

CONTRACT DOCUMENTS AND SPECIFICATIONS

FOR THE

**INDIANA DEPARTMENT OF ADMINISTRATION/INDIANA
DEPARTMENT OF NATURAL RESOURCES**

**LINCOLN LAKE DAM REHABILITATION
PROJECT NO. 300DM-74011-09-C1**

NOVEMBER 2024

PREPARED BY



***COMMONWEALTH™
ENGINEERS, INC.***
A wealth of resources to master a common goal.

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APPROVED BY:

Handwritten signature of Dale A. Gick in black ink.

Dale Gick, P.E.
Indiana P.E. No. 10100195

DATE: November 6, 2024

CERTIFIED BY:

Handwritten signature of Breagan P. Eicher in black ink.

Breagan Eicher, P.E.
Indiana P.E. No. 11100676

DATE: November 6, 2024

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PART A
PRE-BID DOCUMENTATION



STATE OF INDIANA

ERIC J. HOLCOMB, Governor

DEPARTMENT OF ADMINISTRATION

Public Works Division
402 West Washington Street, Room W462
Indiana Government Center – South
Indianapolis, Indiana 46204-2746
PHONE: (317) 232-3001

NOTICE TO BIDDERS

BY STATE OF INDIANA DEPARTMENT OF ADMINISTRATION, PUBLIC WORKS DIVISION FOR A PUBLIC WORKS CONSTRUCTION PROJECT ESTIMATED AT ONE HUNDRED FIFTY THOUSAND DOLLARS OR ABOVE

SECURED ELECTRONIC BIDS FOR:

**Public Works Project No. 300DM-74011-09-C1
Lincoln Lake Dam Rehabilitation
Lincoln State Park, Spencer County, Indiana**

will be received from Contractors, holding a current Certificate of Qualification, at Department of Administration, Public Works Division Email Bid Box-publicworksbids@idoa.in.gov
(note, do not cc: any other party)

Subject line MUST contain “Bid- 300DM-74011-09-C1; Lincoln Lake Dam Rehabilitation at Lincoln State Park - (Your firm)”

Bid File (PDF) MUST be named-“(Bidding Firm name) Bid-300DM-74011-09-C1; Lincoln Lake Dam Rehabilitation at Lincoln State Park)” and not exceed 9Mb

Until 1:31 P.M (Indianapolis Time), Thursday, December 19th, 2024, after which all bids will be publicly opened and read online in a Microsoft Teams Live Event-2:00 PM. <https://on.in.gov/uqq8p>

Minority Contractors are encouraged to submit bids on this project as a prime contractor or through a prime contractor.

Copies of the detailed Instructions to Bidders and Drawings and/or Specifications dated November, 2024 may be obtained from the office of: <https://www.in.gov/dnr/engineering/bidding/>.

Bids shall be taken from Prime Contractors pre-qualified by the Public Works Certification Board in the following classification(s): 1629.03-Dam and Dike Construction

The Specified construction period is completion by December 31st, 2025. The State of Indiana reserves the right to reject any and all bids.

Project Goal of 7% MBE, 5% WBE and 3% IVOSB. Link: <https://www.in.gov/idoa/mwbe/2494.htm>

Project Manager: Michael J. Mathias

Michael J. Mathias, P.E. Civil Engineer DAPW (317) 234-8968 mmathias1@idoa.in.gov

Director of Public Works: Robert Grossman

Robert Grossman, Director

Pre-Bid Information: Pre-Bid **MANDATORY** meeting will be held on Friday, December 6th, 2024 at 10:00 AM (EST) at the Lincoln State Park(Dining Hall at Nature Center) 15476 CR 300 E Lincoln City, IN 47552.

INSTRUCTIONS TO BIDDERS

PROJECT ESTIMATED BY DEPARTMENT OF ADMINISTRATION, PUBLIC WORKS DIVISION
TO BE BID AT ONE HUNDRED FIFTY THOUSAND DOLLARS (\$150,000) AND ABOVE

01 GENERAL

- A. This project is estimated by the Public Works Division, Indiana Department of Administration (the Owner), as stated in the Notice to Bidders, at One Hundred Fifty Thousand Dollars (\$150,000) and above.
- B. QUALIFICATION BY THE CERTIFICATION BOARD IS REQUIRED FOR THIS PROJECT PRIOR TO BID OPENING DATE. For information and procedure contact Executive Secretary, Certification Board, Indiana Department of Administration, 402 W. Washington St., Room W462, Indianapolis, Indiana 46204, E-mail: _____ or phone (317) 232-3005.

02 PROJECT NUMBER, DESCRIPTION AND LOCATION is as stated in the Notice to Bidders.

03 TITLE AND DEFINITIONS

Said building and/or land upon which it stands is the property of the State of Indiana. All references to the title owner of said property hereinafter will be by the term "State" and all references to the person, firm, or corporation awarded the contract for the project will be by the term "Contractor". All references to Designer shall refer to the consulting person or firm employed to contract with the Public Works Division, Indiana Department of Administration to provide architectural, engineering or other consulting services for the project, or to the Public Works Division. The preparation and issuance of contracts for this project are the responsibility of the Commissioner of the Indiana Department of Administration acting with approval of the Governor.

Contract: A written agreement between two or more parties enforceable by law.

Contractor: A person who has entered into or seeks to enter into a contract with Public Works Division.

Prime Contractor: A person or business which is primarily responsible for providing goods and service or performing a specific service, etc. under contract. A prime contractor can also be a Minority Business Enterprise, a Women's Business Enterprise or an Indiana Veteran Owned Small Business Enterprise.

Subcontractor: A person or a business who has a direct contract with a prime contractor who is under contract to provide goods and services or perform a specific service.

Joint Venture: An association of two or more businesses to carry out a single business enterprise for profit for which purpose they combine their property, capital, efforts, skills and knowledge.

Manufacturer: A supplier that produces goods from raw materials or substantially alters them before resale.

Minority Business Enterprise (MBE) and Women's Business Enterprise (WBE): A business concern which is certified as at least fifty-one percent (51%) owned and controlled by one or more of the individuals classified as a minority group which includes: African Americans, Hispanic Americans, Native Americans, Hispanic Americans, Asian Americans, and other racial minority groups as defined by 13 CFR 124.103, or at least fifty-one percent (51%) owned and controlled by a woman or women.

Supplier: Any person or entity engaged to furnish goods, materials and/or equipment, but no on-site labor, is capable of furnishing such goods, materials and/or equipment either directly from its own stock or by ordering materials and/or equipment directly from a manufacturer, and is engaged to furnish such goods, materials and/or equipment directly to a prime contractor or one of its subcontractors.

Indiana Veteran Owned Small Business Enterprise (IVOSB): means an Indiana small business enterprise which is certified as at least fifty-one percent (51%) owned and controlled by a veteran.

04 PRE-BIDDING, BIDDING AND POST BIDDING REQUIREMENTS

- A. The Director, Public Works Division, will authorize the Designer to issue bidding documents, construction documents and addenda to bidders.
- B. It is recommended that all Bidders visit the site prior to submitting bid and become thoroughly familiar with the existing site conditions and work to be performed, as indicated in the bidding documents, construction documents and addenda. Extra compensation or extension of time will not be allowed for failure to examine the site prior to bidding.
- C. During the bidding period, should questions arise as to the meaning of any part of the bidding documents, construction documents or addenda that may affect the Bidder, the Bidder shall contact the Designer and/or Public Works Division and

submit a written request for clarification. The Designer and/or Public Works Division will make such clarification only by written Addendum that will be emailed to each document holder or may be obtained at the office of the Designer and/or Public Works Division. By submitting a bid, the Bidder acknowledges procurement of all Addenda. No written request for clarification will be accepted by the Designer and/or Public Works Division later than fourteen (14) calendar days prior to the scheduled bid date.

- D. Bid as described in Contractor's Bid (DAPW 13) shall include Base Bid (in figures and in words) and Alternates as specified in Section entitled Alternates. In verifying bids, word amounts shall have precedence over figure amounts.
- E. Alternate amount(s) shall be listed where indicated. Add Alternates are not to be included in the Base Bid Scope of Work. Deduct Alternates are to be included in the Base Bid Scope of Work. The bid form must be signed. Note that by signing the bid document, the Bidder is acknowledging the procurement of all addenda and is certifying that the bid recognizes all items in all addenda.
- F. A bid by a corporation shall be in the legal name of the corporation followed by the word "by" and the signature of the president. The secretary of the corporation shall sign indicating his/her authority to sign. A Certificate of Corporate Resolution (DAPW 41) is required with and as a part of the bid if anyone other than the president of the corporation is signing bid documents.
- G. *The Form 96A-Questionnaire and Financial Statement is no longer required to be submitted.* The Director, Public Works Division reserves the right to request additional financial information or contractor experience as a basis for rejection of bid or award of contract.
- H. Each Bidder must file with his bid a Non-Collusion Statement (DAPW-121) signed by the same authorized person(s) who signed the bid.
- I. Each Bidder must file with his bid a completely filled in and executed Bid Bond (DAPW 15A) in accordance with IC 4-13.6-7-5. The bid bond penal sum shall be the minimum amount of ten percent (10%) of the bid including all additive alternates.
- J. Each Bidder must file with his bid a completed MBE/WBE/IVOSB Participation Plan (DAPW 26) and Good Faith Effort Work Sheet (DAPW 26 SUP2). Refer to the Supplement to the General Conditions for MBE/WBE/IVOSB Participation Policy (DAPW 26 SUP1) for specific requirements.
- K. Each Bidder must file with his bid, the completed Contractor's Affidavit of Subcontractors Employed (DAPW 12) only if he proposes to perform any work with a subcontract amount of \$150,000.00 or more.
- L. Each bidder must file with his bid an Employee Drug Testing Plan (DAPW 150A) in accordance with IC 4-13-18 or evidence that the contractor is subject to a collective bargaining agreement containing drug testing requirements that comply with IC 4-13-18.
- M. Each Bidder must include his Federal ID number or Social Security number on page 1 of 3 of the Bid Form (DAPW 13). All required bid documents must contain original handwritten signatures.
- N. All documents required by statute, rule or these instructions to be included in the bid must be submitted together in a single email file, plainly marked on the subject line and in the email file with the Name of Bidder, Project Identification, Project Number, Bid Time and Bid Date. Bids shall be rejected if all required documents are not in the single email file.
- O. A Bidder with proper identification may withdraw his bid at any time prior to the scheduled time for receipt of the bids; however, no bid may be withdrawn without written consent of the Director, Public Works Division for a *period of sixty (60) days after the date of the bid opening*, or unless extended in accordance with IC 4-13.6-6-4. Bids received after the designated due time for any reason, shall be rejected and returned unopened to the Bidder. The Director, Public Works Division, reserves the right to reject any or all bids.
- P. Subcontractors whose work will equal or exceed One Hundred Fifty Thousand Dollars (\$150,000.00) must attain a Certificate of Qualification by the Certification Board before commencing any work on this project. Note paragraph 01. (B) above.
- Q. All Bidders (corporations or other business entities) must be in good standing with the Indiana Secretary of State.

05 SIGNATURE AFFIDAVIT

- A. A Signature Affidavit (DAPW 14) containing the Bidder's authorized signature(s), properly notarized, may be submitted as a signature supplement to all other bid documents, except the bid bond, including:
 - 1. Contractor's Bid (DAPW 13)
 - 2. Non-Collusion Statement (DAPW121)
 - 3. Contractor's Affidavit of Subs Employed (DAPW 12)
 - 4. MBE/WBE/IVOSB Participation Plan and Good Faith Effort Worksheet (DAPW 26 SUP 2)

- B. All documents herein before required with the bid may be unsigned if the signature affidavit is submitted, except for the BID BOND. BIDDER MUST SIGN THE BID BOND.

NOTE: SIGNING THE SIGNATURE AFFIDAVIT OR BID FORM IS ACKNOWLEDGMENT OF PROCUREMENT OF ALL ADDENDA AND CERTIFICATION BY BIDDER THAT THE BID RECOGNIZES ALL ITEMS IN ALL ADDENDA.

06 WORK BY CONTRACTOR

The Contractor shall perform a minimum of 15% of the value of work (measured in dollars of the total contract price) with his own forces, and not more than 85% of the value of work is to be subcontracted.

07 SUBSTITUTIONS

The materials, products, systems and equipment described in the bidding documents, construction documents and addenda establish a standard or required function, dimension, appearance and quality that shall also be met by any proposed substitution. No substitution by manufacturer, or trade name of product named, or of a quality specified will be considered unless written request for approval has been submitted by the Bidder and has been received by the Designer and/or Public Works Division at least fourteen (14) calendar days prior to the date for receipt of bids. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. A statement setting forth any changes in other materials, equipment or work that incorporation of the substitute would require shall be included. The burden of proof of the merit of the proposed substitute is upon the proposer. The Designer and/or Public Works Division decision of approval or disapproval of the proposed substitution shall be final. Products, materials or systems not specified or approved prior to bidding, shall not be accepted for use in this project. All such substitutions accepted shall be acknowledged by addendum. See paragraph. 04 (C).

08 NONDISCRIMINATION

Pursuant to IC 22-9-1-10, the Contractor and subcontractors, if any, shall not discriminate against any employee or applicant for employment, to be employed in the performance of this contract, with respect to his hire, tenure, terms, conditions or privileges of employment, or any matter directly or indirectly related to employment, because of his race, religion, color, sex, disability, national origin, or ancestry. Breach of this covenant may be regarded as a material breach of the contract. Pursuant to IC 5-16-6-1, the contractor agrees:

- A. that in the hiring of employees for the performance of work under this contract or any subcontract hereunder, no contractor, or subcontractor, nor any person acting on behalf of such contractor or subcontractor shall, by reason of race, religion, color, sex, disability, national origin or ancestry, discriminate against any citizen of the State of Indiana who is qualified and available to perform the work to which the employment relates; and
- B. that no contractor, subcontractor, nor any person on his behalf shall, in any manner, discriminate against or intimidate any employee hired for the performance of work under this contract on account of race, religion, color, sex, national origin or ancestry; and
- C. that there may be deducted from the amount payable to the contractor by the State of Indiana or by any municipal corporation thereof, under this contract, a penalty of five dollars (\$5.00) for each person for each calendar day during which such person was discriminated against or intimidated in violation of the provisions of the contract; and
- D. that this contract may be canceled or terminated by the State of Indiana or by any municipal corporation thereof, and all money due or to become due hereunder may be forfeited, for a second or any subsequent violation of the terms or conditions of this section of the contract.

09 EMPLOYMENT ELIGIBILITY VERIFICATION

The Contractor affirms under the penalties of perjury that he/she/it does not knowingly employ an unauthorized alien.

The Contractor shall enroll in and verify the work eligibility status of all his/her/its newly hired employees through the E-Verify program as defined in IC 22-5-1.7-3. The Contractor is not required to participate should the E-Verify program cease to exist. Additionally, the Contractor is not required to participate if the Contractor is self-employed and does not employ any employees.

The Contractor shall not knowingly employ or contract with an unauthorized alien. The Contractor shall not retain an employee or contract with a person that the Contractor subsequently learns is an unauthorized alien.

The Contractor shall require his/her/its subcontractors, who perform work under this contract, to certify to the Contractor that the subcontractor does not knowingly employ or contract with an unauthorized alien and that the subcontractor has enrolled and is participating in the E-Verify program. The Contractor agrees to maintain this certification throughout the duration of the term of a contract with a subcontractor.

The State may terminate for default if the Contractor fails to cure a breach of this provision no later than thirty (30) days after being notified by the State.

The contractor shall submit, before work begins the E-Verify case verification number for each individual who is required to be verified under IC 22-5-1.7. An individual who is required to be verified under IC 22-5-1.7 whose final case result is final non-confirmation may not be employed on the public works project.

A contractor may not pay cash to any individual employed by the contractor for work done by the individual on the public works project.

A contractor must follow the federal Fair Labor Standards Act of 1938, as amended (29 U.S.C. 201-209) and IC 22-2-2. A contractor must be in compliance with IC 22-3-5-1 and IC 22-3-7-34. A contractor must be in compliance with IC 22-4-1 through IC 22-4-39.5. A contractor must be in compliance with IC 4-13-18.

10 NOTICE OF AWARD

- A. Prior to execution of the Contract, in accordance with IC 4-13.6-5-2, the Director of Public Works may require additional submittals from Bidder/s to clarify contractor's experience and plans for performing the proposed work. Submittals which may be required include a critical path construction schedule which coordinates all significant tasks sequences and durations; schedule of values, and documentation of efforts to include minority, woman, and veteran owned businesses in the proposed work. The Director may require Bidder/s to provide a comprehensive list of subcontractors and suppliers within 24 hours of receipt of bids.
- B. Prior to execution of the Contract, the successful Bidder shall furnish a completed Domestic Steel Affidavit (DAPW 11) to Public Works Division, Indiana Department of Administration as part of the contract. The Domestic Steel Affidavit is included for Bidder's review but need not be submitted at the time of the bid opening. Definition of Steel Products:
- "Steel products" means products rolled, formed, shaped, drawn, extruded, forged, cast, fabricated, or otherwise similarly processed, or processed by a combination of two (2) or more of such operations, from steel made in the United States by the open hearth, basic oxygen, electric furnace, Bessemer or other steel making process.
- C. Prior to execution of the Contract, the successful Bidder shall furnish a completed Contractor's Bond for Construction (DAPW 15) (combined performance and payment bond) to Public Works Division, Department of Administration as part of the contract. The Bond form is included for Bidder's review but need not be submitted at the time of the bid opening.
- D. Prior to execution of the Contract, the successful Bidder shall furnish a completed Contractor's Certificate of Insurance (DAPW 16) to Public Works Division, Department of Administration as part of the contract. The Insurance form is included for Bidder's review but need not be submitted at the time of the bid opening.
- E. Prior to execution of the Contract, the State of Indiana will issue to the successful Bidder an email letter stating that its bid was the lowest responsible and responsive bid and that the attached electronic format contract document is submitted to Contractor for its consideration. If Contractor finds it in accordance with the bid documents, Contractor will electronically sign the contract within ten (10) calendar days after receipt. Further state agency approvals are required, and Contractor is cautioned that a contract is not binding on the State until it is approved by all signatories required. Failure to execute the proper contract and furnish the ancillary documents shall constitute reason to surrender the bid bond.
- F. Concurrent with execution of the Contract, the successful Bidder may be required to furnish executed copies of Contractor-Subcontractor agreements as required in Article 5 of the General Conditions.

11 SUMMARY

All required bid documents must contain original handwritten signatures. Complete documents to be submitted with this bid:

- A. The Bid Bond (DAPW 15A) must be signed by both the Bidder and Bonding Company. The Bonding Company must also attach a Power of Attorney. Bid bond information, may be on the Bonding Company's standard form.
- B. The Contractor's Bid (DAPW 13)
 - Page 1: State the amount of the bid in figures and words.
 - Page 2: State the amount of the alternate(s), indicate add, deduct or no change (READ CAREFULLY).
 - Page 3: Authorized signature of the Company. If the signature affidavit is completed and submitted with the bid, this page must be submitted but need not be signed or notarized.
- C. The Signature Affidavit (DAPW 14) must contain the completed authorized signatures properly notarized and submitted with the bid as a supplement.

This Signature Affidavit shall fulfill all of the signature requirements. NOTE: The Signature Affidavit does not apply to the Bid Bond (DAPW 15A). The Bid Bond document must be fully completed with all required signatures and submitted with the bid.
- D. The Non-Collusion Statement (DAPW 121) must be signed by the same authorized person(s) who signed the bid documents. If the signature affidavit is completed and submitted with bid, this form shall be submitted, but need not be signed.
- E. For corporations, if anyone other than the president of the corporation signs, a Certificate of Corporate Resolution (DAPW 41) giving signature authority for the signer must be included.
- F. MBE/WBE/IVOSB Participation Plan and MBE/WBE/IVOSB Good Faith Effort Worksheet (DAPW 26 SUP2) must be completed and signed by the same authorized person who signed the bid documents.
- G. The completed Contractor's Affidavit of Subcontractors Employed (DAPW 12) whose subcontract amount will be \$150,000.00 or more.
- H. The completed plan for Contractor's Employee Drug Testing Plan (or statement of collective bargaining agreement).
- I. One copy only of the Bid Documents is required. Bidders may remove and use the Documents included in the project specifications or use reproductions of the Documents.

12 INDIVIDUAL BIDS SHALL BE REJECTED BY THE DIRECTOR, PUBLIC WORKS DIVISION, FOR THE FOLLOWING REASONS (IC 4-13.6-5-2; IC 4-13.6-6-1; 25 IAC 2-6-5)

- A. If the bid email subject line and bid form heading does not clearly identify the project number and description; if the name of the Bidder is not clearly indicated in the email and/or if the email is not received and date stamped within the Public Works Division electronic bid receipt mailbox prior to the stated time for receipt of bids.
- B. If the estimated base bid cost exceeds \$150,000.00 and the bidding contractor is not certified by Public Works Certification Board to offer bids in one of the specified categories.
- C. If the bidding contractor is under suspension by the Director of Public Works or by the Public Works Certification Board.
- D. If the bidding contractor is a trust and does not identify all beneficiaries and empowered settlors of the trust.
- E. If the contractor's drug plan is not included in the bid documents pursuant to and complies with IC 4-13-18.

13 INDIVIDUAL BIDS MAY BE REJECTED BY THE DIRECTOR, PUBLIC WORKS DIVISION, FOR THE FOLLOWING REASONS (25 IAC 2-6-5)

- A. If the Contractor's Bid (DAPW 13), Non-Collusion Statement (DAPW 121), and/or Bid Bond (DAPW 15A) are not signed and notarized as required by these instructions, or the Signature Affidavit (DAPW 14) and the Bid Bond (DAPW 15A) are not signed and notarized as allowed as an alternative.
- B. If all required bid or alternate(s) amounts, or unit prices are not submitted with the bid when specifically called for by the specifications issued for the project.

- C. When the Bidder adds any provision reserving the right to accept or reject the award, or if the Bidder adds conditions or alternates to his bid not requested (voluntary alternates), or if there are unauthorized additions or irregularities of any kind which tend to make the proposal incomplete, indefinite or ambiguous as to its meaning or amount.
- D. When no bids received are under or within funds that can be appropriated, or within the Designer's estimate or when situations develop which make it impossible or not practical to proceed with the proposed work.
- E. If, subsequent to the opening of the bids, facts exist which would disqualify the Bidder, or that such Bidder is not deemed by the Director, Public Works Division, to be responsive or responsible.
- F. If an out-of-state contractor is not registered with the Indiana Secretary of State or if any bidding contractor is not in good standing with the Secretary of State.

PART A
BID DOCUMENTATION

CONTRACTOR'S AFFIDAVIT OF SUBS EMPLOYED

Public Works Project Number: _____ Date: _____

Project Description: _____

Prime Contractor: _____

Form Submitted for Bid: _____ Contract: _____ or Payment No.: _____

The following companies are subcontractors on this project for the amount indicated:

Subcontractor Name	Subcontract For	Subcontract Amount	Revised Amount	DAPW Certified Y/N	MBE WBE	On Site Y/N

_____ being duly sworn upon oath, deposes and says that he is _____ of the firm of _____ and is familiar with the affidavit herewith and that these entries are complete and true.

STATE OF _____ }
 COUNTY OF _____ } SS:

_____ personally appeared before me, a Notary Public, in and for said County and State, this ___ day of _____, 20___, after being duly sworn upon his oath, says that the facts alleged in the foregoing affidavit are true.

My Commission Expires: _____

 NOTARY PUBLIC - SIGNATURE

 NOTARY PUBLIC PRINTED NAME

(SEAL)

GENERAL BID FOR PUBLIC WORKS

CONTRACTOR'S BID

For _____
(Insert class of work)

Project Number _____

Project Description (Title) _____

Date _____

To: Department of Administration, Public Works Division
Room W467
402 West Washington Street
Indianapolis, Indiana 46204

Pursuant to notices given, the undersigned proposes to furnish and install work
in accordance with the construction documents prepared by:

(Designer Name, Address, Telephone)

for the sum of _____
(State amount in words)

_____ \$ _____
(State amount in figures)

If required add attachment for all unit prices called for in the Specifications.

_____ Federal I.D. Number or Social Security Number

Contractor's Email address _____
(Contract and Purchase Order will be sent to email address provided)

Bidder ID Number _____

(If you do not have an Indiana Department of Administration Bidder ID Number, please obtain one online at:
<http://www.in.gov/idoa/2464.htm>)

ALTERNATE BIDS

Add Alternates Are Not to be included as part of the Base Bid Scope of Work.

Deduct Alternates are items of work that Are to be included in the Base Bid Scope of Work, and deducted from the project as described herein.

The work shall be as described in Section, ALTERNATES.

Bidder shall provide a response to each alternate specified. Response must indicate the amount to be ADDED to the base bid, DEDUCTED from the base bid, or that there is NO CHANGE.

Failure to respond to all alternates may cause the bid to be rejected.

BIDDER SHALL CHECK APPLICABLE BOX for each listed alternate.

