Tablets Required for Dose of 25 mg/L**

Number of 5-g Calcium Hypochlorite Tablets Required For Dose of 25 mg/L					
Length of Pipe Section (Ft)					
Pipe Diameter (in)	13 or less	18	20	30	40
Number of 5-g Calcium Hypochlorite Tablets					
4	1	1	1	1	1
6	1	1	1	2	2
8	1	2	2	3	4
10	2	3	3	4	5
12	3	4	4	6	7
16	4	6	7	10	13
*Based on 3.25-g available chlorine per tablet. Any portion of tablet rounded to next higher number.					

4. Filling and contact. When installation has been completed, the main shall be filled with water at a rate such that water within the main will flow at a velocity no greater than 1 ft/s. Precautions shall be taken to ensure that air pockets are eliminated. This water shall remain in the pipe for at least 24 hr. If the water temperature is less than 41°F (5°C), the water shall remain in the pipe for at least 48 hr. Water used to fill the new main shall be supplied through a temporary connection that shall include an appropriate cross-connection control device, consistent with the degree of hazard, for backflow protection of the active distribution system.

## F. FINAL FLUSHING

1. Clearing the Main of Heavily Chlorinated Water
  - a) After the applicable retention period, heavily chlorinated water should not remain in prolonged contact with pipe. In order to prevent damage to the pipe lining or corrosion damage to the pipe itself, the heavily chlorinated water shall be flushed from the main until chlorine measurements show that the concentrations in the water leaving the main is no higher than that generally prevailing in the distribution system or is acceptable for domestic use.

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involve contact with edible products. Neither product has been approved in accordance with NSF 61. Other company products, such as Permatex Form-A-Gasket No.1, have not received FDA approval.

## 2. Disposing of Heavily Chlorinated Water

- a) The environment into which the chlorinated water is to be discharged shall be inspected. If there is any possibility that the chlorinated discharge shall cause damage to the environment, then a neutralizing chemical shall be applied to the water to be wasted to neutralize thoroughly the chlorine residual remaining in the water. Where necessary, federal, state, provincial, and local regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water.

## G. BACTERIOLOGICAL TESTS

### 1. Standard Conditions

- a) After final flushing and before the new water main is connected to the distribution system. After final flushing and before the new water main is connected to the distribution system, two consecutive sets of acceptable samples, taken at least 24 h apart, shall be collected from the new main. At least one set of samples shall be collected from every 1200 ft of the new water main, plus one set from the end of the line and at least one set from each branch. All samples shall be tested for bacteriological quality in accordance with *Standard Methods for the Examination of Water and Wastewater*, and shall show the absence of coliform organisms. A standard heterotrophic plate count may be required at the option of the purchaser (or purchaser's representative).

### 2. Special Conditions

- a) If trench water has entered the new main during construction or, if in the opinion of the purchaser (or purchaser's representative), excessive quantities of dirt or debris have entered the new main, bacteriological samples shall be taken at intervals of approximately 200 ft and shall be identified by location. Samples shall be taken of water that has stood in the new main for at least 16 hours after final flushing has been completed.

### 3. Sampling Procedures

- a) Samples of bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate as required by *Standard Methods of Examination of Water and Wastewater*. No hose or fire hydrant shall be used in the collection of samples. A suggested combination blowoff and sampling tap useful for mains up to and including 8-in. diameter is shown in Figure 2. A corporation cock may be installed in the main with a copper-tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.

## **H. REDISINFECTION**

1. If the initial disinfection fails to produce satisfactory bacteriological results, the new main may be reflushed and shall be resampled. If check samples also fail to produce acceptable results, the main shall be rechlorinated by the continuous-feed or slug method of chlorination until satisfactory results are obtained.

NOTE: High velocities in the existing system, resulting from flushing the new main, may disturb sediment that has accumulated in the existing mains. When check samples are taken, it is advisable to sample water entering the new main.

## **I. FINAL CONNECTIONS TO EXISTING MAINS (OPTIONAL)**

1. As an optional procedure (if specified by the purchaser), water mains and appurtenances must be completely installed, flushed, disinfected, and satisfactory bacteriological sample results received prior to permanent connections being made to the active distribution system. Sanitary construction practices must be followed during installation of the final connection, so that there is no contamination of the new or existing water main with foreign material or groundwater.