Alternate No. ___ ADD ___ DEDUCT ___ NO CHANGE ___ AMOUNT \$ _____

Alternate No. ___ ADD ___ DEDUCT ___ NO CHANGE ___ AMOUNT \$ _____

Alternate No. ___ ADD ___ DEDUCT ___ NO CHANGE ___ AMOUNT \$ _____

Alternate No. ___ ADD ___ DEDUCT ___ NO CHANGE ___ AMOUNT \$ _____

Alternate No. ___ ADD ___ DEDUCT ___ NO CHANGE ___ AMOUNT \$ _____

Alternate No. ___ ADD ___ DEDUCT ___ NO CHANGE ___ AMOUNT \$ _____

Ethics Compliance. The Contractor and its agents shall abide by all ethical requirements that apply to persons who have a business relationship with the State, as set forth in Indiana Code § 4-2-6 et seq., the regulations promulgated there under, and Executive Order 04-08, dated April 27, 2004. If the Contractor is not familiar with these ethical requirements, the Contractor should refer any questions to the Indiana State Ethics Commission, or visit the Indiana State Ethics Commission website at <<<<http://www.in.gov/ethics/>>>>. If the Contractor or its agents violate any applicable ethical standards, the State may, in its sole discretion, terminate this contract immediately upon notice to the Contractor. In addition, the Contractor may be subject to penalties under Indiana Code § 4-2-6-12.

Pursuant to IC 22-9-1-10, the Contractor and subcontractors, if any, shall not discriminate against any employee or applicant for employment, to be employed in the performance of this contract, with respect to his hire, tenure, terms, conditions or privileges of employment, or any matter directly or indirectly related to employment, because of his race, religion, color, sex, disability, national origin, or ancestry. Breach of this covenant may be regarded as a material breach of the contract.

IN TESTIMONY WHEREOF, the Bidder (a sole proprietor) has hereunto set his hand
this ___ day of _____, 20__.

Proprietorship (Company Name)

(INDIVIDUAL)

Bidder (Owner)

IN TESTIMONY WHEREOF, the Bidder (a partnership) has hereunto set their hands
this ___ day of _____, 20__.

Company Name

Partner

Partner

IN TESTIMONY WHEREOF, the Bidder (a corporation) has caused this proposal to be signed by its
President or other authorized signatory and Secretary this _____ day of _____, 20__.

Corporation Name

By President or Other Authorized Signatory

Secretary

If the bid is signed by other than the President, a Corporation Resolution designating other authorized signatory shall be submitted with this bid unless already on file with the Certification Board of the Public Works Division.

BY SIGNING THIS BID THE BIDDER ACKNOWLEDGES PROCUREMENT OF ALL ADDENDA AND
CERTIFIES THAT THIS BID RECOGNIZES ALL ITEMS IN ALL ADDENDA.

Indiana Department of Natural Resources
Lincoln Lake State Park
Lincoln Lake Dam Rehabilitation

SUPPLEMENTAL UNIT PRICE

The contractor agrees to accept the following unit prices to adjust the amount of the contract, if actual site conditions or later changes in the design require additional work. These unit prices shall be submitted with the lump sum bid.

1. CONCRETE PATCHING, FULL DEPTH (BASE BID – 150 SF)

\$ _____ / SF

2. MILLING, ASPHALT, 1.5 IN (BASE BID – 1,677 SYS)

\$ _____ / SYS

3. HMA (BASE BID – 160 TON)

\$ _____ / TON

4. POLYURETHANE GROUT (BASE BID – 15,000 LB)
(INSTALLED MATERIAL ONLY – MOBILIZATION IS TO BE INCLUDED IN THE BASE BID)

\$ _____ / LB

Name of bidder: _____

Date: _____

SIGNATURE AFFIDAVIT

PROJECT NO: _____

STATE OF _____ }
 } SS:
COUNTY OF _____ }

Before me, the undersigned notary public, appeared _____ and being duly
(name of bidder)

sworn, on his oath says that he/she is _____
(president, general partner, owner)

of _____, bidder on Project No. _____, and
(name of company)

Affirmed that:

- 1. This bid is submitted in good faith in the amount stated herein, and will be fulfilled according to the Contract Documents (contract, general and supplemental conditions, technical specification, drawings and addenda thereto), if this bid is accepted; and
- 2. The statements are true contained in the Non-Collusion Statement, and as applicable, the Contractor’s Affidavit of Subs Employed and the MBE, WBE and IVOSB Participation Plan and Good Faith Efforts Worksheet.

By: _____
(Signature)

(Printed name)

(Printed or typed name of company)

(must be signed by principal of organization)

STATE OF _____ }
 } SS:
COUNTY OF _____ }

_____ personally appeared before me, a Notary Public, in and for said County and State, this _____ day of _____, 20_____, after being duly sworn upon his oath, says that the facts alleged in the foregoing affidavit are true.

My Commission Expires:

NOTARY PUBLIC – SIGNATURE

NOTARY PUBLIC PRINTED NAME

(SEAL)

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we _____
(Contractor's Name and Address)

as Principal, hereinafter called the Principal, and the _____
(Bonding Company Name)

a corporation duly organized under the laws of the State of _____
as Surety, hereinafter called the Surety, are held and firmly bound unto Public Works Division/Department of
Administration, State of Indiana, as Obligee, hereinafter called the Obligee,

in the sum of _____
for the payment of which sum well and truly to be made, the said Principal and the said Surety, bind ourselves,
our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid for: (insert State Project Number, Description and Location)

Project No. _____

Project Description: _____

Project Location: _____

NOW THEREFORE, if the Obligee shall accept the bid of the Principal and the Principal shall enter into a contract
with the Obligee in accordance with the terms of such bid, and give such bond or bonds as may be specified in the
bidding or contract documents with good and sufficient surety for the faithful performance of such contract and for
the prompt payment of labor and material furnished in the prosecution thereof, or in the event of the failure of the
Principal to enter such contract and give such bond or bonds, if the Principal shall pay to the Obligee the difference
not to exceed the penalty hereof between the amount specified in said bid and such larger amount for which the
Obligee may in good faith contract with another party to perform the work covered by said bid, then this obligation
shall be null and void, otherwise to remain in full force and effect.

Signed and sealed this _____ day of _____, 20____.

(Witness)

(Principal)

By: _____
(Title)

(Surety)

Witness)

(Attorney-in-fact)

Indiana Department of Administration MBE/WBE and IVOSB Participation Policy for Public Works Projects

I. Introduction

The Indiana Department of Administration (“IDOA”) in its commitment to Minority, Women’s and Indiana Veteran Owned Small Business participation in the state’s procurement and contracting process, expects MBE, WBE and IVOSB participation in bids for construction services \$150,000 and over with subcontracting opportunities.

II. Definitions

“Certification for MBE and WBE” means certification by the Indiana Department of Administration, Minority and Women’s Business Enterprises Division. (“MWBED”).

“Certification for IVOSB” means certification by the Indiana Department of Administration.

“Commercially useful function” Determination that an enterprise performs a commercially useful function will be made based on the following considerations:

(1) An MBE or a WBE performs a commercially useful function when it is responsible for execution of the work of the contract and is carrying out its responsibilities by actually performing, managing, and supervising the work involved. To perform a commercially useful function, the MBE or WBE must also be responsible, with respect to materials and supplies used on the contract, for negotiating price, determining quality and quantity, ordering the material, and installing (where applicable) and paying for the material itself. To determine whether an MBE or a WBE is performing a commercially useful function, one must evaluate the following:

- (A) The amount of work subcontracted.
- (B) Industry practices.
- (C) Whether the amount the enterprise is to be paid under the contract is commensurate with the work it is actually performing.
- (D) The credit claimed for its performance of the work.
- (E) Other relevant factors.

(2) An MBE or a WBE does not perform a commercially useful function if its role is limited to that of an extra participant in a transaction, contract, or project through which funds are passed in order to obtain the appearance of MBE or WBE participation. In determining whether an MBE or a WBE is such an extra participant, one must examine similar transactions, particularly those in which MBEs or WBEs do not participate.

(3) In the case of construction contracts, if:

- (A) an MBE or a WBE does not perform or exercise responsibility for at least the agency’s requisite percent of the total cost of its contract with its own workforce; or
- (B) the MBE or WBE subcontracts a greater portion of the work of a contract than would be expected on the basis of normal industry practice for the type of work involved;

it is presumed that the enterprise is not performing a commercially useful function.

(4) IVOSB contractors and suppliers must perform a commercially useful function. A commercially useful function is generally deemed to be when an IVOSB contractor or supplier is responsible for execution of the work of the contract and is carrying out its responsibilities by actually performing, managing, and supervising the work involved. To perform a commercially

useful function, an IVOSB contractor or supplier must also be responsible, with respect to materials and supplies used on the contract, for negotiating price, determining quality and quantity, ordering the material, and installing (where applicable) and paying for the material itself. An IVOSB contractor or supplier does not perform a commercially useful function if its role is limited to that of an extra participant in a transaction, contract, or project through which funds are passed in order to obtain the appearance of IVOSB participation.

“Letter of Commitment” means a letter obtained from the MBE, WBE and IVOSB by the Bidders. The Letter of Commitment is a signed letter(s), on company letterhead, from the minority, women’s and/or Indiana Veteran Owned certified business. It must be produced no later than 24 hours after the bid due date and time. This letter(s) shall state and will serve as acknowledgement from the minority, women and/or Indiana Veteran Owned certified business of their level of participation in this solicitation, the dollar amount of the commitment, the scope of service or product to be provided and the anticipated dates of utilization.

“Minority and Women Business Enterprises Division (MWBED)” means the Division which acts on behalf of the State to actively promote, monitor, and enforce the MBE and WBE program. MWBED is the final authority on all matters pertaining to the maintenance and administration of the MBE and WBE program and compliance thereto.

“Minority Business Enterprise (MBE) and Women’s Business Enterprise (WBE)” means a business concern which is certified as at least fifty-one percent (51%) owned and controlled by a woman or women or one or more of the individuals classified as a minority group which includes: African Americans, Hispanic Americans, Asian Americans, American Indians and other racial minorities. The MBE and WBE must meet the eligibility requirements of 25 IAC 5.

“Indiana Veteran Owned Small Business Enterprise (IVOSB)” means an Indiana business which is certified as at least fifty-one percent (51%) owned and controlled by a veteran.

“Participation Plan” means the IDOA prescribed document that sets forth the MBE, WBE and IVOSB subcontractors that will perform work under the contract.

III. Minority and Women Business Enterprise Certification

MBE and WBEs must be listed on the IDOA directory of certified firms at the time the bid is submitted to be eligible to meet the contract goals. The bidder should verify that a firm is certified before the bid is submitted.

Questions regarding Certification should be addressed to the following:

Indiana Department of Administration
Minority and Women's Business Enterprises Division
402 West Washington Street, Room W469
Indianapolis, IN 46204
(317) 232-3061
mwbe@idoa.in.gov

IV. Indiana Veteran Owned Small Business Enterprise

IVOSBs must be listed on the IDOA directory of certified firms at the time the bid is submitted to be eligible to meet the contract goals. The bidder should verify that a firm is certified before the bid is submitted.

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Questions regarding Certification should be addressed to the following:

Indiana Department of Administration
402 W. Washington St., Room W478
Indianapolis, IN 46204
(317) 233-1494
Indianaveteranspreference@idoa.in.gov

V. Bidding Process

IDOA will review projects for viable subcontracting opportunities. All projects will be governed by this policy unless otherwise stated.

A representative from MWBED may attend most pre-bid meetings to discuss and answer questions related to the MBE, WBE and IVOSB participation goals. The MWBED will be available to assist Bidders in locating MBE, WBE or IVOSB firms to engage in the contract.

The 2018-2019 Contract Goals for construction projects are 7% for MBE's, 5% for WBE's and 3% for IVOSBs.

The following procedures will be implemented in the acceptance and evaluation of responsive and responsible bids.

Bidders are expected to submit a Participation Plan on the approved form listing the utilization of MBE, WBE and IVOSB subcontractors who will be providing a commercially useful function on the project and a Letter of Commitment from MBE, WBE and IVOSB firms they plan to engage in the contract, if successful on the bid.

By submission of a bid, a bidder thereby acknowledges and agrees to be bound by the regulatory process set forth in 25 IAC 5.

A bidder who knowingly or intentionally misrepresents the truth about either the status of a firm that is being proposed as an MBE and WBE or who misrepresents the level of the nature of the amount to be subcontracted to the MBE and WBE may suffer penalties pursuant to Indiana Code 5-16-6.5-5.

A Contractor who knowingly or intentionally misrepresents the truth about his/her status as an MBE and WBE or who misrepresents the level or the nature of the amount subcontracted to his/her firm may suffer penalties pursuant to Indiana Code 35-44.1-2-1.

VI. Compliance

Contractors shall contract with all MBE, WBE and IVOSB firms listed on the Participation Plan. The subcontract or purchase order shall be for an amount that is equal to, or greater than, the total dollar amount listed on the form.

Contractors shall notify MWBED immediately if any firm listed on the Participation Plan refuses to enter into a subcontract or fails to perform according to the requirements of the subcontract.

The Contractor's proposed MBE, WBE and IVOSB Contract Goals will become incorporated into and a requirement of the Contract. Contractors shall not substitute, replace or terminate any MBE, WBE and IVOSB firm without prior written authorization from MWBED and the Owner.

Contractors shall cooperate and participate in compliance reviews as determined necessary by MWBED. Contractors shall provide all necessary documentation to show proof of compliance with the requirements as requested by MWBED.

VII. Non Compliance

When a Respondent submits a Minority, Women and Indiana Veteran Owned Business Enterprises Participation Plan in accordance with IC 4-13-16.5, 25 IAC 5 and 25 IAC 9, (the "Plan"), Respondent will be held to those commitments.

After the bid is awarded, and if it is determined by MWBED that the Contractor is not in compliance with its Participation Plan, MWBED will notify the Contractor within ten (10) days after the initial compliance review or the site visit and will identify the deficiencies found and the required corrective action that should be taken to remedy the deficiencies within a specific time period.

If a Contractor is found non-compliant, the Contractor must submit, in writing, a specific commitment, in writing, to correct the deficiencies. The commitment must include the precise action to be taken and the date for completion.

If MWBED determines the Contractor has failed to comply with the provisions of this Participation Program, Contractor's Utilization Statement, 25 IAC 5, or 25 IAC 9, IDOA may impose any or all of the following sanctions:

- a. Withholding payment on the Contract until such time that satisfactory corrective measures are made.
- b. Adjustment to payments due or the permanent withholding of retainages of the Contract.
- c. Suspension or termination of the specific Contract in which the deficiency is known to exist. In the event this sanction is employed, the Contractor will be held liable for any consequential damages arising from the suspension or termination of the Contract, including damages caused as a result of the delay or from increased prices incurred in securing the performance of the balance of the work by other Contractors.
- d. Recommendation to the certification board to revoke the contractor's certification status with the Public Works Division of IDOA. This recommendation may result in the suspension or revocation of the contractor's ability to perform on future state contracts for a period no longer than thirty-six (36) months.
- e. Continued non-compliance may be deemed a material breach of the agreement between MWBED and Contractor, whereupon MWBED shall have all the rights and remedies available to it under the Contract or at law.
- f. Suspension, revocation, or denial of the MBE, WBE or IVOSB certification and eligibility to participate in the MBE, WBE or IVOSB program for a period of not more than thirty-six (36) months.

VIII. Forms and Attachments

Minority, Women's and Indiana Veteran Owned Business Enterprises Participation Plan

I. MINORITY, WOMEN’S AND INDIANA VETERAN OWNED BUSINESS ENTERPRISES PARTICIPATION PLAN

When a Respondent submits a Minority, Women's and Indiana Veteran Owned Business Enterprises Participation Plan in accordance with IC 4-13-16.5, 25 IAC 5 and 25 IAC 9, (the “Plan”), Respondent will be held to those commitments. The Plan must show that there are, participating in the proposed contract, Minority Business Enterprises (MBE), Women’s Business Enterprises (WBE), and Indiana Veteran Owned Small Business Enterprises (IVOSB) listed in the Minority and Women’s Business Enterprises Division (MWBED) directory and the IVOSB directory of certified firms. Respondents must indicate the name of the MBE, WBE and IVOSB with which it will work, the contact name and phone number at the firm(s), the service supplied by the firm(s), the specific dollar amount from this contract that will be directed toward each firm, and the approximate date these products and/or services will be utilized. If participation is met through use of vendors who supply products and/or services, the Respondent must also indicate the vendor’s tax ID number as well as provide a description of products and/or services provided to the Respondent that are directly related to this proposal and the cost of direct supplies for this proposal. All prime contractors, including MBE, WBE and IVOSB prime contractors, are expected to meet the contract goals through use of subcontractors.

The Indiana Department of Administration (“IDOA”) in its commitment to Minority, Women’s and Indiana Veteran Owned Small Business participation in the state’s procurement and contracting process, expects MBE, WBE and IVOSB participation in bids for public works projects with subcontracting opportunities. The Department reserves the right to verify all information included in the Plan.

Respondents may contact MWBED if they have any questions regarding their Participation Plan. A complete list of all currently certified MBE’s and WBE’s is located at this link: <http://www.in.gov/idoa/mwbe/2743.htm>. The complete list of certified IVOSBs can be found at this link http://www.in.gov/idoa/files/ivbe_certification_list.xls.

Minority, Women’s and Indiana Veteran Owned Business Enterprises Participation Letter of Commitment

A signed letter(s), on company letterhead, from the MBE, WBE and/or IVOSB must accompany the Plan. This letter(s) shall state and will serve as acknowledgement from the MBE, WBE and/or IVOSB of its amount of participation, the scope of products and/or services, and approximate date these products and/or services will be utilized.

By submission of the Proposal, the Respondent acknowledges and agrees to be bound by the regulatory processes involving the State’s MBE, WBE and IVOSB Programs. Questions involving the regulations governing the Plan should be directed to MWBED’s Compliance Unit at 317/232-3061 or to IDOA at 317-233-1494.

MBE/WBE and IVOSB PARTICIPATION PLAN

RFP # / Bid # / Quote # _____ DUE DATE _____

(Circle One)

RFP / BID / QUOTE NAME _____

(Circle One)

RESPONDENT _____

ADDRESS _____

CITY/STATE/ZIP _____

PHONE () _____

The following MBEs and/or WBEs listed in the MWBED directory will be participating in the contract:

MBE/WBE PHONE COMPANY NAME SCOPE OF PRODUCTS/SERVICES UTILIZATION DATE AMOUNT

The following IVOSBs listed in the IVOSB directory will be participating in the contract:

IVOSB PHONE COMPANY NAME SCOPE OF PRODUCTS/SERVICES UTILIZATION DATE AMOUNT

***If additional room is necessary, indicate here _____ . Please attach a separate page.**

**Indiana Department of Administration
Public Works and State Office Building Commission
GOOD FAITH EFFORTS WORKSHEET**

BIDDER _____ BID/PROJECT NUMBER _____

CONTRACT GOALS 7% MBE 5% WBE

List the M/WBEs contacted and complete the following information for each. Copies of all communications to and from each vendor should be maintained.

Company Name and Address	MBE	WBE	Type of Contact	Date of Contact	Date Response Due	Goods Or Services Requested	Result (Include Price Quote)

Indicate **Good Faith Efforts** made to utilize MWBEs. Check and explain all that apply or should be considered. Please provide evidence of the efforts that you want to be considered. A complete description of each criteria may be found in the **Indiana Department of Administration Public Works and State Office Building Commission MWBE Participation Policy**.

MBE and WBE Barrier Assistance	Describe
Advertisement	Describe
Agency Assistance	Describe
Other Criteria	Describe

CERTIFICATE OF CORPORATE RESOLUTION

I, _____, do hereby certify that I am the Secretary
Type Name
of _____, a corporation duly organized and
existing under and by virtue of the Laws of the State of Indiana;

I further certify that a regular/special meeting of the members of the Board of Directors of said corporation, duly called held and convened in conformity with the Charter and By Laws of said corporation, on the __day of _____, 20__, a quorum being present and voting thereon, the following resolution was duly adopted, to-wit:

I further certify that the foregoing resolution is a full, true, and complete copy as the same appears on record in the Minute Record Book of said corporation of which I am the legal custodian; that the same has not been altered, amended or repealed and is now in full force and effect.

In Witness Whereof, I have hereunto set my hand for said corporation this _____ day of _____, 20_____.

By: _____
(Signature)

(must be signed by principal of organization)
STATE OF }
 } SS:
COUNTY OF }

_____ personally appeared before me, a Notary Public, in and for said County and State, this _____ day of _____, 20__, after being duly sworn upon his oath, says that the facts alleged in the foregoing affidavit are true.

My Commission Expires:

(SEAL)

NOTARY PUBLIC - SIGNATURE

NOTARY PUBLIC PRINTED NAME

NON-COLLUSION STATEMENT

The undersigned attests, subject to the penalties for perjury, that the undersigned is the Contractor, or that the undersigned is the properly authorized representative, agent, member or officer of the Contractor. Further, to the undersigned's knowledge, neither the undersigned nor any other member, employee, representative, agent or officer of the Contractor, directly or indirectly, has entered into or been offered any sum of money or other consideration for the execution of this Contract other than that which appears upon the face hereof. **Furthermore, if the undersigned has knowledge that a state officer, employee, or special state appointee, as those terms are defined in IC 4-2-6-1, has a financial interest in the Contract, the Contractor attests to compliance with the disclosure requirements in IC 4-2-6-10.5.**

Signature

Printed Name

Title

Company

Date



STATE OF INDIANA DRUG-FREE WORKPLACE CERTIFICATION

State Form 44260 (R2 / 12-22)

Pursuant to Executive Order No. 90-5, April 12, 1990, issued by Governor Evan Bayh, the Indiana Department of Administration requires the inclusion of this certification in all contracts with and grants from the State of Indiana in excess of \$25,000. No award of a contract or grant shall be made, and no contract, purchase order or agreement, the total amount of which exceeds \$25,000, shall be valid unless and until this certification has been fully executed by the Contractor or Grantee and attached to the contract or agreement as part of the contract documents. False certification or violation of the certification may result in sanctions including, but not limited to, suspension of contract payments, termination of the contract or agreement and/or debarment of contracting opportunities with the State for up to three (3) years.

The Contractor/Grantee certifies and agrees that it will provide a drug-free workplace by:

(a) Publishing and providing to all of its employees a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession or use of a controlled substance is prohibited in the Contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition; and

(b) Establishing a drug-free awareness program to inform employees about (1) the dangers of drug abuse in the workplace; (2) the Contractor's policy of maintaining a drug-free workplace; (3) any available drug counseling, rehabilitation, and employee assistance programs; and (4) the penalties that may be imposed upon an employee for drug abuse violations occurring in the workplace;

(c) Notifying all employees in the statement required by subparagraph (a) above that as a condition of continued employment the employee will (1) abide by the terms of the statement; and (2) notify the employer of any criminal drug statute conviction for a violation occurring in the workplace no later than five (5) days after such conviction;

(d) Notifying in writing the contracting State Agency and the Indiana Department of Administration within ten (10) days after receiving notice from an employee under subdivision (c) (2) above, or otherwise receiving actual notice of such conviction;

(e) Within thirty (30) days after receiving notice under subdivision (c) (2) above of a conviction, imposing the following sanctions or remedial measures on any employee who is convicted of drug abuse violations occurring in the workplace: (1) take appropriate personnel action against the employee, up to and including termination; or (2) require such employee to satisfactorily participate in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State or local health, law enforcement, or other appropriate agency; and

(f) Making a good faith effort to maintain a drug-free workplace through the implementation of subparagraphs (a) through (e) above.

THE UNDERSIGNED AFFIRMS, UNDER PENALTIES OF PERJURY, THAT HE OR SHE IS AUTHORIZED TO EXECUTE THIS CERTIFICATION ON BEHALF OF THE DESIGNATED ORGANIZATION.

THE UNDERSIGNED ALSO AGREES THAT BY TYPING THEIR NAME ONTO THIS FORM, THEY AGREE TO THE USE OF THEIR DIGITAL NAME AS A LEGAL SIGNATURE

Printed Name of Organization

Contract/Grant ID Number

Authorized Representative

Date

Title

CONTRACTOR'S EMPLOYEE DRUG TESTING

IC 4-13-18 Chapter 18. Drug Testing of Employees of Public Works Contractors

4-13-18-1	Applicability
4-13-18-2	"Bid"
4-13-18-3	"Contractor"
4-13-18-4	"Public works contract"
4-13-18-5	Employee drug testing plan required in bid; collective bargaining agreements
4-13-18-6	Employee drug testing program requirements
4-13-18-7	Contract cancellation for noncompliance

IC 4-13-18-1 Applicability

Sec. 1. This chapter applies only to a public works contract awarded after June 30, 2006.

As added by P.L.160-2006, SEC.2.

IC 4-13-18-2 "Bid"

Sec. 2. As used in this chapter, "bid" includes a quotation.

As added by P.L.160-2006, SEC.2.

IC 4-13-18-3 "Contractor"

Sec. 3. (a) As used in this chapter, "contractor" refers to a person who:

- (1) submits a bid to do work under a public works contract; or
- (2) does any work under a public works contract.

(b) The term includes a subcontractor of a contractor.

As added by P.L.160-2006, SEC.2.

IC 4-13-18-4 "Public works contract"

Sec. 4. As used in this chapter, "public works contract" refers to:

- (1) a public works contract covered by [IC 4-13.6](#);
- (2) a public works contract covered by [IC 5-16](#) and entered into by a state agency; or
- (3) a state highway contract covered by [IC 8-23-9](#);
- (4) a public works contract covered by [IC 36-1-12](#);

when the estimated cost of the public works project is one hundred fifty thousand dollars (\$150,000) or more.

As added by P.L.160-2006, SEC.2. Amended by P.L.72-2018, SEC.10.

**IC 4-13-18-5 Employee drug testing plan required in bid;
collective bargaining agreements**

Sec. 5. (a) A solicitation for a public works contract must require each contractor that submits a bid for the work to submit with the bid a written plan for a program to test the contractor's employees for drugs.

- (b) A public works contract may not be awarded to a contractor whose bid does not include a written plan for an employee drug testing program that complies with this chapter.
- (c) A contractor that is subject to a collective bargaining agreement shall be treated as having an employee drug testing program that complies with this chapter if the collective bargaining agreement establishes an employee drug testing program that includes the following:
- (1) The program provides for the random testing of the contractor's employees.
 - (2) The program contains a five (5) drug panel that tests for the substances identified in section 6(a)(3) of this chapter.
 - (3) The program imposes disciplinary measures on an employee who fails a drug test. The disciplinary measures must include at a minimum, all the following:
 - (A) The employee is subject to suspension or immediate termination.
 - (B) The employee is not eligible for reinstatement until the employee tests negative on a five (5) drug panel test certified by a medical review officer.
 - (C) The employee is subject to unscheduled sporadic testing for at least one (1) year after reinstatement.
 - (D) The employee successfully completes a rehabilitation program recommended by a substance abuse professional if the employee fails more than one (1) drug test.

A copy of the relevant part of the collective bargaining agreement constitutes a written plan under this section.

As added by P.L.160-2006, SEC.2.

IC 4-13-18-6 Employee drug testing program requirements

Sec. 6. (a) A contractor's employee drug testing program must satisfy all of the following:

- (1) Each of the contractor's employees must be subject to a drug test at least one (1) time each year.
- (2) Subject to subdivision (1), the contractor's employees must be tested randomly. At least two percent (2%) of the contractor's employees must be randomly selected each month for testing.
- (3) The program must contain at least a five (5) drug panel that tests for the following:
 - (A) Amphetamines.
 - (B) Cocaine.
 - (C) Opiates (2000 ng/ml).
 - (D) PCP.
 - (E) THC.
- (4) The program must impose progressive discipline on an employee who fails a drug test.

The discipline must have at least the following progression: (A) After the first positive test, an employee must be:

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- (i) suspended from work for thirty (30) days;
 - (ii) directed to a program of treatment or rehabilitation; and
 - (iii) subject to unannounced drug testing for one (1) year, beginning the day the employee returns to work.
- (B) After a second positive test, an employee must be:
- (i) suspended from work for ninety (90) days;
 - (ii) directed to a program of treatment or rehabilitation; and
 - (iii) subject to unannounced drug testing for one (1) year, beginning the day the employee returns to work.
- (C) After a third or subsequent positive test, an employee must be:
- (i) suspended from work for one (1) year;
 - (ii) directed to a program of treatment or rehabilitation; and
 - (iii) subject to unannounced drug testing for one (1) year, beginning the day the employee returns to work.

The program may require dismissal of the employee after any positive drug test or other discipline more severe than is described in this subdivision.

(b) An employer complies with the requirement of subsection (a) to direct an employee to a program of treatment or rehabilitation if the employer does either of the following:

- (1) Advises the employee of any program of treatment or rehabilitation covered by insurance provided by the employer.
- (2) If the employer does not provide insurance that covers drug treatment or rehabilitation programs, the employer advises the employee of agencies known to the employer that provide drug treatment or rehabilitation programs.

As added by P.L.160-2006, SEC.2.

IC 4-13-18-7 Contract cancellation for noncompliance

Sec. 7. (a) The public works contract must provide for the following:

- (1) That the contractor implement the employee drug testing program described in the contractor's plan.
- (2) Cancellation of the contract by the agency awarding the contract if the contractor:
 - (A) fails to implement its employee drug testing program during the term of the contract;
 - (B) fails to provide information regarding implementation of the contractor's employee drug testing program at the request of the agency; or
 - (C) provides to the agency false information regarding the contractor's employee drug testing program.

(b) The provisions of the public works contract relating to cancellation of the contract by the agency awarding the contract apply to cancellation of the public works contract under this section.

As added by P.L.160-2006, SEC.2.

PART A
PRE-CONTRACT
DOCUMENTATION

CONTRACTOR'S BOND FOR CONSTRUCTION

KNOW ALL MEN BY THESE PRESENT, that _____
(Contractor)

_____ of _____
(Address) (City, State)

as principal and _____
(Bonding Company)

(Address) (City, State) (Zip Code)

as surety, are firmly bound unto the State of Indiana in the penal sum of \$_____ Dollars, for the payment of which, well and truly to be made, we bind ourselves, jointly and severally, and our joint and several heirs, executors, administrators and assigns, firmly by these present, this ____ day of _____, 20_____.

THE CONDITIONS OF THE ABOVE OBLIGATION ARE SURE, THAT, WHEREAS the State of Indiana acting by and through the Commissioner, Department of Administration, has entered into a certain written contract dated _____ of _____

(Project Number and Description)

_____ situated in _____
Indiana, in accordance with the construction documents approved and adopted by said Commissioner, Department of Administration, which are made a part of this bond.

NOW THEREFORE, if the said _____
(Contractor)
_____, shall well and faithfully do and perform the same in all respects according to the plans and specifications adopted by said Commissioner, Department of Administration, and according to the time, terms and conditions specified in said contract and incurred by him or any subcontractor in the prosecution of said work, including labor, service and materials furnished, then this obligation shall be void; otherwise to remain in full force, virtue and effect. This bond shall adhere to the requirements of IC 4-13.6-7-6 and IC 4-13.6-7-7.

IN WITNESS WHEREOF, we hereunto set our hands and seals this _____ day
of _____, 20_____.

By: _____ (Seal)
(Contractor)

By: _____ (Seal)
(Bonding Company)

By: _____
(Attorney-in-fact)

CONTRACTOR'S CERTIFICATE OF INSURANCE

This certifies to the addressee shown below that the following described policies, subject to their terms, conditions, and exclusions, have been issued to:

NAME AND ADDRESS OF INSURED: _____

COVERING (show State project number, name and location) _____

ADDRESSEE: **PUBLIC WORKS DIVISION/DEPARTMENT OF ADMINISTRATION** DATE: _____

TYPE OF INSURANCE	POLICY NUMBER	EFFECTIVE DATE	EXPIRATION DATE	LIMITS	
1. General Liability a. Bodily Injury Including Personal Injury				Each Person - Premises and Operations	\$ _____
				Each Person - Elevators	\$ _____
				Each Person - Independent Contractor	\$ _____
				Each Person - Products Completed Including Operations	\$ _____
				Each Person - Contractual	\$ _____
				Each Occurrence -	\$ _____
				Aggregate - Products Completed Including Operations	\$ _____
b. Property Damage				Each Occurrence - Premises and Operations	\$ _____
				Each Occurrence - Elevators	\$ _____
				Each Occurrence - Independent Contractor	\$ _____
				Each Occurrence - Products Completed Including Operations	\$ _____
				Each Occurrence - Contractual	\$ _____
				Aggregate -	\$ _____
				Aggregate - Operations Protective Products and Contractual	\$ _____
2. Automobile Liability a. Bodily Injury b. Property Damage				Each Person	\$ _____
				Each Occurrence	\$ _____
				Each Accident	\$ _____
3. Excess Liability Umbrella					\$ _____
4. a. Workmen s Compensation b. Employer s Liability				Statutory Workmen s Compensation	\$ _____
				One Accident And Aggregate Disease	\$ _____
5. Builder s Risk					\$ _____

UNDER GENERAL LIABILITY POLICY OR POLICIES

	YES	NO
1. Does Property Damage Liability Insurance shown include coverage for XC and U hazards?	_____	_____
2. Is Occurrence Basis Coverage provided under Property Damage Liability?.. _____	_____	_____
3. Is Broad Form Property Damage Coverage provided for this Project?.....	_____	_____
4. Is Personal Injury Coverage included?.....	_____	_____
5. Is coverage provided for Contractual Liability (including <u>indemnification provision</u>) assumed by insured?.....	_____	_____

UNDER AUTOMOBILE LIABILITY POLICY OR POLICIES

1. Does coverage shown above apply to non-owned and hired automobiles?.....	_____	_____
2. Is Occurrence Basis Coverage provided under Property Damage Liability?.. _____	_____	_____

In the event of cancellation, fifteen (15) days written notice shall be given to the party to whom this certificate is addressed.

NAME OF INSURANCE COMPANY

ADDRESS

SIGNATURE OF AUTHORIZED REPRESENTATIVE

PART A
CONTRACT DOCUMENTATION



**INDIANA DEPARTMENT OF ADMINISTRATION
PUBLIC WORKS DIVISION**

GENERAL CONDITIONS

Indiana Department of Administration
Public Works Division
402 W. Washington Street, W462
Indianapolis, Indiana 46204

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STATE OF INDIANA
GENERAL CONDITIONS

ARTICLE 1 CONTRACT DOCUMENTS

1.1 Definitions

1.1.1 Contract Documents

The Contract Documents consist of the Contract, the Instructions to Bidders, the Contractor's Proposal (Bid), the Conditions of the Contract (General and Supplementary), Drawings, Specifications, and Addenda issued prior to bidding, Change Orders, any written interpretation issued as a field order by the Designer pursuant to Article 1.2, and all field orders for minor changes in the Work by the Designer pursuant to Article 12.3.

1.1.2 Contract

The Contract Documents form the Contract for construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes all prior negotiations, representations, or agreements, either written or oral.

1.1.3 Work

All labor, material, equipment, systems and services necessary to produce the result called for in the Contract Documents.

1.1.4 Project

The Project is the total construction project designed by the Designer of which the Work performed under the Contract Documents may be the whole or a part of the whole Project.

1.2 Execution, Correlation, Intent and Interpretations

1.2.1 The Contract Documents shall be signed by the Owner and the Contractor. The signature process may be done electronically at the discretion of the Owner.

1.2.2 By executing the Contract, the Contractor represents that Contractor has visited the site and correlated its observations with the requirements of the Contract Documents and has no major question pertaining thereto.

1.2.3 The Contract Documents are complementary, and what is called for by any one shall be as binding as if called for by all. The intention of the Contract Documents is to include all labor, equipment, supervision and materials, for the proper execution and completion of the Work, and also to include those things that may be reasonably inferable from the Contract Documents as being necessary to produce the intended results. Words that have a well-known technical or trade meaning are used herein, in accordance with such recognized meaning.

1.2.4 Written interpretations necessary for the proper execution of the Work, in the form of drawings or otherwise will be issued with reasonable promptness by the Designer. Such interpretations shall be consistent with and reasonably inferable from the Contract Documents, and may be issued by field order subject to Owner's approval.

1.3 Copies Furnished and Ownership

1.3.1 The Contractor will be furnished 5 copies of drawings and specifications and any other information necessary for the execution of the Work.

1.3.2 All drawings, specifications, and copies thereof furnished by the Designer are the Designer's property. They are not to be used on any other Project, and, with the exception of one Contract set for each party to the Contract, are to be returned on request to the Designer at the completion of the Work.

ARTICLE 2 DESIGNER

2.1 Definition

2.1.1 The Designer is the person or organization identified as Designer of the Project and is referred to throughout the Contract Documents as if singular in number and, in some places, masculine in gender. The terms Designer, Engineer, Architect, (and in certain projects Director, Public Works Division, or his/her authorized representative), shall mean the Designer.

2.2 Administration of the Contract

2.2.1 The Designer will provide general administration of the Contract, including the functions hereinafter described.

2.2.2 Unless stated otherwise, the Designer shall be the Owner's representative during the construction phase. Designer shall have authority to act on behalf of the Owner only to the extent expressly provided in the Contract Documents or otherwise in writing, which will be shown to the Contractor. The Designer will advise and consult with the Owner and all of the Owner's instructions to the Contractor shall be issued through the Designer.

2.2.3 The Designer shall have access to the Work at all times wherever it is in storage, preparation and progress. The Contractor shall provide facilities for such access so that the Designer and Owner's Site Representative may perform their functions under the Contract Documents.

2.2.4 The Designer will make no less than weekly visits to the site when work is in progress to familiarize itself generally with the progress and quality of the Work and to determine in general if the Work is proceeding in accordance with the Contract Documents. Designer will not be required to make exhaustive or continuous on-site inspection to check the quality or quantity of the Work. On the basis of Designer's on-site observations, Designer will keep the Owner informed of the progress of the Work and will endeavor to guard the Owner against defects and deficiencies in the Work of the Contractor.

2.2.5 Based on such observation and the Contractor's applications for payment, the Designer will determine the amount owed to the Contractor and will issue Certificates for Payment in such amounts.

2.2.6 The Designer will be, in the first instance, the interpreter of the requirements of the Contract Documents and the judge of the performance thereunder. Designer will promptly render such interpretations as Designer may deem necessary for the proper execution or progress of the Work.

2.2.7 All interpretations and decisions of the Designer will be consistent with the intent of the Contract Documents. Designer will exercise its best efforts to insure faithful performance by the Contractor.

2.2.8 Claims, disputes and other matters in question relating to the execution or progress of the Work or interpretation of the Contract Documents shall be referred initially to the Designer for decision and be subject to written appeal within fifteen (15) days by the Contractor. The Designer's decision shall be submitted promptly in writing to the Director, Public Works Division, who shall have full authority to render the final and binding decision.

2.2.9 The Designer will have responsibility to recommend to the Owner the rejection of work that does not conform to the Contract Documents. Whenever the Designer considers it necessary or advisable, Designer shall recommend to the Owner the stoppage of the Work or any portion thereof, and to recommend special examination or testing of the Work (whether or not fabricated, installed, or completed).

2.2.10 The Designer will review and approve or take other appropriate action upon the Contractor's submittals such as shop drawings, product data and samples, but only for conformance with the design concept of the Work and with the information given in the Contract Documents. Such action shall be taken with reasonable promptness so as to cause no delay. The Designer's approval of a specific item shall not indicate approval of all assembly of which the item is a component.

2.2.11 The Designer will prepare change orders in accordance with Article 12.

2.2.12 The Designer will conduct reviews to determine the dates of Substantial Completion and Final Completion, will receive and forward to the Owner for the Owner's review written warranties and related documents required by the Contract and assembled by the Contractor, and will issue a final Certificate for Payment upon compliance with the requirements of Article 9.7.

2.2.13 The Designer, together with representatives from the Contractor and the Owner will conduct a review of the Work nine (9) months after the date of substantial completion to determine any work not in compliance with the Contract Documents at that time. A list of items to be corrected or completed will be forwarded to the Contractor for corrective action prior to the expiration of the one year warranty period.

2.2.14 The duties, responsibilities and limitations of authority of the Designer as the Owner's representative during construction as set forth in Articles 1 through 14 of these General Conditions shall not be modified or extended without written consent of the Owner.

2.2.15 The Designer will not be responsible for the acts or omissions of the Contractor, Subcontractor, or any of their superintendents, supervisory staffs, agents or employees, or any other persons performing any of the Work.

2.2.16 In case of the termination of the employment of the Designer, the Owner shall appoint a Designer against whom the Contractor makes no reasonable objections, whose status under the Contract shall be that of Designer.

ARTICLE 3 OWNER**3.1 Definition**

3.1.1 The Owner is the State of Indiana, represented by the Commissioner, Department of Administration, acting through the Director, Public Works Division, and the Director's designated project manager.

3.2 Information and Service Required of the Owner

3.2.1 The Owner will furnish, through the Designer, surveys, describing known physical characteristics, legal limits and utility locations for the property on which the Project is to be erected, if in the Owner's possession.

3.2.2 Information or services under the Owner's control shall be furnished by the Owner with promptness to avoid delay in the orderly progress of the Work.

3.2.3 The Owner shall issue all instructions to the Contractor through the Designer unless specified elsewhere in these documents.

3.2.4 If the Contractor fails to correct defective work as required by Article 13 or persistently fails to carry out the Work in accordance with the Contract Documents, the Owner, by a written order may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of the Owner to stop the Work shall not give rise to any duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Article 6.1.

3.3 Owner's Site Representative

3.3.1 Notwithstanding the obligations of the Designer as Owner's representative during construction, the Owner may employ an on-site representative to observe the progress of the Work.

3.3.2 The Owner's Site Representative shall function as an observer only. Owner's Site Representative shall report his/her findings to the Designer for review and any required further action. The Owner's Site Representative is not authorized to make changes in the Work or to interpret the Contract Documents.

3.3.3 The Owner's Site Representative shall have at all times access to the Work wherever it is in storage, preparation and progress. Owner's Site Representative may attend meetings at the site and he/she may review and approve the Contractor payment requests.

ARTICLE 4 CONTRACTOR**4.1 Definition**

4.1.1 The Contractor is the person or organization identified as such in the Contract. The Contractor is referred to throughout the Contract Documents as if singular in number and, in some places, masculine in gender. The term Contractor means the Contractor or its authorized representative.

4.2 Review of Contract Documents

4.2.1 The Contractor shall carefully study and compare the Contract Documents and shall at once report to the Designer and the Owner any error, inconsistency or omission Contractor may discover. The Contractor shall perform no portion of the Work at any time without Contract Documents or, where required, approved shop drawings, product data or samples for such portion of the Work.

4.3 Supervision and Construction Procedures

4.3.1 The Contractor shall supervise and direct the Work, using its best skill and attention. Contractor shall be solely responsible for the quality of the Work and for all construction techniques, sequences, and procedures, and for coordinating all portions of the Work.

4.3.2 The Contractor shall not be relieved from its obligations to perform the Work in accordance with the Contract Documents either by the activities or duties of the Designer in administration of the Contract, or by inspections, tests or approvals required or performed under Paragraph 7.9 by persons other than the Contractor.

4.4 Labor and Materials

4.4.1 Unless otherwise specified in Division 1, the Contractor shall provide and pay for all labor, material, equipment, tools, construction equipment, machinery, transportation, and other facilities and services necessary for the proper execution of the Work.

4.4.2 Unless otherwise specified in Division 1, the Contractor shall provide and pay for all electric current, water, heat, and

telephone services and shall maintain necessary discipline to prevent waste.

4.4.3 If any item of work shall be the subject of a jurisdictional dispute as to the craft to be used for said work, the Contractor shall aid in such inter-craft resolution and if arbitrated, abide by the decision, holding the Owner free of involvement in the dispute, and if time is lost by the dispute, extra work days will only be considered through the provisions of Article 12.2. Contractor will endeavor to eliminate any embarrassment to the Owner caused by the dispute.

4.4.4 The Contractor shall at all times enforce strict discipline and good order among its employees and shall not employ on the Work any unfit person or any one employee unskilled in the Work assigned or unqualified as a tradesman in the trade involved.

4.5 Warranty and Guarantee

4.5.1 The Contractor warrants and guarantees that all materials and equipment incorporated in the Project shall be new unless otherwise specified, and all work will be of the highest quality, free from faults and defects, and in strict conformance with the Contract Documents for a period of one year from the date of substantial completion. All work not so conforming to the Contract Documents may be considered defective. If required by the Designer, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. The warranties and guarantees provided in this Article and elsewhere in the Contract Documents shall be in addition to and not in limitation of any other warranty or guarantee or remedy called for the Contract Documents or otherwise prescribed by law. The Contractor, together with the Designer and representatives from the Owner, shall review the Work nine (9) months after the date of substantial completion to determine any work not in compliance with the Contract Documents. The Contractor shall correct such non-complying work prior to the expiration of the one year warranty.

4.6 Permits, Fees and Notices

4.6.1 The Contractor shall secure and pay for all permits, fees and licenses necessary for the execution of the Work.

4.6.2 The Contractor and Subcontractors must submit an "Exemption Certificate for Construction Contractors" (Form ST-105) to each supplier in order to obtain exemption from the Indiana Gross Tax (i.e., sales and use tax).

4.6.3 The Contractor shall give all notices and comply with all laws, ordinances, rules, regulations, and orders of any public authority bearing on the conduct of the Work. If Contractor observes that any of the Contract Documents are at variance therewith in any respect, Contractor shall promptly notify the Designer in writing, and any necessary changes shall be adjusted by change order. If Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice to the Designer, Contractor shall bear all cost arising from such non-conformance.

4.7 Cash Allowances

4.7.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. These allowances cover the net cost of the materials and equipment delivered and unloaded at the site which cost shall be determined by the Owner through proper procedures for receiving quotes or bids as required by law. The Contractor's handling costs on the site, labor, installation costs, overhead, profit, and other expenses shall be included in the Contract sum and not in the allowance. The Contractor shall cause the Work required by these allowances to be performed by such persons as the Designer may direct, but Contractor will not be required to employ persons against whom Contractor has a reasonable objection. If the net cost above, when determined, is more than or less than the allowance, the Contract Sum will be adjusted accordingly by change order.

4.8 Superintendent

4.8.1 The Contractor shall keep on the Project, during the entire contract time, a competent superintendent and necessary assistants, all satisfactory to the Designer, and the superintendent shall not be changed, except with the consent of the Owner, unless the superintendent proves to be unsatisfactory to the Contractor and ceases to be in Contractor's employ. The superintendent shall represent the Contractor and shall have full authority to act on its behalf. All communications given the superintendent shall be as binding as if given by the Contractor. Important communications shall be confirmed in writing.

4.9 Responsibility for Those Performing the Work

4.9.1 The Contractor shall be responsible for the quality of the Work, for acts and omissions of all the Subcontractors, their superintendents, their supervisory staffs, agents, or employees and of all other persons performing any of the Work under a Contract with the Contractor.

4.10 Progress Schedule

4.10.1 Unless otherwise indicated in Division 1, the Contractor, immediately after being awarded the Contract, shall prepare and submit for the Designer's approval a progress schedule for the Work in relation to the entire Project. This schedule in bar graph form, or other form approved by the Owner, shall indicate the dates for the starting and completion of the various stages of construction, and in addition, will state the contractual completion date. The contract completion date, based on the construction period stated in the notice to bidders, shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by change order. A more detailed schedule may be required elsewhere in the documents.

4.11 Record Documents at the Site

4.11.1 The Contractor shall maintain for the Owner as part of the Contract one record copy of all drawings, specifications, addenda, shop drawings, change orders and other modifications at the site in good order, and marked to record all changes made during construction. These shall be available to the Designer and the Owner's Site Representative at all times while Work is in progress. All changes made during construction shall be recorded monthly and reviewed by the Designer before approval of each partial progress payment. The record documents shall be submitted to the Designer prior to the Contractor's final payment.

4.12 Shop Drawings and Samples

4.12.1 Shop drawings are all drawings, diagrams, illustrations, schedules, brochures, and other data, which are prepared by the Contractor, or any Subcontractor, manufacturer, supplier, or distributor, and which illustrate the Work.

4.12.2 The Contractor shall submit all shop drawings and samples required by the Contract or by the Designer in a timely manner, allowing sufficient time for the Designer's review so as not to cause any delay in the Work or in work by any other Contractor.

4.12.3 At the time of such submission, the Contractor shall furnish or verify all field measurements, field construction criteria, materials, catalog numbers, and the like and shall individually check, coordinate and stamp with its approval each submission, and shall in writing call the Designer's attention to any deviations in the shop drawings or samples from the requirements of the Contract Documents.

4.12.4 The Designer will check and approve, with reasonable promptness so as to cause no delay, these shop drawings and samples only for conformance with the design concept of the Project, and with the information given in the Contract Documents. The Designer's approval of a separate item will not indicate approval of the assembly in which the item functions.

4.12.5 The Designer's approval of shop drawings or samples shall not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents unless the Contractor has in writing called the Designer's attention to such deviation at the time of submission and the Designer has given written approval to the specific deviation, nor shall this relieve the Contractor from errors or omissions in the shop drawings or samples.

4.12.6 No work requiring a shop drawing or sample submission shall be commenced until the submission has been approved by the Designer. All such work shall be in accordance with approved shop drawings and samples.

4.13 Use of Premises

4.13.1 The Contractor shall confine operations at the site to areas permitted by law, ordinances, permits and the Contract Documents, and shall not unreasonably encumber the premises with any materials or equipment.

4.14 Cutting and Patching

4.14.1 The Contractor shall do all cutting, fitting or patching of its work that may be required to make its several parts come together properly and shall not endanger any work by cutting, excavating, or otherwise altering the Work or any part of it. Costs caused by defective or ill-timed work shall be borne by the party responsible therefore.

4.15 Cleaning Up

4.15.1 The Contractor shall at all times keep the premises free from accumulation of waste materials or rubbish caused by its operations. At the completion of the Work, Contractor shall remove all waste material and rubbish from and about the building as well as all its tools, scaffolding and surplus materials. Contractor shall clean all glass surfaces, lights and fixtures, ceilings, walls and shall leave the Work dusted, swept and wet mopped clean, unless more exactly specified.