2. Connections Equal To or Less Than One Pipe Length (Less than or Equal to 18 ft)

- a) As an optional procedure (if specified by the purchaser), the new pipe, fittings, and valve(s) required for the connection may be spray-disinfected or swabbed with a minimum 1 percent solution of chlorine just prior to being installed, if the total length of connection from the end of a new main to the existing main is equal to or less than 18ft.

3. Connections Greater Than One Pipe Length (Greater than 18 ft)

- a) As an optional procedure (if specified by the purchaser), the pipe required for the connection must be set up aboveground, disinfected, and bacteriological samples taken, as described in Sec. 5 through Sec. 8, if the total length of connection from the end of a new main to the existing main is greater than 18 ft. After satisfactory bacteriological sample results have been received for this "pre-disinfected" pipe, the pipe can be used in connecting the new main to the active distribution system. Between the time that satisfactory bacteriological sample results are received and the time that the connection piping is installed, the ends of this piping must be sealed with plastic wraps or watertight plugs or caps.

## **J. DINSINFECTION PROCEDURES FOR REPAIRING EXISTING MAINS**

1. The following procedures apply primarily when existing mains are wholly or partially dewatered. After the appropriate procedures have been completed, the existing main may be returned to service prior to completion of bacteriological testing in order to minimize the time customers are out of water. Leaks or breaks that are repaired with clamping devices while the mains remain full of pressurized water present little danger of contamination and require no disinfection.

## 2. Trench Treatment

When an existing main is opened, either by accident or by design, the excavation will likely be wet and may be badly contaminated from nearby sewers. Liberal quantities of hypochlorite applied to open trench areas will lessen the danger from such pollution. Tablets have the advantage in such a situation because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation.

## 3. Swabbing with Hypochlorite Solution

The interior of all pipe and fittings (particularly couplings and sleeves) used in making the repair shall be swabbed or sprayed with a 1 percent hypochlorite solution before they are installed.

## 4. Flushing

Thorough flushing is the most practical means of removing contamination introduced during repairs. If valve and hydrant locations permit, flushing toward the work location from both directions is recommended. Flushing shall be started as soon as the repairs are completed and shall be continued until discolored water is eliminated.

## 5. Slug Chlorination

When practical, in addition to the procedures above, the section of main in which the break is located shall be isolated, all service connections shut off, and the section flushed and chlorinated as described in Sec. 5.3., except that the dose may be increased to as much as 300 mg/L and the contact time reduced to as little as 15 min. After chlorination, flushing shall be resumed and continued until discolored water is eliminated, and the water is free of noticeable chlorine odor.

## 6. Sampling

Bacteriological samples shall be taken after repairs are completed to provide a record for determining the procedure's effectiveness. If the direction of flow is unknown, then samples shall be taken on each side of the main break. If positive bacteriological samples are recorded, then the situation shall be evaluated by the purchaser (or purchaser's representative) who can determine corrective action, and daily sampling shall be continued until two consecutive negative samples are recorded.

**Section XVI- SITE RESTORATION**

**A. SECTION INCLUDES**

1. Restoration of all areas disturbed during construction.

**B. REGULATORY REQUIREMENTS**

1. Conform to requirements of the City of New Castle Building Department, New Castle County Conservation District, Delaware Department of Natural Resources and Environmental Control, and other agencies having jurisdiction.

**C. QUALITY CONTROL**

1. Provide seed mix certifications.

**D. MATERIALS**

1. Dolomitic limestone.
2. 10-10-10 fertilizer.
3. Straw mulch.
4. Chemical tack.
5. Seed Mix A: The seed mixture shall be as follows:

<u>Seed</u>	<u>% By Weight</u>
Kentucky Bluegrass	90
Pennlawn Red Fescue	5
Annual Ryegrass	5

6. Seed Mix B - Annual ryegrass.

**E. PREPARATION**

1. Areas to be seeded shall be limed with dolomitic limestone at a rate of 100 pounds per one thousand (1,000) square feet. The Contractor shall then scarify the soil to a depth of three (3") inches minimum by the use of a disc or similar equipment. The scarification shall be parallel with the contours of the area. Care shall be taken not to scarify under trees. All such work within the dripline of trees shall be performed by hand. A 10-10-10 fertilizer consisting of 30% organic shall then be applied at a rate of 30 pounds per one thousand (1,000) square feet to be followed by the seeding mixture described below applied at a rate of 3-1/2 pounds per one thousand (1,000) square feet. The seeding operation shall be split in half. One

half of the seed shall be applied in one direction and the remainder shall be applied perpendicular to the first. The seed shall be covered by 1/8 inch of soil. This can be performed by hand raking or by dragging a short section, about 5 feet of chain link fence over the area just seeded. The area shall be rolled and watered with a fine spray until soil is wetted to a depth of 2 inches.

2. Immediately following the seeding operation, the same day, the area seeded shall be straw mulched three (3) inches in depth approximately 3 tons per acre, and tacked in place by means of a chemical tack. The chemical tack shall be applied at a rate of fifty (50) gallons per acre. The binder shall be added at a minimum of 500 gallons of water per acre. Asphaltic emulsion tacks shall not be permitted.

#### **F. EXECUTION**

1. Provide Seed Mix A for permanent restoration of disturbed areas.
2. Provide Seed Mix B for temporary seeding for storage piles and disturbed areas.

#### **G. ROADWAY PATCHES**

1. All materials and methods of construction shall meet the requirements as set forth in the current DELAWARE DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS.

## Section XVII- CAST-IN-PLACE CONCRETE

### **A. WORK INCLUDES**

1. Extent of the work is indicated on drawings.

### **B. QUALITY ASSURANCE**

1. Codes and Standards: Comply with provisions of following codes, specifications, except where more stringent requirements are shown or specified:
  - a) ACI 301 "Specifications for Structural Concrete for Buildings".
  - b) ACI 318 "Building Code Requirements for Reinforced Concrete".
  - c) Concrete Reinforcing Steel Institute, "Manual of Standard Practice".
2. Concrete Testing Service: Engage a testing laboratory approved by MSC or the MSC consulting engineer to perform material evaluation tests and to design concrete mixes.
  - a) Materials and installed work may require testing and retesting, as directed by MSC, at anytime during progress of work. Allow free access to material stockpiles and facilities.

### **C. SUBMITTALS**

1. Submit data for materials indicated herein.
  - a) Admixtures: Provide manufacturer's written certification that chloride ion content complies with specified requirements.
  - b) When requested by MSC: Submit data for proprietary materials and items, including reinforcement and forming accessories, admixtures patching compounds, joint systems, curing compounds, dry-shake finish materials.
2. Laboratory Test Reports: Submit laboratory test reports as specified to MSC.

### **D. MATERIALS**

1. Forms
  - a) Forms for Exposed Finish Concrete: Unless otherwise indicated, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings. Provide form material with sufficient thickness to withstand pressure of newly-

placed concrete without bow of deflection. All forms shall be removed after 24 hours.

- b) Forms for Unexposed Finish Concrete: Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit. All forms shall be removed after 24 hours prior to backfilling the opening.
- c) Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

2. Reinforcing Materials:

- a) Reinforcing Bars: ASTM A615, Grade 60, deformed.

3. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications, unless otherwise acceptable.

4. Concrete Materials:

- a) General: Calcium chloride or admixtures containing more than 0.1% chloride ions are not permitted.
- b) Portland Cement: ASTM C150, Type I, unless otherwise acceptable to MSC. Use one (1) brand of cement throughout project.
- c) Normal Weight Aggregates: ASTM C33, and as herein specified. Provide aggregates from a single source for exposed concrete.
- d) Water: Potable.
- e) Air-Entraining Admixture: ASTM C260.

- Products: Subject to compliance with requirements, provide one of the following:

"Sike Aer"; Sika Corp.

"MB-VR or MB-AE"; Master Builders.

"Dorex AEA"; W.R. Grace.

"Edoco 2001 or 2002"; Edoco Technical Products.

- f) Water-Reducing Admixture: ASTM C494, Type A and contain not more than 0.1% chloride ions.

- Products: Subject to compliance with requirements, provide one of the following:

"Eucon WR-75"; Euclid Chemical Co.  
"Pozzolith 344"; Master Builders  
"Plastocrete 160"; Sika Chemical Corp.  
"Chemtard"; Chem-Masters Corp.

#### 5. Related Materials:

- a) Chemical Hardener: Colorless aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, containing not less than 2 lbs. of fluosilicates per gal.