4.15.2 In case of dispute the Owner may remove the rubbish and charge the cost to the several Contractors as the Designer shall determine to be just.

ARTICLE 5 SUBCONTRACTORS

5.1 Definition

As used in this article "contractor tier" refers collectively to the following classes of contractors on a public works project:

- (1) "Tier 1 contractor" includes each person that has a contract with the public agency to perform some part of the work on, supply some of the materials for, or supply a service for, a public works project. A person included in this tier is also known as a "prime contractor" or a "general contractor".
- (2) "Tier 2 contractor" includes each person that has a contract with a tier 1 contractor to perform some part of the work on, supply some of the materials for, or supply a service for, a public works project. A person included in this tier is also known as a "subcontractor".
- (3) "Tier 3 contractor" includes each person that has a contract with a tier 2 contractor to perform some part of the work on, supply some of the materials for, or supply a service for, a public works project. A person included in this tier is also known as a "sub-subcontractor".
- (4) "Lower tier contractor" includes each person that has a contract with a tier 3 contractor or lower tier contractor to perform some part of the work on, supply some of the materials for, or supply a service for, a public works project. A person included in this tier is also known as a "lower tier subcontractor".

A Subcontractor is a person or entity who has a direct Contract with the Contractor to perform any of the Work at the site. The term Subcontractor is referred to throughout the Contract Documents as if singular in number and, in some places, masculine in gender and means a Subcontractor or its authorized representative. The term Subcontractor does not include any separate Contractor or its Subcontractors.

5.2 Award of Subcontracts and Other Contracts for Portions of the Work

5.2.1 Unless otherwise required by the Contract, the Contractor shall furnish to the Owner, with its bid on the prescribed form, the names of all persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each of the principal portions of the Work with an installed value of \$150,000.00 or more. The Designer will promptly reply to the Contractor in writing stating whether or not the Owner or the Designer, after due investigation, has reasonable objection to any such proposed person or entity. Failure of the Owner or Designer to reply within fourteen (14) days shall constitute notice of no reasonable objection.

5.2.2 The Contractor shall not subcontract with any such proposed person or entity to which the Owner or the Designer has made reasonable objection. The Contractor shall not be required to subcontract with anyone to whom Contractor has a reasonable objection.

5.2.3 If the Owner or the Designer has reasonable objection to any such proposed person or entity, the Contractor shall submit a substitute to whom the Owner or the Designer has no reasonable objection.

5.2.4 The Contractor shall make no substitution of any Subcontractor, person or entity previously selected, if the Owner or Designer makes reasonable objection to such substitution.

5.2.5 The Contractor and its subcontractors shall employ only licensed plumbers and shall provide to the Owner the names and license numbers of all plumbers engaged in the Work. The Contractor shall submit this documentation with any monthly progress payment request that includes plumbing labor.

5.3 Sub Contractual Relations

5.3.1 By an appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by the terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by these Documents, assumes toward the Owner. Said agreement shall preserve and protect the rights of the Owner under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor the benefit of all rights, remedies and redress against the Contractor that the Contractor, by these Documents, has against the Owner. Provisions of Article 9 for progress payments, retainage and payment for stored material shall be incorporated without modification in all Contractor-Subcontractor agreements. The Contractor shall require each Subcontractor to enter into similar agreements with Subcontractor's Sub-subcontractors. Prior to execution of the Contractor-Subcontractor agreement, the Contractor shall provide all Subcontractors a complete copy of all proposed Contract Documents for the Project to which the Subcontractor will be bound by this Paragraph 5.3. Each Subcontractor shall similarly make available to its Sub-Subcontractors copies of such Documents. Executed copies of all

agreements shall remain on file with the Contractor and be available for review by the Owner at the Owner's discretion.

ARTICLE 6 SEPARATE CONTRACTS

6.1 Owner's Right to Let Separate Contracts

6.1.1 The Owner reserves the right to let other contracts in connection with other portions of the Project under these or similar General Conditions.

6.1.2 When separate contracts are awarded for different portions of the Project, the "Contractor" in the Contract Documents in each case shall be the Contractor who signs each separate contract with the Owner.

6.1.3 When separate contracts are awarded for portions of the Project, the General Construction Contractor shall be responsible for the overall coordination of all separate contracts for the Project.

6.2 Mutual Responsibility of Contractors

6.2.1 The Contractor shall afford each other Contractor reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their work, and each shall properly connect and coordinate its work with all others as coordinated by the General Contractor.

6.2.2 If any part of the Contractor's work depends on proper execution or results upon the work of any other separate Contractor, the Contractor shall inspect and promptly report to the Designer any discrepancies or defects that shall cause its work to fail or be non-conforming. Failure of the Contractor to so inspect and report shall constitute an acceptance of the other Contractor's work as fit and proper for the reception of its work.

6.2.3 Should the Contractor cause damage to any separate Contractor on the Project, the General Contractor agrees, upon due notice, to settle with such other Contractor by agreement, if at all possible, without involving the Owner. The Owner will be involved only after evidence is presented that sureties cannot settle the problem.

6.2.4 Any costs caused by defective or ill-timed work shall be borne by the party responsible.

ARTICLE 7 MISCELLANEOUS PROVISIONS

7.1 Delinquent State Taxes (IC. 4-13-2-14.5). The Public Works Division may allow the Department of State Revenue access to the name of each person who is either:

- (1) Bidding on a Contract to be awarded under this chapter; or
- (2) A Contractor or Subcontractor under this chapter.

If the Public Works Division is notified by the Department of State Revenue that a bidder is on the most recent tax warrant list, a Contract may not be awarded to that bidder until the bidder provides a statement from the Department of State Revenue that the Bidder's delinquent tax liability has been satisfied. The Department of State Revenue may notify:

- (1) The Department of Administration; and
- (2) The Auditor of State;

that a Contractor or Subcontractor under this chapter is on the most recent tax warrant list, including the amount owed in delinquent taxes. The Auditor of State shall deduct from the Contractor's or Subcontractor's payment the amount owed in delinquent taxes. The Auditor of State shall remit this amount to the Department of State Revenue and pay the remaining balance to the Contractor or Subcontractor.

7.2 Choice of Law

7.2.1 The Contract shall be governed by the laws of the State of Indiana.

7.3 Assignment

7.3.1 The Contractor shall not assign the Contract or sublet it as a whole without the written consent of the Owner, nor shall the Contractor assign any monies due or to become due to it hereunder, without the previous written consent of the Owner.

7.4 Written Notice

7.4.1 Written notice shall be deemed to have been duly served if delivered in person to the individual or member of the firm or to an officer of the corporation for whom it was intended, or sent by electronic mail (email), or by registered or certified mail to the last business address known to the person who gives the notice.

7.5 Claims for Damages

7.5.1 Should either party to the Contract suffer injury or damage to person or property because of any act or omission of the other party or any of its employees, agents or others for whose acts the party is legally liable, claim shall be made in writing to such other party within seven (7) days of the first observance of such injury or damage.

7.6 Performance Bond and Labor and Material Payment Bond

7.6.1 For projects advertised with an estimated base bid amount of One Hundred Fifty Thousand Dollars (\$150,000) or more, the Contractor shall furnish and pay for an approved one hundred percent (100%) combination performance and payment bond (Contractor's Bond for Construction, Public Works Division Form DAPW 15). This bond shall adhere to the requirements of IC. 4-13.6-7-6 and IC. 4-13.6-7-7 as amended and shall cover the faithful performance of the Contract and the payment of all obligations arising thereunder, including reimbursement for any stored materials paid for but returned to materialmen, with such sureties as the Owner may approve. The combination bond shall remain in effect throughout the entire construction period and in addition for a period of one year from the date of final acceptance. The Contractor shall deliver the required bonds to the Owner prior to execution of the Contract by the Owner unless authorized to the contrary in writing by the Owner. All bonds must be issued by bonding companies, which are licensed and approved by the Indiana Insurance Commission.

7.7 Owner's Right to Carry Out the Work

7.7.1 If the Contractor should default or neglect to carry out the Work properly or fail to perform any provision of the Contract, the Owner may, after giving seven (7) days written notice to the Contractor, without prejudice to any other remedy it may have, make good such deficiencies. In such case, an appropriate change order shall be issued deducting the cost thereof including the cost of the Designer's additional service made necessary by such default, neglect, or failure of the Contractor, from the payments then or thereafter due the Contractor, provided, however, that the Designer shall approve both such action and the amount charged to the Contractor. If such payments due to the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Owner.

7.8 Royalties and Patents

7.8.1 The Contractor shall pay all royalties and license fees. Contractor shall defend all suits or claims for infringement of any patent rights and shall save the Owner harmless from liability of any nature or kind including costs and expenses for or on account of any patented or unpatented invention, process, article or appliance manufactured or used in the performance of this Contract, including its use by the Owner.

7.9 Tests & Substitution of Materials

7.9.1 If the Contract Documents, laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction require any work to be inspected, tested, or approved, the Contractor will give the Designer timely notice of its readiness and of the date fixed for such inspection, testing, or approval so that the Designer may observe the same. The Contractor shall bear all cost of such inspections, tests, and approvals unless otherwise provided.

7.9.2 If, after the commencement of the Work, the Designer, with approval of the Owner in writing, determines that the Work requires special inspection, testing, or approval for which subparagraph 7.9.1 does not provide, Designer will, upon written authorization from the Owner, order such special inspection, testing or approval. If such special inspection or test reveals a failure of the Work to fulfill the requirements of the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction, the Contractor shall bear all costs thereof; otherwise, the Owner shall bear such costs. An appropriate change order shall be issued.

7.9.3 Required certificates of inspection, testing or approval shall be secured by the Contractor and promptly delivered by Contractor to the Designer.

7.9.4 Observations by the Designer of the inspections, tests, or approvals required by Article 7 will be promptly made, and where practicable at the source of supply at no additional cost to the Owner.

7.9.5 Neither the observations of the Designer in its administration of the Contract, nor inspections, tests or approvals by persons other than the Contractor shall relieve the Contractor from its obligations to perform the Work in accordance with the Contract Documents.

7.9.6 All building construction and work, alterations, repairs, plumbing, mechanical, and electrical installations and appliances connected therewith, shall comply with the Rules and Regulations of the Indiana Department of Homeland Security, the Indiana Department of Health, local ordinances, Rules for Licensure of Building Trades, and other statutory provisions pertaining to this class of work; such rules and regulations and local ordinances to be considered as a part of these specifications.

7.9.7 Where in these specifications, one or more certain materials, trade names, or articles of certain manufacture are mentioned, it is done for the express purpose of establishing a basis of durability and efficiency and not for the purpose of limiting competition. Approval of other acceptable products for those specified may be obtained by requesting to the Designer no later than fourteen (14) days in advance of bid date with all documentation required for the Designer to evaluate any approval. If approval is granted, the subject product will be added by addendum.

7.9.8 Should there be a reason for change of materials after award of the Contract, the following criteria shall apply:

- a. Original material no longer manufactured,
- b. Delivery not possible within time specified for job, and/or
- c. Unavailability due to causes beyond the control of the Contractor.

7.9.9 After agreement by the Designer and the Owner that a change is necessary, the Contractor shall present a request for substitution to the Designer. The burden of proof of the merit of the proposed substitute is upon the proposing party. The decision of the Designer and the Owner regarding the substitution shall be final.

7.10 Certificate of Qualification

7.10.1 In accordance with IC. 4-13.6-4 as amended, all Contractors and Subcontractors performing work for the State of Indiana on projects estimated to be in excess of one hundred fifty thousand dollars (\$150,000.00), must hold a valid Certificate of Qualification issued by the Public Works Certification Board. The Instructions to Bidders define the procedure for certification and bidding.

7.10.2 The Contractor must perform at least fifteen (15) percent of the total Contract Sum of the Work with its own forces. The Contractor shall submit copies of its payroll records, if requested by the Owner, showing the hours, rates and total costs for all personnel on its payroll detailed to the degree to ensure compliance with this paragraph and any Wage Determination provisions, if required.

7.11 Appropriation

7.11.1 The Contract specifically limits payments to be made in accordance with appropriations made and funds made available under laws of the State of Indiana.

7.12 Federal Wage Determination, if required

7.12.1 If a Davis-Bacon wage determination is included in the Contract Documents, it shall be used as the minimum wage and benefits to be paid for the trades indicated.

7.12.2 Contractor shall submit a schedule of hourly wages to be paid to each employee (including those of its subcontractors) engaged in work on the site. This submittal shall be on Contractor's letterhead stationery and shall be signed by the Contractor and notarized. A copy of this submittal shall be conspicuously posted at the site.

7.12.3 Said rates shall in no case be less than those set out in the Davis-Bacon wage schedule a copy of which is herein bound or is on file with the Owner if it is required.

7.12.4 The Contractor shall provide (and require each Subcontractor to provide) weekly payroll records listing employees engaged in work on the site for the week and the hourly rates for base pay and benefits paid to each employee listed. The payroll record form shall include a statement by the Contractor/Subcontractor certifying the accuracy and completeness of the information provided. Payroll records shall be maintained by the Contractor during the course of the Work until the end of the required warranty period.

7.13 Out-of-State Contractors

7.13.1 Out-of-State business entities must be authorized to do business in the State, pursuant to Indiana Code Title 23, prior to submitting bids. Forms may be obtained by contacting the Secretary of State, State of Indiana, Indianapolis, Indiana.

7.14 Material Delivery

7.14.1 Shipments of material to be used by the Contractor or any Subcontractor under this Contract should be delivered to the job site only during the regular working hours of the Contractor or Subcontractor. If a delivery is made during other than the normal working hours of the Contractor or Subcontractor, its authorized agent must be on duty to receive such material. No employee of the Owner is authorized to receive any shipments designated for the Contractor or Subcontractor.

7.15 Weather

7.15.1 The Contractor shall at all times provide protection against weather, rain, wind, storms, frost or heat, so as to maintain all work, materials, apparatus and fixtures free from injury or damage. At the end of the day's work, all new work likely to be damaged shall be covered.

7.15.2 During cold weather, the Contractor shall protect all work from damage. If low temperature makes it impossible to continue operations safely, in spite of cold weather precaution, the Contractor shall cease work and shall so notify the Owner and Designer.

7.15.3 Any work damaged by failure to provide protection above required, shall be removed and replaced with new work at the Contractor's expense.

7.15.4 The Contractor shall provide and maintain on the premises, where directed, watertight storage shed (or sheds) for storage of all materials, which might be damaged by exposure to weather.

7.16 Fire Hazards

7.16.1 Wherever and whenever any burning, welding, cutting or soldering operation is in progress, or equipment is in use, or any work involving a fire hazard, is performed, the Contractor responsible for such operation shall have at all times acceptable fire extinguisher or protection within five (5) feet of the operation.

7.17 Dismissal

7.17.1 Any foreman or workman employed by the Contractor or by any Subcontractor who, in the opinion of the Director, Public Works Division and/or the Designer, does not perform his/her work in a proper and skillful manner, or is disrespectful, intemperate, disorderly, intoxicated or otherwise objectionable shall at the written request of either of the above, be forthwith discharged by the Contractor or Subcontractor employing such foreman or workman and said employee shall not be employed again on any portion of the Work without the written consent of the Director of the Division of Public Works and the Designer. Should the Contractor fail to furnish suitable and sufficient machinery, equipment or personnel for the proper prosecution of the Work, the Owner or Designer may withhold all payments that are or may become due, or may suspend the Work until such orders are upheld.

ARTICLE 8 TIME

8.1 Definitions

8.1.1 Unless otherwise provided, the Contract Time is the period of time allotted in the Contract Documents for Substantial Completion of the Work as defined herein, including authorized adjustments thereto.

8.1.2 The date of commencement of the Work is the date established in a notice to proceed. If there is no notice to proceed, it shall be the date of the approval by the final state approving agency on the Owner-Contractor Contract or such other date as may be established therein.

8.1.3 The Date of Substantial Completion of the Work, or designated portion thereof, is the date certified by the Director, Public Works Division, when construction is sufficiently complete, in accordance with the Contract Documents, so the Owner may occupy or utilize the Work, or designated portion thereof, for the use for which it is intended.

8.1.4 The term day as used in the Contract Documents shall mean calendar day unless otherwise specifically designated.

8.2 Progress and Completion

8.2.1 All time limits stated in the Contract Documents are of the essence of the Contract.

8.2.2 The Contractor shall begin the Work on the date of commencement as defined herein. Contractor shall carry the Work forward expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

8.2.3 The Owner fully expects the Contractor to employ any and all means necessary to complete the Work within the Contract Time. Conduct of the Owner's affairs, such as unforeseen site conditions or delay in processing change orders, shall not be viewed as justification for delaying the Project unless the Owner can be shown to have breached the Contract. Contractor must employ all reasonable means to execute the Project in a timely manner and in conformance with the Contract Documents even if the Contractor or Designer seeks legal remedy against the Owner for claim of damage.

8.3 Delays and Extensions of Time

8.3.1 If the Contractor is delayed at any time in the progress of the Work by any act or neglect of the Owner or the Designer, or by any employee of either, or by any separate Contractor employed by the Owner, or by changes ordered in the Work, or by labor disputes, fire, unusual delay in transportation, adverse weather conditions not reasonable to anticipate, unavoidable casualties, or

any causes beyond the Contractor's control, or by delay authorized by the Owner pending arbitration, or by any other cause which the Designer determines may justify the delay, then the Contract Time shall be extended by a Change Order for such reasonable time as the Designer may determine.

8.3.2 Claims for extension of time shall be made in writing to the Designer. In case of a continuing delay only one claim is necessary. The Contractor shall provide an estimate of the probable effect of such delay on the progress of the Work.

8.3.3 If no agreement is made stating the dates upon which interpretations as provided in Article 2.2 shall be furnished, then no claim for delay shall be allowed on account of failure to furnish such interpretations until fifteen days after written request is made for them, and not unless such claim is reasonable.

8.3.4 This Paragraph 8.3 does not exclude the recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

9.1 Contract Sum

9.1.1 The Contract Sum is the total amount payable by the Owner for the performance of the Work under the Contract Documents.

9.2 Schedule of Values

9.2.1 Before the first application for payment, the Contractor shall submit to the Owner a schedule of various parts of the Work, including quantities if required by the Owner, aggregating the total Contract Sum, divided so as to facilitate payments to Subcontractors in accordance with Article 5.3, made out in such form as the Owner and the Contractor may agree upon, and supported by such data to substantiate its correctness as the Owner may require. Each item in the Schedule of Values shall include its proper share of overhead, profit, and other general charges. This schedule, when approved by the Owner, shall be used as a basis for the Contractor's Applications for Progress and Final Payments.

9.3 Progress Payments

9.3.1 Completed work: The Contractor shall submit to the Designer an itemized Application for Payment, supported by such data substantiating the Contractor's right to payment as the Designer may direct. The Owner shall make payments on account of the Contract, upon issuance of Certificates of Payment certified by the Designer and the Owner's Representative, for labor and materials incorporated into the Work at the rate of ninety-four (94%) percent of such value until fifty (50%) percent of the value of the Work is completed. After that fifty (50%) percent, no further retainage will be deducted. The Director, Public Works Division has the option to require that three (3%) percent of the value of the Work be retained throughout the duration of the entire Contract. The retainage schedule shall be determined prior to award of Contract. Retainage may be paid with final payment at the discretion of the Director, Public Works Division, but shall not be paid in any event until a minimum of sixty-one (61) days after all work is completed.

9.3.2 Materials Stored: Payments may be made on account for materials or equipment not incorporated in the Work, but delivered and suitably stored at the site. With written approval of the Owner, materials may be stored at another location other than the Work site if properly identified as the property of the Owner and properly protected. Storage of material at the place of business of the vendor is not acceptable (25 IAC 2-9-2). Such payments shall be conditional upon the submission by the Contractor of one of the following: 1) receipts marked by the supplier as paid; 2) supplier's final waiver of lien listing specific materials involved; 3) invoice with copy of canceled check showing payment; or 4) such other evidence of payment as the Owner may require in lieu thereof to establish ownership of all items except those listed as miscellaneous materials below. For the aggregate of miscellaneous stored materials for which payment is requested and above proof of payment is not available, a complete list will be provided along with the affidavit of payment. Upon certification by the Owner's representative that the listed materials are suitably stored, payment can be made. Miscellaneous materials are defined as pipe, fittings, wire, conduit, etc., normally stored as stock items in Contractor's warehouse. For materials stored other than at the construction site applicable insurance and transportation to the site shall be provided by the Contractor.

9.3.3 As stored materials are incorporated into the Work, the value shall be removed from the total value of stored materials requested in successive payments. Proof of ownership through one of the above methods will be required for additional materials. When, in the judgment of the Owner, retainage for completed work is not sufficient in relation to excessive amounts requested for stored materials or equipment, the Owner may elect to place the retainage for such materials or equipment in escrow. This retainage shall apply as a credit toward retainage due to be held for completed work on future payments.

9.3.4 The Contractor warrants that title to all work, materials and equipment covered by an Application for Payment will pass to the Owner either by incorporation in the construction or upon the receipt by the Contractor of payment, whichever occurs first, free and clear of all liens, claims, security interest or encumbrances, hereinafter referred to in this Article 9 as "liens"; and that no Work, materials or equipment covered by an Application for Payment will have been acquired by the Contractor, or by any other person performing work at the site or furnishing materials and equipment for the Project, subject to an agreement under which an interest

therein or an encumbrance thereon is retained by the seller or otherwise imposed by the Contractor or such other person.

9.3.5 The Contractor shall accompany each application for payment request with a certification that all Subcontractors (fabricators) have been paid within ten (10) days of receipt of payment that pro rata amount of funds Contractor has received from the Owner for the value of work or services (fabricated materials or equipment) performed by the Subcontractor (supplied by fabricator) contained in previous progress payments. The Contractor's inclusion of a value of subcontract work in its progress pay estimate is prima facie evidence of acceptance of work having such a value; therefore, if the Owner receives a certification from a Subcontractor that Subcontractor has not been paid such amounts as were included in the Contractor's partial billing and subsequently paid to the Contractor by the Owner, then the Owner will hold all subsequent partial payment requests until satisfactory evidence is received from the Subcontractor that Subcontractor has been paid such amounts presented to the Owner by the Contractor, paid to the Contractor by the Owner, and not distributed by the Contractor to the Subcontractor. The making of an incorrect certification of either partial payment or final payment may be considered by the Owner to be a breach of contract, and Owner may exercise all of its prerogatives set out in the Contract in addition to the remedies for falsifying an affidavit. Such an action could result in a suspension of qualification with the State Certification Board for a period of up to two (2) years.

9.4 Certificates for Payment

9.4.1 When the Contractor has made application for payment as above, the Designer will issue a Certificate of Payment to the Owner for such amount as Designer determines to be properly due, or state in writing its reasons for withholding a certificate as provided in Articles 9.5.1.

9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Designer to the Owner, based on the Designer's observations at the site as provided in Article 2.2.4 and the data comprising the Application for Payment, that the Work has progressed to the point indicated, and that, to the best of its knowledge, information and belief, the quality of work is in accordance with the Contract Documents subject to an evaluation of the Work as a functioning whole upon substantial completion, to the results of any subsequent tests called for in the Contract documents, to minor deviations correctable prior to the next certificate for payment and to any specific qualifications stated in its certificate, and that the Contractor is entitled to payment in the amount certified.

9.4.3 The Designer's final Certificate for Payment will constitute a further representation that the conditions precedent to the Contractor's being entitled to final payment as set forth in Article 9.7 have been fulfilled. However, by issuing a Certificate, the Designer shall not thereby be deemed to represent that Designer has made any examination to ascertain how or for what purpose the Contractor has used the monies paid on account of the Contract Sum.

9.4.4 The Owner shall make payment as soon as the fiscal procedure of the State can process same after receipt from the Designer of the Certificate for Payment. The fiscal procedure by the State can include, but not be limited to, review by the Owner's using agency, verification of the Certificate by the Owner's Site Representative, review for accuracy of form and calculation by the Owner's accountant, review by the Owner's project management and execution by the Director, Public Works Division, and others.

9.4.5 No certificate for a progress payment or progress payment for partial or entire occupancy of the Project by the Owner shall constitute an acceptance of work not in accordance with the Contract Documents.

9.4.6 Pursuant to IC. 4-13.6-7-2 all Contract awards of One Million Dollars (\$1,000,000) or above, if elected by the Contractor, an escrow agent will be selected by the State with whom the retainage funds for this Contract will be deposited and held until receipt of notice from the Director, Public Works Division (Escrow Form DAPW 32A) and from all other necessary parties as specified in and in accordance with the procedures and provisions of said Act.

9.5 Payments Withheld

9.5.1 The Designer (or Owner) will not approve an application in whole or in part, if in Designer's opinion, Designer is unable to make representations to the Owner as provided in Article 9.4. The Designer (or Owner) will not approve Application for Payment or, because of subsequent inspections, may nullify the whole or any part of the Certificate for Payment previously issued to such extent as may be necessary in Designer's opinion to protect the Owner from loss because of:

- A. defective work not remedied,
- B. claim filed or reasonable evidence indicating probable filing of claims,
- C. failure of the Contractor to make payments properly to Subcontractors or for materials, equipment or labor,
- D. reasonable doubt that the Contract can be completed for the unpaid balance,
- E. damage to another Contractor,
- F. reasonable indication that the Owner may be damaged by delay in receiving use of the Work as scheduled, or,
- G. unsatisfactory prosecution of the Work by the Contractor.