- Products: Subject to compliance with requirements, provide one of the following:

"Surfhard"; Euclid Chemical Co.  
"Lapidolith"; Sonneborn-Contech  
"Saniseal"; Master Builders  
"Burk-O-Lith"; The Burke Co.

- b) Moisture-Retaining Cover: One of the following, complying with ASTM C171. Waterproof paper, Polyethylene film, or Polyethylene-coated burlap

### **E. PROPORTIONING AND DESIGN OF MIXES**

#### 1. Design Mixes

- a) Design mixes to provide normal weight concrete with the following properties, as indicated on drawings and schedules:

- 4000 psi 28-day compressive strength; W/C ratio, 0.50 maximum (non-air-entrained), 0.45 maximum (air-entrained).

- b) Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; and as accepted by MSC. Laboratory test data for revised mix design and strength results must be submitted to and accepted by MSC or its consulting engineer before using in work.

#### 2. Admixtures:

- a) Use water-reducing admixture in concrete as required for placement and workability.
- b) Use air-entraining admixture in exterior exposed concrete and all floor slabs, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air

content with a tolerance of plus-or-minus 1-1/2% within the limits of 2% to 4% air.

- c) Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.

### 3. Mix Proportioning:

- a) Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (WC) ratios as follows:

- Subjected to freezing and thawing; WC 0.50.
- Subjected to deicers/watertight; WC 0.45.

### 4. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

- a) Slabs: Not more than 3".
- b) Reinforced foundation systems: Not less than 1" and not more than 3".
- c) Other concrete: Not more than 4".

## F. CONCRETE MIXES

### 1. Ready-Mix Concrete: Comply with requirements of ASTM C94, and as herein specified.

- a) During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required.
- b) When air temperature is between 85°F (30°C) and 90°F (32°C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90°F (32°C), reduce mixing and delivery time to 60 minutes.

## G. EXECUTION

### 1. Forms

- a) Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position.
- b) Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.

- c) Construct forms to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.
- d) Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
- e) Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
- f) Form Ties: Factory-fabricated, adjustable-length, removable or snapoff metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal.
  - Unless otherwise indicated, provide ties so portion remaining within concrete after removal is 1" inside concrete and will not leave holes larger than 1" diameter in concrete surface.
- g) Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.
- h) Cleaning and Tightening: Thoroughly clean forms and adjacent surface to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms and bracing after concrete placement is required to eliminate mortar leaks and maintain proper alignment.

## **H. PLACING REINFORCEMENT**

1. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
2. Clean reinforcement of loose rust and mill scale, earth, ice and other materials which reduce or destroy bond with concrete.

3. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.
4. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

## **I. JOINTS**

1. Construction Joints: Locate and install construction joints as indicated.

## **J. INSTALLATION OF EMBEDDED ITEMS**

1. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto.
2. Pipe Sleeves: Where piping as specified on drawings is required to pass through concrete construction, the plumbing contractor shall furnish a sleeve to the General Contractor for inclusion in the concrete work.  
**Standard for pipe sleeves to foundations- Jay and Ryan**

## **K. CONCRETE PLACEMENT**

1. Preplacement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.
2. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.
3. General: Comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete", and as herein specified.
  - a) Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which is hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.
4. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

5. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI recommended practices.
6. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
7. Maintain reinforcing in proper position during concrete placement operations.
8. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.
9. When air temperature has fallen to or expected to fall below 40°F (4°C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F (10°C), and not more than 80°F (27°C) at point of placement.
10. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
11. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.
12. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
13. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F (32°C). Mixing water may be chilled or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
14. Fog spray forms, reinforcing steel and subgrade just before concrete is placed.
15. Use water-reducing retarding admixture (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.

#### **L. FINISHES FOR EXTERIOR EXPOSED CONCRETE SURFACE**

1. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete slabs.
  - a) Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

## **M. CONCRETE CURING AND PROTECTION**

1. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
2. All buttresses shall cure for a minimum of 24 hours prior to backfilling or pressure testing.

## **N. REMOVAL OF FORMS**

1. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50°F (10°C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

## **O. MISCELLANEOUS CONCRETE ITEMS**

1. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.
2. Reinforced Masonry: Provide concrete grout for reinforced masonry lintels and bond beams where indicated on drawings and as scheduled. Maintain accurate location of reinforcing steel during concrete placement.