9.5.2 When the above grounds are removed, payment shall be processed for amounts withheld.

9.6 Failure of Payment

9.6.1 If the Designer should fail to issue any Certificate for Payment, through no fault of the Contractor, or if the Owner should fail to pay the Contractor in a reasonable time considering the fiscal procedures of the State for processing same after receipt from the Designer the amount certified by the Designer, then the Contractor may, after seven (7) additional days, give written notice to the Owner and Designer, that work will stop until payment of the amount owing has been received.

9.7 Substantial Completion and Final Payment

9.7.1 When advised by the Contractor that the Work or a designated portion thereof is substantially complete, the Designer; the Director, Public Works Division, and the Contractor shall determine jointly by inspection that the Work is substantially complete. If they determine that the Work is substantially complete, the Contractor shall then prepare a Certificate of Substantial Completion with an accompanying list of incomplete items of work (punch list) and submit it to the Designer for its signature and subsequent forwarding for approval by the Director, Public Works Division. The Certificate shall fix the date of Substantial Completion and shall state the responsibilities of the Owner and the Contractor for maintenance, heat, utilities and insurance.

9.7.2 Upon approval of the above, and notice that the Work is ready for final acceptance, the Designer, the Contractor and Owner will promptly make final review, and when they find the Work acceptable under the Contract and the Contract fully performed, the Contractor shall promptly submit the final Certificate for Payment with all other required documents, showing that the Work has been completed in accordance with the terms and conditions of the Contract, and that the entire balance in said final certificate, is due and payable.

9.7.3 Neither the final payment nor any part of the retained percentage shall become due until the Contractor shall submit to the Designer releases or waivers of all liens arising out of the Contract; an affidavit that the releases and waivers include all the labor, materials, and equipment for which a lien could be filed and that all payrolls, material bills, and other indebtedness connected with the Work for which the Owner or its property might in any way be responsible have been paid or otherwise satisfied; and such other data establishing payment or satisfaction of all such obligations as the Owner may require. If any such lien or claim remains unpaid, the Contractor shall refund to the Owner all monies that the latter may be compelled to pay in discharging such lien or claim, including all costs.

9.7.4 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor, and the Designer so confirms, the Owner shall, upon certification by the Designer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted, or such portion as may be available from funds not already released to an escrow agent pursuant to IC 4-13.6-7. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

9.7.5 The making of final payment shall constitute a waiver of all claims by the Owner except those arising from:

- A. unsettled liens,
- B. faulty work appearing after Substantial Completion,
- C. failure of the Work to comply with the requirements of the Contract Documents,
- D. terms of any special guarantees required by the Contract Documents.

9.7.6 If upon Substantial Completion of the Work there are any remaining uncompleted minor items, the Owner shall withhold, until those items are completed, an amount equal to two hundred percent (200%) of the value of each item as determined by the Designer or Owner.

9.7.7 The acceptance of final payment shall constitute a waiver of all claims by the Contractor, except those previously made in writing and still unsettled and covered by other agreed arrangements.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

10.1 Safety Precautions and Programs

10.1.1 The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work.

10.2 Safety of Person and Property

10.2.1 The Contractor shall take all necessary precautions for the safety of, and will provide all necessary protection to prevent damage, injury, or loss to:

- A. all employees on the Project and all other persons who may be affected thereby,
- B. all the Work and all materials and equipment to be incorporated therein, whether in storage on or off the site, and,
- C. other property at the site or adjacent thereto, including trees, shrubs, lawns, pavements, roadways, structures and

utilities not designated for removal, relocation or replacement in the course of construction.

10.2.2 The Contractor shall comply with all applicable laws, ordinances, rules, regulations and orders of any public authority having jurisdiction for the safety of persons or property or to protect them from damage, injury, or loss. Contractor shall erect and maintain, as required by the conditions and progress of the Work, all necessary safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations, and notifying owners and users of adjacent utilities.

10.2.3 All damage or loss to all property specified herein caused directly or indirectly, in whole or in part, by the Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable, shall be remedied by the Contractor, except damage or loss attributable solely to faulty Contract Documents or to the acts or omissions of the Owner, or Designer or their employees, or for those whose acts either of them may be liable.

10.2.4 The Contractor shall designate a responsible member of its organization on the Work whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent, unless otherwise designated in writing by the Contractor to the Owner and the Designer.

10.2.5 When the use or storage of explosives or other hazardous materials or equipment is necessary for the prosecution of the Work, the Contractor shall carry on such activities under the supervision of properly qualified personnel.

10.2.6 The Contractor shall not overload, or permit any part of the Work to be loaded so as to endanger its safety.

10.2.7 All excavations creating a trench of five (5) or more feet in depth shall strictly adhere to the shoring and other safety requirements called for and described under Indiana OSHA Regulation 29 C.F.R. 1926, Subpart "P", for trench safety systems.

10.3 Emergencies

10.3.1 In an emergency affecting the safety of persons or property, the Contractor shall act, at its discretion, to prevent threatened damage, injury or loss. Any additional compensation or extension of time claimed by the Contractor because of emergency work shall be determined as provided for in Article 12, Changes in the Work, and Contractor shall notify the Owner of such a decision within seven (7) days of the event giving rise to such claim.

ARTICLE 11 INSURANCE

11.1 General Requirements for Insurance

11.1.1 The Contractor will be required to furnish to the Owner, evidence of its compliance with all items of insurance listed herein and in the Contract. All insurance policies/certificates shall be on file with the Owner prior to release of the signed Contract and commencement of work.

11.1.2 The Contractor shall purchase and maintain, with a company or companies licensed to do business in Indiana, such insurance as will protect Contractor from claims set forth below, arising out of or resulting from the Contractor's operations under the Contract, whether such operations be by the Contractor or by any Subcontractor or by anyone directly or indirectly employed by any of them:

- A. claims under Workmen's Compensation Acts and other employee benefit acts;
- B. claims for damages because of bodily injury, personal injury, occupational sickness or disease, or death of its employees;
- C. claims for damages because of bodily injury, personal injury, sickness, disease or death of any person other than its employees;
- D. claims for damages to tangible property, including loss of use thereof.

11.1.3 This insurance shall be written for not less than any limits of liability specified herein, or required by law, whichever is greater. Policies or certificates of insurance, acceptable to the Owner, shall be filed with the Owner prior to execution of the Contract. These Certificates shall contain a provision that coverages afforded under the policies will be for the life of the Work.

11.1.4 Policies (certificates) shall show name and complete address of the Company, expiration date or dates, and policy number or numbers. Policies shall not be canceled until at least thirty (30) days prior written notice has been given to the Owner and acknowledged by the Owner in writing.

11.2 Property Insurance

11.2.1 The Contractor shall furnish and maintain, at the Contractor's expense, Fire, Extended Coverage, Vandalism, and Malicious Mischief Insurance (Builder's Risk), in the sum of 100% of the Contract amount. Builder's Risk insurance shall cover the structure on/in which the Work of this Contract is to be done including items of labor and material connected therewith, whether in or adjacent to the structure insured; material in place or to be used as part of the permanent construction, including surplus materials; shanties, protective fences, bridges, or temporary structures; miscellaneous materials and supplies incident to the Work; scaffolding, staging, towers, forms, and equipment, if included in the cost of the Work. This insurance need not cover any tools owned by mechanics, or any tools, equipment, scaffolding, staging, towers, and forms owned or rented by the Contractor, the capital value of which is not included in the cost of the Work.

11.2.3 Any loss under this Article 11.2 is to be adjusted with the Owner and made payable to the Owner as trustee for the insured, as their interests may appear.

11.3 Liability Insurance

11.3.1 The Contractor and their subcontractors (if any) shall secure and keep in force during the term of this Contract the following insurance coverages (if applicable) covering the Contractor for any and all claims of any nature which may in any manner arise out of or result from Contractor's performance under this Contract:

- A. Commercial general liability, including contractual coverage, and products or completed operations coverage (if applicable), with minimum liability limits not less than \$700,000 per person and \$5,000,000 per occurrence unless additional coverage is required by the State. The State is to be named as an additional insured on a primary, non-contributory basis for any liability arising directly or indirectly under or in connection with this Contract.
- B. Automobile liability for owned, non-owned and hired autos with minimum liability limits of \$700,000 per person and \$5,000,000 per occurrence. The State is to be named as an additional insured on a primary, non-contributory basis.
- C. The Contractor shall provide proof of such insurance coverage by tendering to the undersigned State representative a certificate of insurance prior to the commencement of this Contract and proof of workers' compensation coverage meeting all statutory requirements of IC §22-3-2. In addition, proof of an "all states endorsement" covering claims occurring outside the State is required if any of the services provided under this Contract involve work outside of Indiana.
- D. The Contractor's insurance coverage must meet the following additional requirements:
 1. The insurer must have a certificate of authority or other appropriate authorization to operate in the state in which the policy was issued.
 2. Any deductible or self-insured retention amount or other similar obligation under the insurance policies shall be the sole obligation of the Contractor.
 3. The State will be defended, indemnified and held harmless to the full extent of any coverage actually secured by the Contractor in excess of the minimum requirements set forth above. The duty to indemnify the State under this Contract shall not be limited by the insurance required in this Contract.
 4. The insurance required in this Contract, through a policy or endorsement(s), shall include a provision that the policy and endorsements may not be canceled or modified without thirty (30) days' prior written notice to the undersigned State agency.
 5. The Contractor waives and agrees to require their insurer to waive their rights of subrogation against the State of Indiana.
- E. Failure to provide insurance as required in this Contract may be deemed a material breach of contract entitling the State to immediately terminate this Contract. The Contractor shall furnish a certificate of insurance and all endorsements to the State before the commencement of this Contract.
- F. Boiler and Machinery Explosion Insurance shall be required when the Work includes boiler, other pressure

vessels or steam piping installation or repair.

- G. After June 30, 2015, this entire Article will apply to **any** contractor that will be on the construction site pursuant to IC 5-16-13 and an acceptable certificate of insurance will be provided by each and every contractor.

ARTICLE 12 CHANGES IN THE WORK

12.1 Change Orders

12.1.1 The Owner, without invalidating the Contract, may order changes in the Work consisting of additions, deletions, or modifications, with the Contract Sum and the Contract Time being adjusted accordingly. All such changes in the Work shall be authorized by Change Order, and shall be executed under the applicable conditions of the Contract Documents.

12.1.2 A Change Order is a written order to the Contractor compiled and reviewed by the Designer, prepared by the Owner and then signed by the Owner and the Contractor. The order is issued after the execution of the Contract authorizing a change in the Work, and documenting any adjustment in the Contract Sum and/or the Contract Time. The Contract Sum may be changed only by change order.

12.1.3 The value of any work involved in a change in the Work shall be determined in one or more of the following ways, in order of priority listed:

- A. by mutual acceptance of a lump sum. For all amounts over \$500, the Contractor shall provide a complete listing of quantities and unit prices of materials, hours of labor with cost per hour, and separate agreed percentages for any overhead and profit. The maximum aggregate increase for overhead and profit (including all home office and field office overhead) for any Subcontractor or for the Contractor performing its own work is fifteen (15%) percent; the maximum increase for a Contractor on work performed by a Subcontractor is five (5%) percent. If the cost of performance and payment bond(s) is shown as a separate line item in the Contractor's schedule of values for the project, then an increase will be permitted to provide for the additional cost of the bond(s). If the cost of the bond(s) is not indicated on the Contractor's schedule of values for the Project, any increase in cost for bond(s) shall be included in the Contractor's allowed overhead. For listings under \$500, list lump sum for each item, or,
- B. by unit prices named in the Contract or subsequently agreed upon, or,
- C. by cost plus a mutually acceptable fixed or percentage fee.

12.1.4 Should conditions be encountered below the surface of the ground that are:

- A. at variance with the conditions indicated by the Contract Documents, and
- B. different than could be expected after a reasonable viewing of the site by the bidders, and
- C. not evident from available soil samples,

then the Contract sum may be equitably adjusted by Change Order upon claim by Contractor made within a reasonable time after the first observance of the conditions.

12.1.5 If the Contractor claims that a written interpretation issued pursuant to Article 1.2 or a written order for a minor change issued pursuant to Article 12.3 involves additional cost or time, the Contractor shall make such claim as provided in Article 12.2.

12.2 Claims for Additional Cost or Time

12.2.1 If the Contractor wishes to make a claim under the provisions of the Contract Documents for an increase in the Contract Sum or an extension in the Contract Time, Contractor shall give the Designer written notice thereof within fifteen (15) days after the occurrence of the event giving rise to such claim. This notice shall be given by the Contractor and authority received in writing from the Owner before proceeding to execute the Work, except in an emergency endangering life or property. No such claim shall be valid unless so made. Any approved change in the Contract Sum or Contract Time resulting from such claim shall be incorporated in a Change Order, initiated by the Designer and executed by the Owner. If the Designer does not initiate or the Owner execute a Change Order within a reasonable time in response to the request, such lack of action shall be construed as prima facie evidence of rejection of the request. For the purpose of this section "reasonable time" is expected not to exceed 30 days after receipt by the Owner.

12.3 Minor Changes in the Work

12.3.1 The Designer shall have authority, with Owner's approval, to order minor changes in the Work not involving an increase in the Contract Sum or an extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such change may be affected by written field order, with copy transmitted to the Owner. Such minor changes need not be approved in writing by the Owner; however, the Owner may provide written approval of any substitution of significant materials or equipment.

12.4 Field Orders

12.4.1 The Designer may issue written field orders, which interpret the Contract Documents in accordance with Article 1.2.4 without change in Contract Sum or Contract Time. The Contractor shall carry out such field orders promptly. The Designer shall

transmit copies of field orders to the Owner.

ARTICLE 13 EXAMINATION AND CORRECTION OF WORK

13.1 Examination of Work

13.1.1 If any portion of the Work should be covered contrary to the request of the Designer or to requirements specifically expressed in the Contract Documents, it must, if required in writing by the Designer, be uncovered for Designer's observation and shall be replaced at the Contractor's expense.

13.1.2 Examination of questioned work may be ordered by the Designer with the approval of the Owner, and if so ordered the Work must be uncovered by the Contractor. If such work were found in accordance with the Contract Documents, the cost of re-examination and replacement shall, by appropriate change order, be charged to the Owner. If such work be found not in accordance with the Contract Documents, the Contractor shall pay such costs, unless it is found that the defect in the Work was caused by a separate Contractor employed as provided in Article 6 and in that event, the separate Contractor shall pay such costs.

13.2 Correction of Work before Substantial Completion

13.2.1 The Contractor shall promptly remove from the site all work rejected by the Designer as failing to conform to the Contract Documents, whether or not incorporated in the Project, and the Contractor shall promptly replace and re-execute its own work in accordance with the Contract Documents and without cost to the Owner and shall bear the cost of repair to or replacement of all work of separate Contractors destroyed or damaged by such removal or replacement.

13.2.2 If the Contractor does not remove such rejected work within a reasonable time, fixed by written notice from the Designer, the Owner may remove and store the material at the expense of the Contractor. If the Contractor does not agree to pay or credit the Contract with the cost of such removal within ten days thereafter, the Owner may acquire a lien upon such property and materials. If proceeds of lien foreclosure do not cover all costs, which the Owner has then borne, the difference shall be deducted from the amount to be paid to the Contractor.

13.3 Correction of Work after Substantial Completion

13.3.1 The Contractor shall correct all faults and deficiencies in the Work which appear within one year of the date of substantial completion or such longer period of time as may be prescribed by the terms of any special guarantees called for by the Contract Documents, and Contractor shall pay for all damage to other work caused thereby. The Contractor shall remove all defective work where necessary.

13.3.2 If the Contractor does not correct such faulty or defective work and remove defective work where necessary, within a reasonable time fixed by the Designer in writing, the Owner may do the corrective work and remove the defective work, as described in Article 13.2 above.

13.3.3 All costs attributable to correcting and removing faulty or defective work shall be borne by the Contractor.

13.3.4 The obligations of the Contractor under this Article 13.3 shall be in addition to and not a limitation of any obligations imposed upon Contractor by special guarantees called for by the Contract Documents or otherwise prescribed by law.

ARTICLE 14 TERMINATION OF THE CONTRACT

14.1 Termination by the Contractor

14.1.1 If the Work is stopped for a period of thirty days under an order of any court or other public authority through no act of fault of the Contractor or of anyone employed by the Contractor, or if the Work should be stopped for a period of thirty days by the Contractor for the Designer's failure to issue a Certificate for payment as provided in Article 9.6, or for the Owner's failure to make payment thereon as provided in said Article, then the Contractor may, upon seven days' written notice to the Owner and the Designer, terminate the Contract and recover from the Owner, in satisfaction of all claims of the Contractor, payment for all work executed, except those items involved in Designer's failure to issue Certificate, or Owner's failure to make payment.

14.2 Termination by the Owner

14.2.1 If the Contractor should be adjudged bankrupt, or if Contractor should make a general assignment for the benefit of its creditors, or if a receiver should be appointed on account of Contractor's insolvency, or if Contractor should persistently or repeatedly refuse or should fail, except in cases for which extension of time is provided, to supply enough properly skilled workmen or proper materials, or if Contractor should fail to make prompt payment to Subcontractors for materials or labor, or persistently disregard laws, ordinances, rules, regulations or orders of any public authority or otherwise be guilty of a substantial violation of a provision of the Contract Documents, then the Owner, upon certification by the Designer that sufficient cause exists to justify such action, may without prejudice to any right or remedy against the Contractor or its surety and after giving the Contractor and its surety seven days written

notice, terminate the employment of the Contractor and take possession of the site and of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor and finish the Work by whatever method the Owner deems expedient. In such case the Contractor shall not be entitled to receive any further payment until the Work is completed, and an accounting made as set out below.

14.2.2 If the unpaid balance of the Contract sum exceeds the cost of finishing the Work, including compensation for the Designer's additional services such excess shall be paid to the Contractor. If such cost exceeds such unpaid balance, the Contractor shall pay the difference to the Owner. The Designer shall certify the cost incurred by the Owner as hereinprovided.

END

**STATE OF INDIANA'S
STANDARD CONTRACT FOR PUBLIC WORKS CONSTRUCTION PROJECT
(For projects estimated more than \$150,000)**

Contract # _____

THIS PUBLIC WORKS CONSTRUCTION CONTRACT (“Contract”), entered into by and between the Indiana Department of Administration’s Public Works Division (“State”) and **XXXXXXXXXXXX** (“Contractor”), is executed pursuant to the terms and conditions set forth herein and is governed by Indiana Code 4-13.6, *et seq.* In consideration of those mutual undertakings and covenants, the parties agree as follows for the following Public Works Project:

Project Number: **XXXXXXXXXX**
Project Name: **XXXXXXXXXX**
Designer (if applicable): **XXXXXXXXXX**
Purchase Order Number: **XXXXXXXXXX**
Institution/Department: **XXXXXXXXXX**
Req. No: **XXXXXXXXXX**

1. Definitions. The following definition of “Contract Documents” applies throughout this Contract for the State’s Public Works Project Number **XXXXXX** (“Project”).

The term “Contract Documents” shall mean and include the following: this Contract and the Project Bid Package, which includes but is not limited to the Contractor’s Application for Pre-Qualification, the Public Work’s Solicitation for Quotation (DAPW 30), Bid Documentation, Pre-Contract Document, General Conditions (DAPW 26), Supplementary Conditions, Instructions to Bidders, Drawings, Specifications, and Addenda issued by the State in connection with the Project and prior to the submission of the Contractor’s Proposal.

Subject to Section 39, *Order of Precedence, Incorporation by Reference*, of this Contract, Contract Documents shall also consist of the Contractor’s Proposal and Response, as well as any other documentation submitted by it in response to the Project (hereinafter collectively referred to as “Contractor’s Proposal”).

Additionally, Contract Documents shall include any subsequent amendments, change orders and any written interpretations issued as field orders by the Designer pursuant to General Conditions, Article 1.2 (DAPW 26) and all field orders for minor changes by the Designer pursuant to General Conditions, Article 12.3 (DAPW 26). Change orders and amendments shall be executed in the manner authorized by Section 35, *Merger and Modification*, of this Contract.

When applicable, Contract Documents shall include the Performance Bond and/or the Labor and Materials Payment Bond, as required by IC 4-13.6-7-6 and IC 4-13.6-7-7, and fully described and captured in the General Conditions (DAPW 26).

The Contract Documents are specifically and collectively incorporated herein by reference.

2. Duties of Contractor. The Contractor shall furnish all labor and materials, perform all of the work, and otherwise fulfill all of its obligations in conformance with the Contract Documents. These duties are described and captured in the Contract Documents. The Contractor agrees that not less than fifteen percent (15%) of the work, measured in dollar volume, will be performed by its own forces. Any subcontractor

employed for any part of this Contract awarded in excess of One Hundred Fifty Thousand Dollars (\$150,000.00) shall be qualified with the State of Indiana's Public Works Division Certification Board and shall have a valid Certificate of Qualification in the prime classification of work for this Contract.

3. Consideration. All payments provided herein are subject to appropriations made and funds allocated as provided by laws of the State of Indiana. The State shall pay the Contractor for performance of this Contract in current funds as follows:

BASE BID: **\$XXXXXX.XX**

ALTERNATE(S):

TOTAL CONTRACT PRICE: **\$XXXXXX.XX**

4. Term. The term of this Contract is **[X year(s) and/or xx month(s)]** commencing on the date of the last state signatory to this Contract.

5. Licensing Standards. The Contractor and its employees and subcontractors shall comply with all applicable licensing standards, certification standards, accrediting standards and any other laws, rules or regulations governing services to be provided by the Contractor pursuant to this Contract. The State shall not be required to pay the Contractor for any services performed when the Contractor, its employees or subcontractors are not in compliance with such applicable standards, laws, rules or regulations. If licensure, certification or accreditation expires or is revoked, or if disciplinary action is taken against the applicable licensure, certification or accreditation, the Contractor shall notify the State immediately and the State, at its option, may immediately terminate this Contract.

6. Escrow Agreement. Contemporaneously with the execution of this Contract, the parties may provide for the escrow of retained portions of payments to the Contractor by entering into a separate Escrow Agreement, pursuant to IC 4-13.6-7, with an escrow agent described in IC 4-13.6-7-2(b). Should the Contractor elect to escrow retainage, the Escrow Agreement will become a part of this contract as if fully contained herein.

7. Contractor's Certification. The Contractor certifies that it has been pre-qualified by the State of Indiana's Public Works Division Certification Board to perform the work and furnish the services required by this Project. The Contractor further certifies that all information and documentation submitted by it in its Application for Prequalification Certification, the Contractor's Proposal and submitted in response to the Project, is true, accurate and complete as of the date of this Contract's effectiveness. The Contractor shall immediately notify the State of any material change to such information. The Contractor shall immediately notify the State if, during the course of performance of this Contract, it or any of its principals are proposed for debarment or ineligibility, or become debarred or declared ineligible, from entering into contracts with the federal government or any department, agency or political subdivision of the State.

8. Contractor Employee Drug Testing. Pursuant to IC 4-13-18, the Contractor shall implement the employee drug testing program submitted as part of its Contractor's Proposal. The State may cancel this Contract if it determines that the Contractor:

- A. Has failed to implement its employee drug testing program during the term of this Contract;
- B. Has failed to provide information regarding implementation of the Contractor's employee drug testing program at the request of the State; or

- C. Has provided to the State false information regarding the Contractor's employee drug testing program.

9. Access to Records. The Contractor and its subcontractors, if any, shall maintain all books, documents, papers, accounting records, and other evidence pertaining to all costs incurred under this Contract. They shall make such materials available at their respective offices at all reasonable times during this Contract, and for three (3) years from the date of final payment under this Contract, for inspection by the State or its authorized designees. Copies shall be furnished at no cost to the State if requested.

10. Assignment; Successors.

A. The Contractor binds its successors and assignees to all the terms and conditions of this Contract. The Contractor may assign its right to receive payments to such third parties as the Contractor may desire without the prior written consent of the State, provided that the Contractor gives written notice (including evidence of such assignment) to the State thirty (30) days in advance of any payment so assigned. The assignment shall cover all unpaid amounts under this Contract and shall not be made to more than one party.

B. The Contractor shall not assign or subcontract the whole or any part of this Contract without the State's prior written consent. Additionally, the Contractor shall provide prompt written notice to the State of any change in the Contractor's legal name or legal status so that the changes may be documented and payments to the successor entity may be made.

11. Assignment of Antitrust Claims. As part of the consideration for the award of this Contract, the Contractor assigns to the State all right, title and interest in and to any claims the Contractor now has, or may acquire, under state or federal antitrust laws relating to the products or services which are the subject of this Contract.

12. Audits. The Contractor acknowledges that it may be required to submit to an audit of funds paid through this Contract. Any such audit shall be conducted in accordance with IC § 5-11-1, *et seq.*, and audit guidelines specified by the State.