## **P. CONCRETE SURFACE REPAIRS**

1. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to MSC.
2. Cut out honeycomb, rock pockets, voids over 1/4" in any dimension, and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.
3. Perform structural repairs with prior approval of MSC for method and procedure, using specified epoxy adhesive and mortar.
4. Repair methods not specified above may be used, subject to acceptance of MSC.

## **Q. QUALITY CONTROL TESTING DURING CONSTRUCTION**

1. The Contractor shall employ a testing laboratory to perform tests and to submit test reports, as directed by MSC.

2. Test results will be reported in writing to MSC and Contractor within 24 hours that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.
3. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
4. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by MSC. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed. Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

## Section XVIII- PRE-CAST CONCRETE STRUCTURES

### **A. WORK SPECIFIED HEREIN: PRECAST CONCRETE STRUCTURES**

1. Products
  - a) Water
  - b) Cement
  - c) Aggregates
  - d) Reinforcing
  - e) Welded Wire Fabric
  - f) Rubber Gaskets

### **B. DEFINITIONS**

1. ASTM - American Society for Testing Materials.
2. AASHO - American Association of State Highway Officials.
3. AEI - American Concrete Institute
4. PCI - Pre-Cast Concrete Institute

### **C. QUALITY ASSURANCE**

1. Testing
  - a) Certification from independent testing agency supplied by the manufacturer.
  - b) Cost of Testing: Borne by Contractor.
2. Codes and Standards:
  - a) Except as modified by the requirements specified herein and/or the details shown on the Drawings, all work included in this section shall conform to the applicable provisions of the following codes and standards:
    1. ACI 211.1 - Recommended Practice for Selecting Proportions for Normal and Heavy Weight Concrete.
    2. ACI-304 - Recommended Practice for Measuring, Mixing and Placing Concrete.
    3. ASTM Standards C33, C150, A615.
    4. ACI-318 - Building Code Requirements for Reinforced Concrete.
    5. ACI - 350R Concrete Sanitary Engineering Structures.
    6. PCI MNL-116 PCI MNL 123, PCI MNL 127. Concrete Reinforcing Steel Institute, "Manual of Standard Practices".
    7. The most stringent code govern.

#### **D. STRUCTURAL DESIGN REQUIREMENTS**

1. The Contractor shall address all anticipated loading conditions as indicated on the drawings, as specified herein, and as required by local and state building codes. All load cases shall be considered and the design shall be based on the governing cases which produce the greatest stresses on the structure. Load cases to be addressed include: tanks empty with saturated soil outside, tanks full with saturated soil outside, tanks full with dry soil outside and tanks full with no soil pressure outside.
2. Maximum groundwater elevation shall be assumed to be at finish grade level. Saturated soil shall be assumed to exert a minimum equivalent fluid pressure of 90 p.c.f. onto the structure.
3. All structures shall be designed to resist buoyancy when empty.
4. Effects of all vertical, horizontal and lifting loads anticipated on the finished structure shall be included in the analysis and design. Loading from piping and equipment, snow, H-20 live load shall be included.
5. All structures shall be watertight.
6. Where conditions arise which are not specifically covered by these notes and specifications, the Current Standards of ACI 301, 304, 305, 306, 311, 315, 318, 350, and ASTM C-94 shall govern.
7. Design calculations for the above conditions shall be prepared, signed and sealed by a Registered Professional Engineer, registered in the State of Delaware and submitted to the Owner's Engineer for review.

#### **E. SUBMITTALS**

1. Submit design calculations and shop drawings indicating fabrication details, reinforcement, connection details, support items, member cross-sections and dimensions, gaskets, openings, size and type of reinforcement and lifting devices, and signed and sealed by a Professional Engineer licensed in the State of Delaware.
2. Indicate design loads, deflections, cambers, bearing requirements and special conditions.
3. Submit product data indicating standard component configurations, design loads, deflections, cambers, and bearing requirements.
4. Submit data on proposed use of any admixtures.
5. Submit fabricator's installation instructions.
6. Submit design data reports indicating calculations for loadings and stresses of fabricated, designed framing.

## **F. QUALIFICATIONS**

1. Fabricator: Company specializing in manufacturing the work of this Section with minimum three years documented experience. A.C. Miller; Rotondo Penn Cast. Terre Hill Concrete Products or approved equal.
2. Fabricator must be producer/member of the Prestressed Concrete Institute (PCI) and/or participate in its Plant Certification Program.