The State considers the Contractor to be a "Contractor" under 2 C.F.R. 200.331 for purposes of this Contract. However, if it is determined that the Contractor is a "subrecipient" and if required by applicable provisions of 2 C.F.R. 200 (Uniform Administrative Requirements, Cost Principles, and Audit Requirements), Contractor shall arrange for a financial and compliance audit, which complies with 2 C.F.R. 200.500 *et seq.*

13. Authority to Bind Contractor. The signatory for the Contractor represents that he/she has been duly authorized to execute this Contract on behalf of the Contractor and has obtained all necessary or applicable approvals to make this Contract fully binding upon the Contractor when his/her signature is affixed, and accepted by the State.

14. Changes in Work. The Contractor shall not commence any additional work or change the scope of the work until authorized in writing by the State. The Contractor shall make no claim for additional compensation in the absence of a prior written approval and amendment executed by all signatories hereto. This Contract may only be amended, supplemented or modified by a written document executed in the same manner as this Contract.

15. Compliance with Laws.

A. The Contractor shall comply with all applicable federal, state, and local laws, rules, regulations, and ordinances, and all provisions required thereby to be included herein are hereby incorporated by reference. The enactment or modification of any applicable state or federal statute or the promulgation of rules or regulations thereunder after execution of this Contract shall be reviewed by the State and the Contractor to determine whether the provisions of this Contract require formal modification.

B. The Contractor and its agents shall abide by all ethical requirements that apply to persons who have a business relationship with the State as set forth in IC § 4-2-6, *et seq.*, IC § 4-2-7, *et seq.* and the regulations promulgated thereunder. **If the Contractor has knowledge, or would have acquired knowledge with reasonable inquiry, that a state officer, employee, or special state appointee, as those terms are defined in IC § 4-2-6-1, has a financial interest in the Contract, the Contractor shall ensure compliance with the disclosure requirements in IC § 4-2-6-10.5 prior to the execution of this Contract.** If the Contractor is not familiar with these ethical requirements, the Contractor should refer any questions to the Indiana State Ethics Commission, or visit the Inspector General's website at <http://www.in.gov/ig/>. If the Contractor or its agents violate any applicable ethical standards, the State may, in its sole discretion, terminate this Contract immediately upon notice to the Contractor. In addition, the Contractor may be subject to penalties under IC §§ 4-2-6, 4-2-7, 35-44.1-1-4, and under any other applicable laws.

C. The Contractor certifies by entering into this Contract that neither it nor its principal(s) is presently in arrears in payment of taxes, permit fees or other statutory, regulatory or judicially required payments to the State of Indiana. The Contractor agrees that any payments currently due to the State of Indiana may be withheld from payments due to the Contractor. Additionally, further work or payments may be withheld, delayed, or denied and/or this Contract suspended until the Contractor is current in its payments and has submitted proof of such payment to the State.

D. The Contractor warrants that it has no current, pending or outstanding criminal, civil, or enforcement actions initiated by the State, and agrees that it will immediately notify the State of any such actions. During the term of such actions, the Contractor agrees that the State may delay, withhold, or deny work under any supplement, amendment, change order or other contractual device issued pursuant to this Contract.

E. If a valid dispute exists as to the Contractor's liability or guilt in any action initiated by the State or its agencies, and the State decides to delay, withhold, or deny work to the Contractor, the Contractor may request that it be allowed to continue, or receive work, without delay. The Contractor must submit, in writing, a request for review to the Indiana Department of Administration (IDOA) following the procedures for disputes outlined herein. A determination by IDOA shall be binding on the parties. Any payments that the State may delay, withhold, deny, or apply under this section shall not be subject to penalty or interest, except as permitted by IC § 5-17-5.

F. The Contractor warrants that the Contractor and its subcontractors, if any, shall obtain and maintain all required permits, licenses, registrations, and approvals, and shall comply with all health, safety, and environmental statutes, rules, or regulations in the performance of work activities for the State. Failure to do so may be deemed a material breach of this Contract and grounds for immediate termination and denial of further work with the State.

G. The Contractor affirms that, if it is an entity described in IC Title 23, it is properly registered and owes no outstanding reports to the Indiana Secretary of State.

H. As required by IC § 5-22-3-7:

- (1) The Contractor and any principals of the Contractor certify that:
 - (A) the Contractor, except for de minimis and nonsystematic violations, has not violated the terms of:
 - (i) IC §24-4.7 [Telephone Solicitation Of Consumers];
 - (ii) IC §24-5-12 [Telephone Solicitations]; or
 - (iii) IC §24-5-14 [Regulation of Automatic Dialing Machines];in the previous three hundred sixty-five (365) days, even if IC § 24-4.7 is preempted by federal law; and
 - (B) the Contractor will not violate the terms of IC § 24-4.7 for the duration of the Contract, even if IC §24-4.7 is preempted by federal law.
- (2) The Contractor and any principals of the Contractor certify that an affiliate or principal of the Contractor and any agent acting on behalf of the Contractor or on behalf of an affiliate or principal of the Contractor, except for de minimis and nonsystematic violations,
 - (A) has not violated the terms of IC § 24-4.7 in the previous three hundred sixty-five (365) days, even if IC §24-4.7 is preempted by federal law; and
 - (B) will not violate the terms of IC § 24-4.7 for the duration of the Contract, even if IC §24-4.7 is preempted by federal law.

16. Condition of Payment. All services provided by the Contractor under this Contract must be performed to the State's reasonable satisfaction, as determined at the discretion of the undersigned State representative and in accordance with all applicable federal, state, local laws, ordinances, rules and regulations. The State shall not be required to pay for work found to be unsatisfactory, inconsistent with this Contract or performed in violation of and federal, state or local statute, ordinance, rule or regulation.

17. Confidentiality of State Information. The Contractor understands and agrees that data, materials, and information disclosed to the Contractor may contain confidential and protected information. The Contractor covenants that data, material, and information gathered, based upon or disclosed to the Contractor for the purpose of this Contract will not be disclosed to or discussed with third parties without the prior written consent of the State.

The parties acknowledge that the services to be performed by Contractor for the State under this Contract may require or allow access to data, materials, and information containing Social Security numbers maintained by the State in its computer system or other records. In addition to the covenant made above in this section and pursuant to 10 IAC 5-3-1(4), the Contractor and the State agree to comply with the provisions of IC § 4-1-10 and IC § 4-1-11. If any Social Security number(s) is/are disclosed by Contractor, Contractor agrees to pay the cost of the notice of disclosure of a breach of the security of the system in addition to any other claims and expenses for which it is liable under the terms of this contract.

18. Continuity of Services.

A. The Contractor recognizes that the service(s) to be performed under this Contract are vital to the State and must be continued without interruption and that, upon Contract expiration, a successor, either the State or another contractor, may continue them. The Contractor agrees to:

1. Furnish phase-in training; and
2. Exercise its best efforts and cooperation to effect an orderly and efficient transition to a successor.

B. The Contractor shall, upon the State's written notice:

1. Furnish phase-in, phase-out services for up to sixty (60) days after this Contract expires; and
2. Negotiate in good faith a plan with a successor to determine the nature and extent of phase-in, phase-out services required. The plan shall specify a training program and a date for transferring responsibilities for each division of work described in the plan, and shall be subject to the State's approval. The Contractor shall provide sufficient experienced personnel during the phase-in, phase-out period to ensure that the services called for by this Contract are maintained at the required level of proficiency.

C. The Contractor shall allow as many personnel as practicable to remain on the job to help the successor maintain the continuity and consistency of the services required by this Contract. The Contractor also shall disclose necessary personnel records and allow the successor to conduct on-site interviews with these employees. If selected employees are agreeable to the change, the Contractor shall release them at a mutually agreeable date and negotiate transfer of their earned fringe benefits to the successor.

D. The Contractor shall be reimbursed for all reasonable phase-in, phase-out costs (i.e., costs incurred within the agreed period after contract expiration that result from phase-in, phase-out operations).

19. Debarment and Suspension.

A. The Contractor certifies by entering into this Contract that neither it nor its principals nor any of its subcontractors are presently debarred, suspended, proposed for debarment, declared ineligible or voluntarily excluded from entering into this Contract by any federal agency or by any department, agency or political subdivision of the State of Indiana. The term "principal" for purposes of this Contract means an officer, director, owner, partner, key employee or other person with primary management or supervisory responsibilities, or a person who has a critical influence on or substantive control over the operations of the Contractor.

B. The Contractor certifies that it has verified the state and federal suspension and debarment status for all subcontractors receiving funds under this Contract and shall be solely responsible for any recoupment, penalties or costs that might arise from use of a suspended or debarred subcontractor. The Contractor shall immediately notify the State if any subcontractor becomes debarred or suspended, and shall, at the State's request, take all steps required by the State to terminate its contractual relationship with the subcontractor for work to be performed under this Contract.

20. Default by State. If the State, sixty (60) days after receipt of written notice, fails to correct or cure any material breach of this Contract, the Contractor may cancel and terminate this Contract and institute measures to collect monies due up to and including the date of termination.

21. Disputes.

A. Should any disputes arise with respect to this Contract, the Contractor and the State agree to act immediately to resolve such disputes. Time is of the essence in the resolution of disputes.

B. The Contractor agrees that, the existence of a dispute notwithstanding, it will continue without delay to carry out all of its responsibilities under this Contract that are not affected by the dispute. Should the Contractor fail to continue to perform its responsibilities regarding all non-disputed work, without delay,

any additional costs incurred by the State or the Contractor as a result of such failure to proceed shall be borne by the Contractor, and the Contractor shall make no claim against the State for such costs.

C. If the parties are unable to resolve a contract dispute between them after good faith attempts to do so, a dissatisfied party shall submit the dispute to the Commissioner of the Indiana Department of Administration for resolution. The dissatisfied party shall give written notice to the Commissioner and the other party. The notice shall include: (1) a description of the disputed issues, (2) the efforts made to resolve the dispute, and (3) a proposed resolution. The Commissioner shall promptly issue a Notice setting out documents and materials to be submitted to the Commissioner in order to resolve the dispute; the Notice may also afford the parties the opportunity to make presentations and enter into further negotiations. Within thirty (30) business days of the conclusion of the final presentations, the Commissioner shall issue a written decision and furnish it to both parties. The Commissioner's decision shall be the final and conclusive administrative decision unless either party serves on the Commissioner and the other party, within ten (10) business days after receipt of the Commissioner's decision, a written request for reconsideration and modification of the written decision. If the Commissioner does not modify the written decision within thirty (30) business days, either party may take such other action helpful to resolving the dispute, including submitting the dispute to an Indiana court of competent jurisdiction. If the parties accept the Commissioner's decision, it may be memorialized as a written Amendment to this Contract if appropriate.

D. The State may withhold payments on disputed items pending resolution of the dispute. The unintentional nonpayment by the State to the Contractor of one or more invoices not in dispute in accordance with the terms of this Contract will not be cause for the Contractor to terminate this Contract, and the Contractor may bring suit to collect these amounts without following the disputes procedure contained herein.

E. With the written approval of the Commissioner of the Indiana Department of Administration, the parties may agree to forego the process described in subdivision C. relating to submission of the dispute to the Commissioner.

F. This paragraph shall not be construed to abrogate provisions of IC § 4-6-2-11 in situations where dispute resolution efforts lead to a compromise of claims in favor of the State as described in that statute. In particular, releases or settlement agreements involving releases of legal claims or potential legal claims of the state should be processed consistent with IC § 4-6-2-11, which requires approval of the Governor and Attorney General.

22. Drug-Free Workplace Certification. As required by Executive Order No. 90-5 dated April 12, 1990, issued by the Governor of Indiana, the Contractor hereby covenants and agrees to make a good faith effort to provide and maintain a drug-free workplace. The Contractor will give written notice to the State within ten (10) days after receiving actual notice that the Contractor, or an employee of the Contractor in the State of Indiana, has been convicted of a criminal drug violation occurring in the workplace. False certification or violation of this certification may result in sanctions including, but not limited to, suspension of contract payments, termination of this Contract and/or debarment of contracting opportunities with the State for up to three (3) years.

In addition to the provisions of the above paragraph, if the total amount set forth in this Contract is in excess of \$25,000.00, the Contractor certifies and agrees that it will provide a drug-free workplace by:

- A. Publishing and providing to all of its employees a statement notifying them that the unlawful manufacture, distribution, dispensing, possession or use of a controlled substance

is prohibited in the Contractor's workplace, and specifying the actions that will be taken against employees for violations of such prohibition;

- B. Establishing a drug-free awareness program to inform its employees of (1) the dangers of drug abuse in the workplace; (2) the Contractor's policy of maintaining a drug-free workplace; (3) any available drug counseling, rehabilitation and employee assistance programs; and (4) the penalties that may be imposed upon an employee for drug abuse violations occurring in the workplace;
- C. Notifying all employees in the statement required by subparagraph (A) above that as a condition of continued employment, the employee will (1) abide by the terms of the statement; and (2) notify the Contractor of any criminal drug statute conviction for a violation occurring in the workplace no later than five (5) days after such conviction;
- D. Notifying the State in writing within ten (10) days after receiving notice from an employee under subdivision (C)(2) above, or otherwise receiving actual notice of such conviction;
- E. Within thirty (30) days after receiving notice under subdivision (C)(2) above of a conviction, imposing the following sanctions or remedial measures on any employee who is convicted of drug abuse violations occurring in the workplace: (1) taking appropriate personnel action against the employee, up to and including termination; or (2) requiring such employee to satisfactorily participate in a drug abuse assistance or rehabilitation program approved for such purposes by a federal, state or local health, law enforcement, or other appropriate agency; and
- F. Making a good faith effort to maintain a drug-free workplace through the implementation of subparagraphs (A) through (E) above.

23. Employment Eligibility Verification As required by IC § 22-5-1.7, the Contractor swears or affirms under the penalties of perjury that the Contractor does not knowingly employ an unauthorized alien. The Contractor further agrees that:

A. The Contractor shall enroll in and verify the work eligibility status of all his/her/its newly hired employees through the E-Verify program as defined in IC § 22-5-1.7-3. The Contractor is not required to participate should the E-Verify program cease to exist. Additionally, the Contractor is not required to participate if the Contractor is self-employed and does not employ any employees.

B. The Contractor shall not knowingly employ or contract with an unauthorized alien. The Contractor shall not retain an employee or contract with a person that the Contractor subsequently learns is an unauthorized alien.

C. The Contractor shall require his/her/its subcontractors, who perform work under this Contract, to certify to the Contractor that the subcontractor does not knowingly employ or contract with an unauthorized alien and that the subcontractor has enrolled and is participating in the E-Verify program. The Contractor agrees to maintain this certification throughout the duration of the term of a contract with a subcontractor.

The State may terminate for default if the Contractor fails to cure a breach of this provision no later than thirty (30) days after being notified by the State.

24. Employment Option. If the State determines that it would be in the State's best interest to hire an employee of the Contractor, the Contractor will release the selected employee from any non-competition agreements that may be in effect. This release will be at no cost to the State or the employee.

25. Force Majeure. In the event that either party is unable to perform any of its obligations under this Contract or to enjoy any of its benefits because of natural disaster or decrees of governmental bodies not the fault of the affected party (hereinafter referred to as a "Force Majeure Event"), the party who has been so affected shall immediately give notice to the other party and shall do everything possible to resume performance. Upon receipt of such notice, all obligations under this Contract shall be immediately suspended. If the period of nonperformance exceeds thirty (30) days from the receipt of notice of the Force Majeure Event, the party whose ability to perform has not been so affected may, by giving written notice, terminate this Contract.

26. Funding Cancellation. As required by Financial Management Circular 3.3 and IC § 5-22-17-5, when the Director of the State Budget Agency makes a written determination that funds are not appropriated or otherwise available to support continuation of performance of this Contract, this Contract shall be canceled. A determination by the Director of State Budget Agency that funds are not appropriated or otherwise available to support continuation of performance shall be final and conclusive.

27. Governing Law. This Contract shall be governed, construed, and enforced in accordance with the laws of the State of Indiana, without regard to its conflict of laws rules. Suit, if any, must be brought in the State of Indiana.

28. HIPAA Compliance. If this Contract involves services, activities or products subject to the Health Insurance Portability and Accountability Act of 1996 (HIPAA), the Contractor covenants that it will appropriately safeguard Protected Health Information (defined in 45 CFR 160.103), and agrees that it is subject to, and shall comply with, the provisions of 45 CFR 164 Subpart E regarding use and disclosure of Protected Health Information.

29. Indemnification. The Contractor agrees to indemnify, defend, and hold harmless the State, its agents, officials, and employees from all claims and suits including court costs, attorney's fees, and other expenses caused by any act or omission of the Contractor and/or its subcontractors, if any, in the performance of this Contract. The State shall **not** provide such indemnification to the Contractor.

30. Independent Contractor; Workers' Compensation Insurance. The Contractor is performing as an independent entity under this Contract. No part of this Contract shall be construed to represent the creation of an employment, agency, partnership or joint venture agreement between the parties. Neither party will assume liability for any injury (including death) to any persons, or damage to any property, arising out of the acts or omissions of the agents, employees or subcontractors of the other party. The Contractor shall provide all necessary unemployment and workers' compensation insurance for the Contractor's employees, and Contractor shall provide the State with a Certificate of Insurance evidencing such coverage prior to starting work under this Contract.

31. Indiana Veteran Owned Small Business Enterprise Compliance. Award of this Contract was based, in part, on the Indiana Veteran Owned Small Business Enterprise ("IVOSB") participation plan, as detailed in the IVOSB Subcontractor Commitment Form, commonly referred to as "Attachment A-1" in the procurement documentation and incorporated by reference herein. Therefore, any changes to this information during the Contract term must be approved by IDOA's Division of Supplier Diversity and may require an amendment. It is the State's expectation that the Contractor will meet the subcontractor

commitments during the Contract term. The following certified IVOSB subcontractor(s) will be participating in this Contract: **[Add additional IVOSBs using the same format.]**

IVOSB	COMPANY NAME	PHONE	EMAIL OF CONTACT PERSON	PERCENT
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Briefly describe the IVOSB service(s)/product(s) to be provided under this Contract and include the estimated date(s) for utilization during the Contract term:

A copy of each subcontractor agreement must be submitted to the Division of Supplier Diversity within thirty (30) days of the effective date of this Contract. The subcontractor agreements may be uploaded into Pay Audit (Indiana’s subcontractor payment auditing system), emailed to IndianaVeteransPreference@idoa.IN.gov, or mailed to IDOA, 402 W. Washington Street, Room W-462, Indianapolis, IN 46204. Failure to provide a copy of any subcontractor agreement may be deemed a violation of the rules governing IVOSB procurement and may result in sanctions allowable under 25 IAC 9-5-2. Requests for changes must be submitted to IndianaVeteransPreference@idoa.IN.gov for review and approval before changing the participation plan submitted in connection with this Contract.

The Contractor shall report payments made to certified IVOSB subcontractors under this Contract on a monthly basis using Pay Audit. The Contractor shall notify subcontractors that they must confirm payments received from the Contractor in Pay Audit. The Pay Audit system can be accessed on the IDOA webpage at: www.in.gov/idoa/mwbe/payaudit.htm. The Contractor may also be required to report IVOSB certified subcontractor payments directly to the Division of Supplier Diversity, as reasonably requested and in the format required by the Division of Supplier Diversity.

The Contractor’s failure to comply with the provisions in this clause may be considered a material breach of the Contract.

32. Information Technology Enterprise Architecture Requirements. If this Contract involves information technology-related products or services, the Contractor agrees that all such products or services are compatible with any of the technology standards found at <https://www.in.gov/iot/2394.htm> that are applicable, including the assistive technology standard. The State may terminate this Contract for default if the terms of this paragraph are breached.

33. Insurance

A. The Contractor and their subcontractors (if any) shall secure and keep in force during the term of this Contract the following insurance coverages (if applicable) covering the Contractor for any and all claims of any nature which may in any manner arise out of or result from Contractor’s performance under this Contract. The required limits of liability can be obtained with a combination of primary and excess liability policies.

1. Commercial general liability, including contractual coverage, and products or completed operations coverage (if applicable), with minimum liability limits not less than \$700,000 per person and \$5,000,000 per occurrence unless additional

coverage is required by the State. The State is to be named as an additional insured on a primary, non-contributory basis for any liability arising directly or indirectly under or in connection with this Contract.

2. Automobile liability for owned, non-owned and hired autos with minimum liability limits of \$700,000 per person and \$5,000,000 per occurrence. The State is to be named as an additional insured on a primary, non-contributory basis.
3. The Contractor shall secure the appropriate Surety or Fidelity Bond(s) as required by the state department served or by applicable statute.
4. The Contractor and their subcontractors shall provide proof of such insurance coverage by tendering to the undersigned State representative a certificate of insurance prior to the commencement of this Contract and proof of workers' compensation coverage meeting all statutory requirements of IC §22-3-2. In addition, proof of an "all states endorsement" covering claims occurring outside the State is required if any of the services provided under this Contract involve work outside of Indiana.

B. The Contractor's insurance coverage must meet the following additional requirements:

1. The insurer must have a certificate of authority or other appropriate authorization to operate in the state in which the policy was issued.
2. Any deductible or self-insured retention amount or other similar obligation under the insurance policies shall be the sole obligation of the Contractor.
3. The State will be defended, indemnified and held harmless to the full extent of any coverage actually secured by the Contractor in excess of the minimum requirements set forth above. The duty to indemnify the State under this Contract shall not be limited by the insurance required in this Contract.
4. The insurance required in this Contract, through a policy or endorsement(s), shall include a provision that the policy and endorsements may not be canceled or modified without thirty (30) days' prior written notice to the undersigned State agency.
5. The Contractor waives and agrees to require their insurer to waive their rights of subrogation against the State of Indiana.

C. Failure to provide insurance as required in this Contract may be deemed a material breach of contract entitling the State to immediately terminate this Contract. The Contractor shall furnish a certificate of insurance and all endorsements to the State before the commencement of this Contract.

34. Key Person(s).

A. If both parties have designated that certain individual(s) are essential to the services offered, the parties agree that should such individual(s) leave their employment during the term of this Contract for whatever reason, the State shall have the right to terminate this Contract upon thirty (30) days' prior written notice.

- B. In the event that the Contractor is an individual, that individual shall be considered a key person and, as such, essential to this Contract. Substitution of another for the Contractor shall not be permitted without express written consent of the State.

Nothing in Sections A and B, above shall be construed to prevent the Contractor from using the services of others to perform tasks ancillary to those tasks which directly require the expertise of the key person. Examples of such ancillary tasks include secretarial, clerical, and common labor duties. The Contractor shall, at all times, remain responsible for the performance of all necessary tasks, whether performed by a key person or others.

Key person(s) to this Contract is/are:

35. Merger & Modification. This Contract constitutes the entire agreement between the parties. No understandings, agreements, or representations, oral or written, not specified within this Contract will be valid provisions of this Contract. This Contract may not be modified, supplemented, or amended, except by written agreement signed by all necessary parties.

36. Minority and Women’s Business Enterprises Compliance. Award of this Contract was based, in part, on the Minority and/or Women’s Business Enterprise (“MBE” and/or “WBE”) participation plan as detailed in the Minority and Women’s Business Enterprises Subcontractor Commitment Form, commonly referred to as “Attachment A” in the procurement documentation and incorporated by reference herein. Therefore, any changes to this information during the Contract term must be approved by the Division of Supplier Diversity and may require an amendment. It is the State’s expectation that the Contractor will meet the subcontractor commitments during the Contract term.

The following Division of Supplier Diversity certified MBE and/or WBE subcontractors will be participating in this Contract: **[Add additional MBEs and WBEs using the same format.]**

MBE or WBE	COMPANY NAME	PHONE	EMAIL OF CONTACT PERSON	PERCENT
<hr/>				

Briefly describe the MBE and/or WBE service(s)/product(s) to be provided under this Contract and include the estimated date(s) for utilization during the Contract term:

A copy of each subcontractor agreement must be submitted to the Division of Supplier Diversity within thirty (30) days of the effective date of this Contract. The subcontractor agreements may be uploaded into Pay Audit (Indiana’s subcontractor payment auditing system), emailed to MWBECompliance@idoa.IN.gov, or mailed to Division of Supplier Diversity, 402 W. Washington Street, Indianapolis IN 46204. Failure to provide a copy of any subcontractor agreement may be deemed a violation of the rules governing MBE/WBE procurement and may result in sanctions allowable under 25 IAC 5-7-8. Requests for changes must be submitted to MWBECompliance@idoa.IN.gov for review and approval before changing the participation plan submitted in connection with this Contract.

The Contractor shall report payments made to Division of Supplier Diversity certified subcontractors under this Contract on a monthly basis using Pay Audit. The Contractor shall notify subcontractors that

they must confirm payments received from the Contractor in Pay Audit. The Pay Audit system can be accessed on the IDOA webpage at: www.in.gov/idoa/mwbe/payaudit.htm. The Contractor may also be required to report Division of Supplier Diversity certified subcontractor payments directly to the Division of Supplier Diversity, as reasonably requested and in the format required by the Division of Supplier Diversity.

The Contractor's failure to comply with the provisions in this clause may be considered a material breach of the Contract.

37. Nondiscrimination. Pursuant to the Indiana Civil Rights Law, specifically including IC § 22-9-1-10, and in keeping with the purposes of the federal Civil Rights Act of 1964, the Age Discrimination in Employment Act, and the Americans with Disabilities Act, the Contractor covenants that it shall not discriminate against any employee or applicant for employment relating to this Contract with respect to the hire, tenure, terms, conditions or privileges of employment or any matter directly or indirectly related to employment, because of the employee's or applicant's race, color, national origin, religion, sex, age, disability, ancestry, status as a veteran, or any other characteristic protected by federal, state, or local law ("Protected Characteristics"). Contractor certifies compliance with applicable federal laws, regulations, and executive orders prohibiting discrimination based on the Protected Characteristics in the provision of services. Breach of this paragraph may be regarded as a material breach of this Contract, but nothing in this paragraph shall be construed to imply or establish an employment relationship between the State and any applicant or employee of the Contractor or any subcontractor.

The State is a recipient of federal funds, and therefore, where applicable, Contractor and any subcontractors shall comply with requisite affirmative action requirements, including reporting, pursuant to 41 CFR Chapter 60, as amended, and Section 202 of Executive Order 11246 as amended by Executive Order 13672.

38. Notice to Parties. Whenever any notice, statement or other communication is required under this Contract, it will be sent by E-mail or first-class U.S. mail service to the following addresses, unless otherwise specifically advised. Such notice, statement or other communication shall include the Public Works Project Number in the subject line of the E-mail and the body of the notice or other communication.

A. Notices to the State shall be sent to:

Public Works Division, Director
Indiana Department of Administration
402 W Washington St Room W462
Indianapolis, IN 46204
E-mail: rgrossman@idoa.IN.gov

B. Notices to the Contractor shall be sent to:

[INSERT CONTRACTOR NAME]
[INSERT CONTRACTOR'S
ADDRESS]
E-mail: _____

As required by IC § 4-13-2-14.8, payments to the Contractor shall be made via electronic funds transfer in accordance with instructions filed by the Contractor with the Indiana Auditor of State.

39. Order of Precedence; Incorporation by Reference. Any inconsistency or ambiguity in this Contract shall be resolved by giving precedence in the following order: (1) this Contract, (2) the Project Bid Package, (3) attachments prepared by the State; (4) Contractor's Proposal; and (5) attachments prepared by the

Contractor. All of the foregoing are incorporated fully by reference. All attachments, and all documents referred to in this paragraph are hereby incorporated fully by reference.

40. Ownership of Documents and Materials.

A. All documents, records, programs, applications, data, algorithms, film, tape, articles, memoranda, and other materials (the "Materials") not developed or licensed by the Contractor prior to execution of this Contract, but specifically developed under this Contract shall be considered "work for hire" and the Contractor hereby transfers and assigns any ownership claims to the State so that all Materials will be the property of the State. If ownership interest in the Materials cannot be assigned to the State, the Contractor grants the State a non-exclusive, non-cancelable, perpetual, worldwide royalty-free license to use the Materials and to use, modify, copy and create derivative works of the Materials.

B. Use of the Materials, other than related to contract performance by the Contractor, without the prior written consent of the State, is prohibited. During the performance of this Contract, the Contractor shall be responsible for any loss of or damage to the Materials developed for or supplied by the State and used to develop or assist in the services provided while the Materials are in the possession of the Contractor. Any loss or damage thereto shall be restored at the Contractor's expense. The Contractor shall provide the State full, immediate, and unrestricted access to the Materials and to Contractor's work product during the term of this Contract.

41. Payments.

A. All payments shall be made thirty five (35) days in arrears in conformance with State fiscal policies and procedures and, as required by IC §4-13-2-14.8, the direct deposit by electronic funds transfer to the financial institution designated by the Contractor in writing unless a specific waiver has been obtained from the Indiana Auditor of State. No payments will be made in advance of receipt of the goods or services that are the subject of this Contract except as permitted by IC § 4-13-2-20.

B. If the Contractor is being paid in advance for the maintenance of equipment, software or a service as a subscription, then pursuant to IC § 4-13-2-20(b)(14), the Contractor agrees that if it fails to fully provide or perform under this Contract, upon receipt of written notice from the State, it shall promptly refund the consideration paid, pro-rated through the date of non-performance.

42. Penalties/Interest/Attorney's Fees. The State will in good faith perform its required obligations hereunder and does not agree to pay any penalties, liquidated damages, interest or attorney's fees, except as permitted by Indiana law, in part, IC § 5-17-5, IC § 34-54-8, IC § 34-13-1 and IC § 34-52-2.

Notwithstanding the provisions contained in IC § 5-17-5, any liability resulting from the State's failure to make prompt payment shall be based solely on the amount of funding originating from the State and shall not be based on funding from federal or other sources.

43. Progress Reports. The Contractor shall submit progress reports to the State upon request. The report shall be oral, unless the State, upon receipt of the oral report, should deem it necessary to have it in written form. The progress reports shall serve the purpose of assuring the State that work is progressing in line with the schedule, and that completion can be reasonably assured on the scheduled date.

44. Public Record.

The Contractor acknowledges that the State will not treat this Contract as containing confidential information, and the State will post this Contract on the transparency portal as required by Executive

Order 05-07 and IC § 5-14-3.5-2. Use by the public of the information contained in this Contract shall not be considered an act of the State.

45. Renewal Option. This Contract may be renewed under the same terms and conditions, subject to the approval of the Commissioner of the Department of Administration and the State Budget Director in compliance with IC § 5-22-17-4. The term of the renewed contract may not be longer than the term of the original contract.

46. Severability. The invalidity of any section, subsection, clause or provision of this Contract shall not affect the validity of the remaining sections, subsections, clauses or provisions of this Contract.

47. Substantial Performance. This Contract shall be deemed to be substantially performed only when fully performed according to its terms and conditions and any written amendments or supplements.

48. Taxes. The State is exempt from most state and local taxes and many federal taxes. The State will not be responsible for any taxes levied on the Contractor as a result of this Contract.

49. Termination for Convenience. This Contract may be terminated, in whole or in part, by the State, which shall include and is not limited to the Indiana Department of Administration and the State Budget Agency whenever, for any reason, the State determines that such termination is in its best interest. Termination of services shall be effected by delivery to the Contractor of a Termination Notice at least thirty (30) days prior to the termination effective date, specifying the extent to which performance of services under such termination becomes effective. The Contractor shall be compensated for services properly rendered prior to the effective date of termination. The State will not be liable for services performed after the effective date of termination. The Contractor shall be compensated for services herein provided but in no case shall total payment made to the Contractor exceed the original contract price or shall any price increase be allowed on individual line items if canceled only in part prior to the original termination date. For the purposes of this paragraph, the parties stipulate and agree that the Indiana Department of Administration shall be deemed to be a party to this agreement with authority to terminate the same for convenience when such termination is determined by the Commissioner of IDOA to be in the best interests of the State.

50. Termination for Default.

- A. With the provision of thirty (30) days' notice to the Contractor, the State may terminate this Contract in whole or in part if the Contractor fails to:
1. Correct or cure any breach of this Contract; the time to correct or cure the breach may be extended beyond thirty (30) days if the State determines progress is being made and the extension is agreed to by the parties;
 2. Deliver the supplies or perform the services within the time specified in this Contract or any extension;
 3. Make progress so as to endanger performance of this Contract; or
 4. Perform any of the other provisions of this Contract.
- B. If the State terminates this Contract in whole or in part, it may acquire, under the terms and in the manner the State considers appropriate, supplies or services similar to those terminated, and the Contractor will be liable to the State for any excess costs for those supplies or services. However, the Contractor shall continue the work not terminated.

- C. The State shall pay the contract price for completed supplies delivered and services accepted. The Contractor and the State shall agree on the amount of payment for manufacturing materials delivered and accepted and for the protection and preservation of the property. Failure to agree will be a dispute under the Disputes clause. The State may withhold from these amounts any sum the State determines to be necessary to protect the State against loss because of outstanding liens or claims of former lien holders.
- D. The rights and remedies of the State in this clause are in addition to any other rights and remedies provided by law or equity or under this Contract.

51. Travel. No expenses for travel will be reimbursed unless specifically authorized by this Contract. Permitted expenses will be reimbursed at the rate paid by the State and in accordance with the *Indiana Department of Administration's Travel Policies and Procedures* in effect at the time the expenditure is made. Out-of-state travel requests must be reviewed by the State for availability of funds and for conformance with *Travel Policy* guidelines.

52. Waiver of Rights. No right conferred on either party under this Contract shall be deemed waived, and no breach of this Contract excused, unless such waiver is in writing and signed by the party claimed to have waived such right. Neither the State's review, approval or acceptance of, nor payment for, the services required under this Contract shall be construed to operate as a waiver of any rights under this Contract or of any cause of action arising out of the performance of this Contract, and the Contractor shall be and remain liable to the State in accordance with applicable law for all damages to the State caused by the Contractor's negligent performance of any of the services furnished under this Contract.

53. Work Standards. The Contractor shall execute its responsibilities by following and applying at all times the highest professional and technical guidelines and standards. If the State becomes dissatisfied with the work product of or the working relationship with those individuals assigned to work on this Contract, the State may request in writing the replacement of any or all such individuals, and the Contractor shall grant such request.

THE REMAINDER OF THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

Non-Collusion and Acceptance

The undersigned attests, subject to the penalties for perjury, that the undersigned is the Contractor, or that the undersigned is the properly authorized representative, agent, member or officer of the Contractor. Further, to the undersigned’s knowledge, neither the undersigned nor any other member, employee, representative, agent or officer of the Contractor, directly or indirectly, has entered into or been offered any sum of money or other consideration for the execution of this Contract other than that which appears upon the face hereof. **Furthermore, if the undersigned has knowledge that a state officer, employee, or special state appointee, as those terms are defined in IC 4-2-6-1, has a financial interest in the Contract, the Contractor attests to compliance with the disclosure requirements in IC 4-2-6-10.5.**

Agreement to Use Electronic Signatures

I agree, and it is my intent, to sign this Contract by accessing State of Indiana Supplier Portal using the secure password assigned to me and by electronically submitting this Contract to the State of Indiana. I understand that my signing and submitting this Contract in this fashion is the legal equivalent of having placed my handwritten signature on the submitted Contract and this affirmation. I understand and agree that by electronically signing and submitting this Contract in this fashion I am affirming to the truth of the information contained herein. I understand that this Contract will not become binding on the State until it has been approved by the Department of Administration, the State Budget Agency, and the Office of the Attorney General, which approvals will be posted on the Active Contracts Database:
<https://secure.in.gov/apps/idoa/contractsearch/>

IN WITNESS WHEREOF, the Contractor and the State have, through their duly authorized representatives, entered into this Contract for Public Works Project Number XXXXX. The parties, having read and understood the foregoing terms of this Contract, do by their respective signatures dated below agree to the terms thereof.

Contractor: XXXXXXXXXXXX

**Department of Administration
Public Works Division**

By: _____
Printed Name: _____
Title: _____

Date: _____

By: _____
Robert Grossman, Director
For IDOA Commissioner if less than \$10,000,000

Date: _____

Approved by:
Department of Administration

Approved by:
State Budget Agency

By: _____ (for)
Rebecca Holwerda, Commissioner

By: _____ (for)
Zachary Q. Jackson, Director

Date: _____

Date: _____

Approved as to Form and Legality:
*Form approval has been granted by the
Office of the Attorney General pursuant to
IC 4-13-2-14.3(e) on October 5, 2022.
FA 22-49*

This document prepared and reviewed by:

Counsel, Indiana Department of Administration

TEMPLATE

**STATE OF INDIANA'S
PUBLIC WORKS CONSTRUCTION CONTRACT
CHANGE ORDER/AMENDMENT #_**
Contract # _____

THIS IS AMENDMENT # [] to the Public Works Construction Contract ("Contract") entered into by and between the Indiana Department of Administration's Public Works Division ("State") and XXXXXXXXXX ("Contractor"), executed pursuant to the terms and conditions set forth herein, governed by Indiana Code 4-13.6, *et seq.* and approved by the last State signatory on [] .

In consideration of the mutual undertakings and covenants hereinafter set forth, the parties agree to amend the Contract as follows:

1. A written change has been requested by the Contractor, as detailed in **Amendment #** [] **Exhibit A**, attached hereto and incorporated herein, in connection with the following Public Works Project:

Project Number: **XXXXXXXXXX**
 Project Name: **XXXXXXXXXX**
 Designer (if applicable): **XXXXXXXXXX**
 Purchase Order Number: **XXXXXXXXXX**
 Institution Department: **XXXXXXXXXX**
 Req. No: **XXXXXXXXXX**
 Change Order No: **XXXXXXXXXX**

2. [] The Designer has recommended the Contractor's change in writing, as evidenced by **Amendment #** [] **Exhibit** [] , attached hereto and incorporated herein.
 [] No Designer has been contracted for this Project.

3. The State has approved the change request, as detailed in **Amendment #** [] **Exhibit B**, attached hereto and incorporated herein.

4. The consideration for this Amendment # [] is as follows:

ORIGINAL CONTRACT VALUE	\$ _____
TOTAL PREVIOUS AMENDMENT VALUE	\$ _____
PRE-AMENDMENT CONTRACT TOTAL	\$ _____
[] INCREASE/[] DECREASE THIS AMENDMENT	\$ _____
[] INCREASE/[] DECREASE REMEDIATION ALLOWANCE	\$ _____
NEW CONTRACT TOTAL REMUNERATION	\$ _____

This change represents a \$XX,XXX [] increase/[] decrease in the original contract and a \$XX,XXX [] increase/[] decrease in remediation allowance, for a total [] increase/[] decrease of \$XX,XXX. Retainage [] will/[] will not be withheld on this change order amount.

5. The term of this Contract is hereby [] extended for an additional **XXX** days.
 [] decreased by **XXX** days.
 [] remains the same.

Therefore, the Contract shall terminate on [] .

6. **A. Minority and Women's Business Enterprises Compliance. *Include one of the options, as applicable; delete the inapplicable option.***

OPTION 1-to be used if the MBE and/or WBE subcontractor(s) will continue to be utilized during the extension period.

As required by 25 IAC 5-6-2(b), the following Division of Supplier Diversity certified MBE or WBE subcontractor(s) will be participating in this Contract under this Change Order/Amendment. This participation represents [] the same percentage or [] an increase of [] % above the original MBE and/or WBE commitment. **[Add additional MBEs and WBEs using the same format.]**

MBE or WBE	COMPANY NAME	PHONE	EMAIL OF CONTACT PERSON	PERCENT

Briefly describe the MBE and/or WBE service(s)/product(s) to be provided under this Amendment and include the estimated date(s) for utilization during the extension period:

A copy of each subcontractor agreement must be submitted to the Division of Supplier Diversity within thirty (30) days of the effective date of this Amendment. The subcontractor agreements may be uploaded into Pay Audit (Indiana’s subcontractor payment auditing system), emailed to MWBECompliance@idoa.IN.gov, or mailed to Division of Supplier Diversity, 402 W. Washington Street, RoomW-462, Indianapolis IN 46204. Failure to provide a copy of any subcontractor agreement may be deemed a violation of the rules governing MBE/WBE procurement and may result in sanctions allowable under 25 IAC 5-7-8. Requests for changes must be submitted to MWBECompliance@idoa.IN.gov for review and approval before changing the participation plan submitted in connection with this Amendment.

The Contractor shall report payments made to Division of Supplier Diversity certified subcontractors under this Contract on a monthly basis using Pay Audit. The Contractor shall notify subcontractors that they must confirm payments received from Contractor in Pay Audit. The Pay Audit system can be accessed on the IDOA webpage at: www.in.gov/idoa/mwbe/payaudit.htm. Contractor may also be required to report Division of Supplier Diversity certified subcontractor payments directly to the Division of Supplier Diversity, as reasonably requested and in the format required by the Division of Supplier Diversity.

Contractor’s failure to comply with the provisions in this clause may be considered a material breach of the Contract.

OPTION 2 – to be used if the original Contract identified subcontractors in this clause, but the Contractor will not be utilizing the MBE and WBE subcontractors during the extension period.

No certified MBE or WBE subcontractors will be participating in this Contract under this Change Order/Amendment.

B. Indiana Veteran Owned Small Business Enterprises Compliance. *Include one of the options, as applicable; delete the inapplicable option.*

OPTION 1-to be used if the IVOSB subcontractor(s) will continue to be utilized during the extension period.

As required by 25 IAC 9-4-1(b), the following certified IVOSB subcontractors will be participating in this Contract under this Change Order/Amendment. This participation represents [] the same percentage or [] an increase of [] % above the original IVOSB commitment. **[Add additional IVOSBs using the same format.]**

IVOSB	COMPANY NAME	PHONE	EMAIL OF CONTACT PERSON	PERCENT

Briefly describe the IVOSB service(s)/product(s) to be provided under this Amendment and include the estimated date(s) for utilization during the extension period:

A copy of each subcontractor agreement must be submitted to IDOA's Division of Supplier Diversity within thirty (30) days of the effective date of this Amendment. The subcontractor agreements may be uploaded into Pay Audit (Indiana's subcontractor payment auditing system), emailed to IndianaVeteransPreference@idoa.IN.gov, or mailed to IDOA, 402 W. Washington Street, Room W-462, Indianapolis, IN 46204. Failure to provide a copy of any subcontractor agreement may be deemed a violation of the rules governing IVOSB procurement and may result in sanctions allowable under 25 IAC 9-5-2. Requests for changes must be submitted to IndianaVeteransPreference@idoa.IN.gov for review and approval before changing the participation plan submitted in connection with this Amendment.

The Contractor shall report payments made to certified IVOSB subcontractors under this Contract on a monthly basis using Pay Audit. The Contractor shall notify subcontractors that they must confirm payments received from Contractor in Pay Audit. The Pay Audit system can be accessed on the IDOA webpage at: www.in.gov/idoa/mwbe/payaudit.htm. The Contractor may also be required to report IVOSB certified subcontractor payments directly to the Division of Supplier Diversity, as reasonably requested and in the format required by the Division of Supplier Diversity.

The Contractor's failure to comply with the provisions in this clause may be considered a material breach of the Contract.

OPTION 2 – to be used if the original Contract identified subcontractors in this clause, but the Contractor will not be utilizing the IVOSB subcontractors during the extension period.

No certified IVOSB subcontractors will be participating in this Contract under this Change Order/Amendment.

All matters set forth in the original Contract and not affected by this Amendment shall remain in full force and effect.

Non-Collusion and Acceptance

The undersigned attests, subject to the penalties for perjury, that the undersigned is the Contractor, or that the undersigned is the properly authorized representative, agent, member or officer of the Contractor. Further, to the undersigned’s knowledge, neither the undersigned nor any other member, employee, representative, agent or officer of the Contractor, directly or indirectly, has entered into or been offered any sum of money or other consideration for the execution of this Amendment other than that which appears upon the face hereof. **Furthermore, if the undersigned has knowledge that a state officer, employee, or special state appointee, as those terms are defined in IC 4-2-6-1, has a financial interest in the Contract, the Contractor attests to compliance with the disclosure requirements in IC 4-2-6-10.5.**

Agreement to Use Electronic Signatures

I agree, and it is my intent, to sign this Contract by accessing State of Indiana Supplier Portal using the secure password assigned to me and by electronically submitting this Contract to the State of Indiana. I understand that my signing and submitting this Contract in this fashion is the legal equivalent of having placed my handwritten signature on the submitted Contract and this affirmation. I understand and agree that by electronically signing and submitting this Contract in this fashion I am affirming to the truth of the information contained therein. I understand that this Contract will not become binding on the State until it has been approved by the Department of Administration, the State Budget Agency, and the Office of the Attorney General, which approvals will be posted on the Active Contracts Database: <https://secure.in.gov/apps/idoa/contractsearch/>

In Witness Whereof, the Contractor and the State have, through their duly authorized representatives, entered into this Amendment for Public Works Project Number **XXXXXX**. The parties, having read and understood the foregoing terms of this Amendment, do by their respective signatures dated below agree to the terms thereof.

Contractor: XXXXXXXXXXX

**Department of Administration
Public Works Division**

By: _____

Printed Name: _____

Title: _____

Date: _____

By: _____

Robert Grossman, Director

For IDOA Commissioner if less than \$10,000,000

Date: _____

Approved by:
Department of Administration

Approved by:
State Budget Agency *PURSUANT TO IC 4-13-2-14.1*
APPROVAL OF THE BUDGET AGENCY
IS NOT REQUIRED FOR CONTRACTS
UNDER \$100,000.00

By: _____ (for)
Rebecca Holwerda, Commissioner

By: _____ (for)
Zachary Q. Jackson, Director

Date: _____

Date: _____

Approved as to Form and Legality:
Form approval has been granted by the
Office of the Attorney General pursuant to
IC 4-13-2-14.3(e) on October 5, 2022.
FA 22-48

This document prepared and reviewed by:

Counsel, Indiana Department of Administration

TEMPLATE

CONSTRUCTION CONTRACT CHANGE ORDER/AMENDMENT #

AMENDMENT # EXHIBIT A

See Documents to Follow for Exhibit

TEMPLATE

CONSTRUCTION CONTRACT CHANGE ORDER/AMENDMENT #

AMENDMENT # EXHIBIT B

See Documents to Follow for Exhibit

TEMPLATE



CERTIFICATE OF SUBSTANTIAL COMPLETION

State Form 1084 (R / 10-22) / DAPW 5

INDIANA PUBLIC WORKS PROJECT NUMBER: _____

PROJECT NAME: _____

TO: Department of Administration
State of Indiana

THROUGH: Director Public Works

DESIGNER: _____

CONTRACTOR: _____

CONTRACT FOR: _____
(GENERAL, MECHANICAL, ELECTRICAL, OTHER)

CONTRACT DATE: _____ CONTRACTOR P.O.NO: _____

PROJECT OR DESIGNATED AREA SHALL INCLUDE: _____

The contractor hereby certifies the Work of this project to be in complete conformance to the Contract Documents and to be substantially complete, enabling the Owner to make use of the Work as intended.

By his signature below the Contractor further requests Designer and Owner to inspect the Work and to concur in the Work's substantial completion by their signature and/or to provide in a timely manner to Contractor a listing of work items adjudged by them as remaining to be completed or corrected. Contractor agrees to complete and correct all work items representative of such listing within ___ days from date of receipt from designer.

Contractor Company Name _____
By (written) (typed or printed) _____ Date _____
(Shall be signed by same representative who signed Contract)

A list of items to be completed or corrected, verified by the Designer and Owner, is (is not) appended hereto. Failure to include any incomplete items on such list does not alter the responsibility of the Contractor to provide all Work in complete conformance with the Contract Documents.

Designer Company Name _____
By (written) (typed or printed) _____ Date _____
(Shall be signed by Designer of Record with Certification Responsibility to the State of Indiana)

The Work performed under this Contract has been reviewed and found to be substantially complete by the Director of Public Works who has hereby established the Date of Substantial Completion as _____ which is also the date of commencement of all warranties and guarantees required by the Contract Documents. The Date of Substantial Completion of the Work or designated portion thereof is the date established by the Director of Public Works when construction is sufficiently complete, in accordance with the Contract Documents, so the Owner may occupy the Work, or designated portion thereof, for the use for which it is intended.

The Owner accepts the Work or designated portion thereof as substantially complete and assumes full possession thereof, in accordance with the contract documents.

STATE OF INDIANA
Owner _____
By: Director Public Works _____ Date _____
(Shall be signed by Director of Public Works as Owner's representative)

The responsibilities of the Owner and the Contractor for maintenance, heat, utilities, and insurance shall be as set out in the Contract Documents.

PART B
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12	C1-03	EXISTING SITE IMPROVEMENTS PLAN
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PART C

WORKMANSHIP AND MATERIALS

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WORKMANSHIP AND MATERIALS SPECIFICATIONS

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WORKMANSHIP AND MATERIALS SPECIFICATIONS

(SECTION WM 1)

GENERAL

PART 1 GENERAL

1.01 The following specifications for Workmanship and Materials are of general application, and are to be used with the Detailed Specifications and drawings as far as applicable.

The Sections of the Workmanship and Materials Specifications shall accompany or be attached to each set of the Detailed Specifications. Additional Sections of Workmanship and Materials Specifications, other than those listed, may be included as a part of the contract documents attached to the listed Sections.

Materials for which no detailed specifications are given herein or under the Detailed Specifications shall in general conform to the physical characteristics and methods of treatment as set forth in the latest specifications of the American Society for Testing Materials insofar as they may apply, and shall be of the quality and character best adapted to the purpose for which they are to be used. No material shall be used for any purpose unless the material has previously been in use for a like purpose for a sufficient length of time to demonstrate the materials' satisfactory use.

All materials and equipment to be provided by the Contractor under this contract shall be new, unless otherwise specified. Any equipment offered shall be new and of a make and type which can be shown to have operated satisfactorily and continually in actual service for a sufficient length of time to demonstrate the equipment's success for the purpose for which the equipment is to be used.