## **G. DELIVERY, STORAGE AND HANDLING**

1. Deliver products to site at such times to assure continuity of installation.
2. Handle precast members in position consistent with their shape and design. Lift and support only from support points.
3. Lifting or Handling Devices: Capable of supporting member in positions anticipated during manufacture, storage, transportation, erection.
4. Protect members to prevent staining, cracking, chipping, spalling, or other physical damage of concrete.
5. Mark each member with date of production and final position in structure.

## **H. MATERIALS**

1. Water: Clean and free of organic materials, strong acids or alkalis, oils and salt.
2. Portland Cement ASTM-C150, Type I. American manufacture. One (1) brand used throughout project.
3. Sand: (Fine aggregate) shall be clean, sharp, coarse, (minimum fines) hard, natural sand free from salt, loam, clay and other deleterious materials and shall conform to ASTM Specification C33 or C330.
4. Coarse Aggregate: Shall be well graded, washed gravel or crushed stone and shall conform to ASTM Specification C33 for normal weight aggregate.
5. Reinforcing Steel: Reinforcing bars shall be deformed high strength bars conforming to ASTM A615, Grade 40 or Grade 60.
6. Welded Wire Fabric: Shall conform to ASTM A-185-73 Standard Specifications for Welded Steel Wire Fabric for Concrete Reinforcement.
7. Admixtures: No admixture shall be used without written approval of the MSC.
8. Forms: Wood, metal, or fiber type.
9. Curing Materials: Waterproof paper, mats, burlap or polyethylene film.

10. Gaskets: Rubber or neoprene.

#### **I. CONCRETE STRENGTH**

1. Minimum ultimate compressive strength of the concrete at age 28 days shall be 5000 pounds per square inch. Slump shall not exceed 4".

#### **J. REINFORCEMENT**

1. Before placing, clean rust mill scale or coating, including ice, that would destroy or reduce bond, from surface.
2. Reinforcement shall not be bent or straightened in a manner injurious to the material.
3. Splices at maximum stress not permitted. Laps and splices shall be of adequate length to transmit stresses. Splices in adjacent bars shall be staggered.
4. Wire reinforcement shall be cut and supported at proper elevations by standard accessories.

#### **K. CONCRETE**

1. If requested by the MSC, certificates shall be furnished to the MSC showing that the concrete and reinforcement complies with tests and samples of applicable specifications.
2. Forms used shall be clean and free from shavings, debris and frost, and thoroughly wetted except in freezing weather, or oiled before placing concrete.
3. Care shall be exercised to prevent honey-combing or segregation of the ingredients of the concrete.

#### **L. CURING**

1. For purposes of early re-use of forms, the concrete may be steam cured after an initial set has taken place. The steam temperature shall not exceed 160 degrees and the temperature shall be raised from normal ambient temperature at a rate that does not exceed 40 degrees per hour.
2. The steam cured units shall not be removed from the forms until the units are able to withstand sufficient strength and any structural strain that might be applied during the form stripping process.
3. After stripping of forms, further curing by means of water spraying or membrane curing compound may be used. The compound shall conform to ASTM C309.

## **M. SEALANTS**

1. All precast concrete structures are to be constructed so as to be totally watertight through the use of rubber or neoprene gaskets or approved caulking or grouting.

## **N. EXAMINATION**

1. Verify that site conditions are ready to receive work and field measurements are as on Drawings.
2. Beginning of installation means installer accepts existing conditions.

## **O. PREPARATIONS**

1. Prepare support equipment for the erection procedure, temporary shoring and bracing, and induced loads during erection.

## **P. INSTALLATION**

1. Install precast units according to manufacturer's recommendations and the Drawings without damage to structural capacity, shape, or finish. Replace or repair damaged members.
2. Align and maintain uniform horizontal and vertical joints, as erection progresses.
3. Maintain temporary bracing in place until final support is provided. Protect members from staining.
4. Grout open spaces at connections and joints. Provide forms or other acceptable method to retain grout in place until sufficiently hard to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, plumb and level with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it hardens.
5. Do not use power-actuated fasteners for surface attachment of accessory items in precast, prestressed unit unless otherwise accepted by precast manufacturer.

## **Q. ERECTION TOLERANCES**

1. Erect members level and plumb within allowable tolerances.
2. Conform to PCI MNL-127.