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(SECTION WM 2)

EXCAVATION

PART 1 GENERAL

1.01 Description

- A. The Contractor shall make all earth excavations required, to the widths and depths necessary for proper construction (and only to such widths and depths), for constructing according to the plans, all structures included in this contract. Earth shall mean all kinds of materials, wet and/or dry, excavated, or which are to be excavated, including rock, shale, hardpan, muck, quicksand, etc., unless provisions are made elsewhere in the contract documents for specified soil types.
- B. Excavation shall include clearing the site for the work; the loosening, loading, removing, transporting, and disposing of all materials, wet or dry, necessary to be removed for purposes of construction; all sheeting and bracing; all draining, dewatering and pumping; backfilling of trenches, excavations and pits; earth borrow; the supporting of the excavations and structures (new and existing) above and below ground; the handling of water; and all incidental work.
- C. Prior to commencing construction operations, the Contractor shall make all the provisions necessary to assure the protection of all existing improvements, both public and private. He shall protect trees, shrubs, plantings and grassed areas and shall make provisions for maintaining public travel in an acceptable manner.

PART 2 EXECUTION

2.01 Clearing

Preparatory to excavation, the site of all open cut excavations, embankments and fills shall be first cleared of obstructions and existing facilities (except those which must remain temporarily or permanently in service). On all public or private property where grants or easements have been obtained, and on the property of the Owner, the Contractor shall remove and keep separate the topsoil, and shall carefully replace it after the backfilling is completed.

2.02 Pavement Cutting

Prior to excavating paved areas all excavation edges falling within the pavement shall be saw cut in a neat straight manner. Cutting shall be performed with a saw designed specifically for this purpose. The cut shall penetrate the entire pavement thickness where possible. If the existing pavement is more than 6 inches thick then a cut of not less than 6 inch depth shall be made. Sawing equipment shall be submitted to the Engineer for approval before initial use. When the approved cutting equipment makes a cut more than 1" wide the cutting shall precede the excavation no more than one block or 400 feet which ever is less. If pavement cuts (those less than 1 inch wide) are made in streets which are reopened to traffic prior to excavation then the cuts shall be thoroughly filled with sand and maintained full until the excavation is performed.

2.03 Protection of Existing Improvements

- A. Before any excavation is started, adequate protection shall be provided for all lawns, trees, shrubs, landscape work, fences, sidewalks, hydrants, utility poles, street, alley and driveway paving, curbs, storm sewers, ditches, headwalls, catch basins, surface inlets and all other improvements that are to remain in place. Such protection shall be provided as long as necessary to prevent damage from the Contractor's operations. Shrubs, bushes, small trees and flowers, which have to be removed to permit excavation for the project, shall be protected and replanted or replaced when the backfill is complete unless otherwise directed by the Engineer.
- B. The Contractor shall exercise every precaution to prevent damage to property within and outside the immediate vicinity of the work. He shall remove all debris and rock from the site and restore the ground surfaces, replace or repair all driveways, buildings, fences, retaining walls, culverts, drains, paving, sidewalks, etc., which are removed or damaged during construction.
- C. Repair, restoration or replacement of any improvements damaged or removed outside of the work to be performed shall be the obligation of the Contractor at no additional cost to the Owner.

2.04 Protection of Trees and Shrubs

- A. No existing trees or shrubs in street Rights-of-Way and easements shall be damaged or destroyed. Where branches of trees or shrubs interfere with the Contractor's operations, they shall be protected by tying back wherever possible. No limbs or branches shall be cut. If his operations will not permit saving certain trees, the Contractor shall be wholly responsible for satisfying all claims for restoration or restitution resulting from their damage or removal.
- B. If small trees and shrubs are moved or pruned to permit more working space, pruning shall be done in accordance with HGB083 (1984), U.S. Department of Agriculture, "Pruning Shade Trees and Repairing Their Injuries." However, the Contractor shall obtain, in writing, the property owner's permission to move or prune trees or shrubs on his property.
- C. Trees and shrubs damaged by the Contractor's operation shall be repaired in accordance with said HGB083 (1984).
- D. Payment for protecting trees and shrubs shall be the obligation of the Contractor at no additional cost to the Owner.

2.05 Maintenance of Public Travel

- A. The CONTRACTOR shall carry out the WORK in a manner which will cause a minimum of interruption to traffic, and may close to through travel not more than two (2) consecutive blocks, including the cross street intersected. Where traffic must cross open trenches, the CONTRACTOR shall provide suitable bridges to street intersections and driveways. The CONTRACTOR shall post suitable signs indicating that a street is closed and necessary detour signs for the proper

maintenance of traffic. Prior to closing of any streets the CONTRACTOR shall notify responsible municipal authorities.

- B. The CONTRACTOR shall plan construction activities to minimize impact to traffic. Local traffic access must be maintained at all times. To maintain traffic movement, appropriate traffic control devices shall be used. Such traffic control devices shall comply with the latest edition of the State Manual on Uniform Traffic Control Devices. The CONTRACTOR shall follow the requirements of the State Department of Transportation Standard Specifications Traffic Control Plans when no other plan is submitted for review.
- C. The Local Highway Department shall be notified no less than five (5) calendar days prior to any construction activities occurring within the right-of-way.

2.06 Utility Interruption

- A. The CONTRACTOR shall proceed with caution in the excavation and preparation of the trench or pit so that the exact location of underground structures may be determined. Prior to proceeding with trench excavation the CONTRACTOR shall contact all utility companies in the area to aid in locating their underground services.
- B. The CONTRACTOR shall take all reasonable precautions against damage to existing utilities. However, in the event of a break in an existing water main, gas main, sewer or underground cable, he shall immediately notify the responsible official of the organization operating the utility interrupted. The CONTRACTOR shall lend all possible assistance in restoring services and shall assume all costs, charges, or claims connected with the interruption and repair of such services.

2.07 Construction in Easements

- A. In easements across private property, the CONTRACTOR shall confine all operations in the easement area and shall be responsible and liable for all damage outside of the easement area. Trees, fences, shrubbery or other types of surface improvements located in easements will require protection during construction. Precautions shall be taken by adequate sheeting or other approved method to prevent any cave-in or subsidence beyond the easement limits or damage to improvements within the easement. In general, the easement area is intended to provide reasonable access and working area for efficient operation by the CONTRACTOR. Where easement space for efficient operation is not provided, the CONTRACTOR shall be responsible for organizing his operations to perform within the restrictions shown on the plans. When requested, the OWNER shall furnish the CONTRACTOR a copy of the construction easements. Anytime the CONTRACTOR has to work outside of the easement area, he must obtain written permission from the property owner and furnish the ENGINEER with a copy.

2.08 Drainage

- A. The Contractor shall make provisions for handling all flows in existing creeks, ditches, sewers and trenches by pipes, flumes or other approved methods at all

times when his operations would, in any way, interfere with the natural functioning of said creeks, ditches, sewers and drains. The Contractor shall at all times during construction provide and maintain sufficient equipment for the disposal of all water which enters the excavation, both in open cut trenches and in tunnels, to render such excavation firm and dry, until the structures to be built thereon are completed.

- B. Pipe underdrains, well point systems, deep well pumps or other suitable equipment and methods shall be used to keep all excavations firm and dry, at no additional cost to the Owner unless otherwise provided in the Proposal.

2.09 Disposal of Unsuitable Materials

- A. Excavated materials which are either surplus and not required or are unsuitable for backfilling shall be removed from the site of operations as soon as excavated. All excavated materials so removed shall be disposed of, at no additional cost to the Owner, on privately owned property for which the Contractor has made prior arrangements. The Contractor is responsible for the restoration of areas within Public Rights-of-Way bordering properties for which the Contractor has a dump permit or release.
- B. The Contractor is to provide the Engineer with a copy of the said permit, stating the condition in which the Property Owner will accept the spoil materials.

2.10 Storage of Suitable Materials

- A. Excavated materials suitable and required for immediate backfill, shall be stored in neat piles adjacent to the excavation in a manner so as to interfere as little as possible with traffic, but shall not be placed at such heights above or closeness to the sidewalls of the excavation to endanger such operations due to slides or cave-ins. Fire hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, or other utility controls within Right-of-Ways shall be left unobstructed and accessible until the WORK is completed.
- B. Excavated materials suitable for use as backfill, fill and embankments but not needed immediately shall be transported to a location approved by the Engineer and stored at the contractors expense. Storage shall be on the owners property provided the site offers sufficient room without hindering the Work or the normal operation of the Owner's facilities. All weather access must be maintained to all operating facilities on the site at no additional expense to the Owner. Gutters and catch basins shall be kept clear or other satisfactory provisions made for drainage. Natural watercourses shall not be obstructed.

2.11 Open Cut Excavation

- A. Open cut excavation, either in earth or rock, shall be safely supported and of sufficient width and depth (and only to such width and depth) to provide adequate room for the construction or installation of the work to the lines, grades and dimensions shown on the Plans.

2.12 Trench Dimensions

- A. The bottom width of the trench at and below the top of the pipe and inside the sheeting and bracing, if used, shall not exceed the recommendations as contained in the applicable ASTM Standard for the pipe being used.
- B. Trench sheeting and bracing or a trench shield or box shall be used as required by the rules and regulations of OSHA. The bottom of the trench shall still meet the above standards.
- C. If the trench widths are exceeded without the written permission of the Engineer, the pipe shall be installed with a concrete cradle or with concrete encasement or other ASTM approved methods as approved by the Engineer and at no additional cost to the Owner.

2.13 Excavations With Sloping Sides, Limited

- A. The Contractor may, at his option, where working conditions and right of way permit (as determined by the Engineer), excavate pipe line trenches and pits for structures with sloping sides, but with the following limitations:
 - 1. In general, only braces and vertical trenches will be permitted in traveled streets, alleys, narrow easements and for pit excavations more than 10 feet deep.
 - 2. Where pipe line trenches with sloping sides are permitted, the slopes shall not extend below the top of the pipe, and trench excavations below this point shall be made with near-vertical sides with widths not exceeding those specified herein before.
 - 3. Slopes shall conform to all OSHA regulations.
 - 4. When pit excavations with sloping sides are permitted, the Contractor shall assume full responsibility for all costs incurred to backfill the larger excavation in accordance with the Contract Documents including furnishing materials if adequate quantities of suitable materials are not available from those excavated on the site.

2.14 Sheeting and Bracing

- A. The Contractor shall furnish, place and maintain adequate sheeting and bracing as may be required to support the sides of the excavation and prevent any movements of earth which could, in any way; diminish the width of the excavation to less than that necessary for proper construction; cause damage to the pipe or structure being constructed or to adjacent structures, utilities, pavements or walks; cause injury to workmen or others through movement of the adjacent earth banks; or to otherwise damage or delay the work.
 - 1. Materials: Sheeting may be of wood or steel and shall be of adequate strength for the excavation, subject to the approval of the Engineer, who

shall have the right to order the Contractor to furnish heavier sheeting than that being used or proposed to be used by the Contractor, at no additional cost to the Owner.

2. Additional Supports: If the Engineer is of the opinion that sufficient or proper supports have not been provided at any location, he may order additional supports installed at the expense of the Contractor, and the compliance with such orders shall not relieve or release the Contractor from his responsibility for adequately supporting the sides of the excavation.
3. Methods: Wherever possible, the sheeting and bracing shall be driven ahead of the excavation to avoid loss of material from behind the sheeting. If it is necessary to excavate below the sheeting, care shall be taken to avoid trimming behind the face along which the sheeting will be driven. Care shall be taken to prevent voids outside the sheeting; but, if voids develop, they shall be immediately filled with selected sandy materials and compacted by flushing and jetting with water or as directed by the Engineer. Where drop inlets or stacks are constructed, the excavation shall be offset, as required, without additional compensation.
4. Left in Place: The engineer may order sheeting and bracing to be left in place at locations other than shown by the Plans. Sheeting left in place may be ordered to be cut off at any specified elevation, but in no case shall it be left in the ground above an elevation eighteen (18) inches below the existing or proposed surface of the ground. All voids created by the cutting off of the sheeting to be left in place shall be immediately filled with selected sandy materials and compacted by flushing and jetting with water or as directed by the Engineer. Sheeting and bracing left in place in open cut trenches as shown on the Plans or as ordered by the Engineer shall be paid for only in accordance with applicable provisions of the Contract Documents.

If the Contractor elects not to remove certain sheeting and bracing, he will not be paid additionally for such sheeting and bracing left in place.

5. Not Left In Place: All sheeting and bracing not to be left in place shall be carefully removed (after the backfill is complete) so as not to endanger the pipes and other structures. All voids created by withdrawal of the sheeting shall be immediately filled with selected sandy materials and compacted by flushing and jetting with water or as approved by the Engineer.
6. All sheeting and shoring is to be done in accordance with the Occupational Safety and Health Standards 40 CFR Part 1926 Subpart P, Excavation.

2.15 Earth Excavation

- A. Earth materials shall be excavated so that the open cuts conform with the lines, grades and dimensions shown on the drawings.

1. Unsuitable Foundation: When the bottom of the excavation is unsuitable as a foundation, it shall be excavated below grade and then refilled with concrete or crushed stone to the grade as the Engineer may direct. The crushed stone refill shall be mechanically compacted in six (6) inch layers or as directed by the Engineer. Such authorized work shall be paid for as set forth under the appropriate Item of the Proposal or the Change Order. This provision shall not relieve the Contractor of his obligation to dewater the excavation at no additional expense to the Owner.
2. Unauthorized Excavation: Unauthorized excavation below grade shall be filled with crushed stone or concrete and compacted as ordered and directed by the Engineer at no additional cost to the Owner.
3. Excavated Earth For Backfill: Excavated earth materials may be used for backfill subject to the approval of the Engineer, and the Contract Documents. Such material may be used only where its class is allowed. For example: Excavated material conforming to "Class II" description may be used where "Class II" material is required. When the Contract provides a unit price payment for classified backfill or fill material, excavated materials may qualify for such payment only if it is transported to another location for installation or temporary storage. The Contractor shall not transport the material solely to qualify it for such payments.

2.16 Rock Excavation

- A. Rock shall be defined as follows: Boulders measuring one-half (½) cubic yard or more in volume; rock material in ledges, bedded deposits, unstratified masses and conglomerate deposits so firmly cemented that they possess the characteristics of solid rock that cannot be removed without systematic drilling and blasting; and concrete and masonry structures, except sidewalks and paving. Pockets or seams of earth or clay less than four (4) inches in thickness, occurring below or between solid ledges of rock, shall be considered rock.
- B. When rock is encountered in open cut excavation, it shall be removed by drilling, blasting, digging or other approved methods so that open cut trenches conform with the lines, grades and dimensions shown on the Plans as specified herein or in the Detailed Specifications as follows:
 1. Explosives: The Contractor shall comply with all Federal, State and Local laws, rules, regulations, insurance and ordinances governing the transportation, storage, use and permits for explosives.
 2. Description: Solid rock excavation shall consist of the necessary excavation and satisfactory disposal of all rock in place which can not be removed from its original position without the use of explosives, or with a modern power shovel of not less than three-quarter (¾) cubic yard capacity, properly used, having adequate power and in good running condition, or other equivalent powered equipment. The excavation shall also include all loose stone or boulders necessary to be removed which

have a volume of one-half ($\frac{1}{2}$) cubic yard or more. Boulders of less than one-half ($\frac{1}{2}$) cubic yard in volume shall not be classed as rock excavation.

3. Safety Precautions: When blasting is required for the removal of rock, every precaution shall be used for the protection of persons and private and public property. Each blast shall be well covered with mats or other suitable means to confine the rock fragments within the excavation. At the discretion of the Engineer, he may order an evaluation survey of properties within the blasting zone. Only the minimum amounts of explosives shall be used; no excessive charges will be permitted. Except with written permission and approval of the Engineer, no blasting of rock will be permitted at nights or on Sundays.
4. Blasting Methods:
 - a. The method of blasting will be as determined by the Contractor, subject to the approval of the Engineer prior to construction. Blasting shall be performed at a safe distance ahead of the installation of the pipe and structures to prevent damage to them as the work progresses. Blasting of rock for property service connections, T-branches, Y-branches, and stubs shall be performed at the same time as the pipe trench blasting. The rock at the ends of all pipes, branches, stubs and property service connections, shall be shattered by continuing the drilling and blasting operations six (6) feet beyond the end of the pipe, branch, stub or property service connection.
 - b. Sufficient dynamite shall be used to shatter the rock for future excavation, as may be determined and ordered by the Engineer.
 - c. The blasting of rock under existing paving prior to uncovering the rock will be permitted, provided, the Contractor assumes full responsibility for all damage to the existing paving; however, the Owner reserves the right to require the uncovering of rock prior to blasting if blasting without uncovering proves unsatisfactory.
 - d. If the Contractor chooses to blast rock under paving without uncovering the rock, he shall immediately repair humps in the paving which create a traffic hazard, as determined by the Engineer; and, all distortions outside the limits of the trench caused by this method of blasting shall later be removed and replaced as part of the paving restoration, as directed by the Engineer. The Contractor is fully responsible for all damages that occur.
5. Repairs of Damage: In case injury occurs to any portion of the work, or to the material surrounding or supporting the same, through blasting the Contractor at his own expense shall remove such injured work and shall rebuild said work and shall replace the material surrounding or supporting the same, or shall furnish such material and perform such work of repairs or replacements as are necessary for satisfactory restoration. Any

damage whatever to any existing structure due to blasting shall be promptly, completely and satisfactorily repaired by the Contractor at his own expense.

2.17 **Boring and Jacking**

- A. Construction of the pipeline by boring and jacking methods will be permitted unless otherwise specified on the plans.
 - 1. **Backstop**: The backstop shall be of sufficient strength and positioned to support the thrust of the boring equipment without incurring any vertical or horizontal displacement during such boring operations.
 - 2. **Guide Rails**: The guide rails for the boring equipment may be of either timber or steel. They shall be laid accurately to line and grade and maintained in this position until completion of the boring operations.
 - 3. **Casing Pipe**: Steel casing pipe shall be new, conform to ASTM A 139 and shall be of the size (diameter) shown on the plans. The lengths of pipe shall be welded as they are installed. Where lengths of casing pipe are joined during the boring operations, care shall be taken to insure that the proper line and grade is maintained.
- B. The minimum wall thickness for casing pipes under highways, railroads and streams shall be 0.375 inches. Steel shall be Grade B under railroads and Grade A at all other locations.

2.18 **Removal of Water**

- A. The Contractor shall at all times during construction provide and maintain ample means and devices with which to promptly remove and properly dispose of all water and sewage entering the excavations or other parts of the work and shall keep said excavations dry until the structures to be built therein are completed or connections to existing structures are completed. No masonry shall be laid in water nor shall water be allowed to rise over masonry, until the concrete and mortar have attained a sufficient and satisfactory set. In no event shall concrete be placed in water, nor shall water be allowed in the excavation, which may set up unequal pressures in the concrete, until the concrete has set at least twenty-four (24) hours and any danger of flotation has been removed.
- B. In order to provide a dry foundation, the Contractor, if required by the Engineers, shall pre-drain all wet material (except hardpan or rock) by lowering the ground water to a depth of at least one (1) foot below the deepest point of subgrade. The work of pre-draining shall be done by the use of a well point system, or by any other method approved by the Engineer that will permit the construction work to be carried on under dry foundation conditions. All discharge water shall be piped to the nearest point of disposal in order to prevent such water from again entering the excavation. Any method or system that may be used to lower the ground water shall be kept in operation continuously unless otherwise permitted. The Engineer's approval of the proposed system shall not relieve the Contractor from the responsibility of providing and maintaining dry excavations as required.

- C. The Contractor shall dispose of water from the work in a suitable manner without damage to adjacent property or piping. No water shall be drained into work built or under construction unless the consent of the Engineers is first obtained.
- D. All removal and handling of water required to maintain dry trenches or other excavations for the construction of sewers, water mains, or other structures in the dry, shall be at the expense of the Contractor. This includes providing material, tools, and labor to transport such water to an acceptable outlet. Prior to bidding, the Contractor shall visit the project area to determine what drainage system is available to accept water.
- E. The Contractor shall be responsible to provide all equipment and labor to maintain bypass pumping during connections to existing structures. The Contractor shall maintain adequate pumping capacity at all times to prevent any spills, overflows, or discharges from the existing sanitary system.

(SECTION WM 3)

BACKFILL, FILLS AND EMBANKMENTS

PART 1 GENERAL

1.01 Description

- A. All trenches or excavations shall be backfilled to the original surface of the ground or such other grades as shown or directed. In general, the backfilling shall be carried along as speedily as possible and as soon as the concrete, mortar, and/or other masonry work and pipe joints have sufficient strength to resist the imposed load without damage.

1.02 Backfill Materials

- A. The following materials shall be used for backfill in accordance with and in the manner indicated by the requirements specified herein.

Class I - Angular, 6 to 40 mm (1/4 to 1 ½ inch), graded stone such as crushed stone.

Class II - Coarse sands and gravel with maximum particle size of 40 mm (1 ½ inch), including various grades of sands and gravel containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW and SP are included in this class. Class II material is further defined as materials with less than 7 percent passing the No. 200 sieve with borderline dual symbol USCS soil types such as GW-GC, SP-SM, etc.

Class III - Silty or clayey sand and gravel mixtures. Soil types GM, GC, SM and SC are included in this class.

Class IV - Silt, silty clays and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil types MH, ML, CH, CL-ML, and CL are included in this class. These materials are not recommended for bedding. This class shall also include any excavated material free from rock (3 inches and larger), concrete, roots, stumps, organic material, rubbish, frozen material, and other similar articles whose presence in the backfill would cause excessive settlement.

Flowable Fill Controlled low strength material (CLSM).

Separation Fabric – Non-woven polypropylene used to prevent migration of finer sands and aggregates and native soils into the coarser crushed aggregates. Material shall consist of TenCate Mirafi 160N, or an approved equal.

PART 2 PRODUCTS

2.01 Backfill of Trench Excavations for Pipes and Conduits

- A. Bedding and Backfill materials samples shall be submitted to the Engineer prior to start of construction. Approved samples shall be kept at the Engineer's field office. Materials differing significantly from these samples shall not be used without written authorization from the Engineer.

PART 3 EXECUTION

3.01 Backfill Above Pipe

A. **Method A - Backfill in Areas Not Subject to Vehicular Traffic**

1. For purposes of this specification, trenches shall be considered subject to vehicular traffic if all or any portion of the excavation is located within five (5) feet of a roadway or alley which is routinely traveled by powered vehicles. In the event of any question regarding the susceptibility of an area to traffic, the Engineer's decision shall govern.
2. The trench between the pipe bedding and the ground surface shall be backfilled with Class I or II materials, as described above, deposited with mechanical equipment in such a manner that it will "flow" onto the bedding and not free fall. Class III materials could be considered in non-structural areas if the proper compaction can be achieved. Materials containing appreciable amounts of silt or clay can be difficult to compact in confined areas. The Contractor shall compact the backfill by the back and forth travel of a suitable roller, wheeled device or other similar heavy equipment to the required compaction specification. Open-graded material should be compacted until the material is stable and no further settlement is obtained during compaction. Heavy equipment shall not be used until there is a cover of not less than three (3) feet over the pipes. To assist in promoting maximum densification, the surface of the trench shall be left in a slightly rounded condition. Periodical dressing of the backfill in the trench to promote the drainage and safety conditions shall be made during the course of the contract as required or ordered by the Engineer.

B. **Method B - Backfill in Areas Subject to Vehicular Traffic (Mechanical Compaction)**

1. The trench between the pipe bedding and the surface, which are located in areas subject to or possibly subject to vehicular traffic, shall be backfilled with Class I or II materials, deposited in level horizontal layers not exceeding nine (9) inches in loose thickness. Each layer shall be thoroughly compacted by mechanical tamping utilizing a crane mounted hydraulic vibratory compactors, or other suitable methods approved by the Engineer. Each layer shall be thoroughly compacted and tested before the next succeeding layer is placed. This procedure shall be followed where trench walls remain stable during compaction.

2. The crane mounted vibratory compactors shall be capable of producing 1900 cycles per minute and have a compaction plate with the minimum dimensions of twenty-three by thirty-one (23 x 31) inches. The compactor shall be similar to those as manufactured by Allied, Ho-Pac, or equal.
3. When Class I or II materials do not contain sufficient moisture to obtain proper compaction, in the opinion of the Engineer and/or his representative, it shall be moistened or wetted to within +/- two percent (2%) of the optimum moisture content and as directed by the Engineer and/or his representative.
4. In areas of predominantly clayey subgrade soils, the upper 18 to 24 inches of the trench shall be backfilled with a compacted lean clay engineered fill similar to the surrounding subgrade to limit surface water infiltration into sand or gravel-filled trenches.
5. Granular backfill materials shall terminate at a point below finished grade sufficient to allow placement of the permanent surface materials. For portions of the surface subject to vehicular traffic, the remaining trench shall be filled with compacted aggregate base material, shaped, graded and compacted with a ten (10) ton roller. Where the permanent surface is asphalt or concrete the aggregate base thickness shall be the specified thickness of the pavement material plus a minimum of six (6) inches. Where temporary cold mixed asphalt pavement is specified the compacted aggregate materials shall be stopped at required grade to accommodate the temporary pavement. Where the permanent surface is compacted aggregate the layer shall be eight (8) inches thick or otherwise specified by the pavement section design. In either case, the Contractor shall maintain the surface daily until the permanent pavement is placed.
6. For portions of the trench surface not subject to traffic the backfill material shall end eight (8) inches below the finished grade. This eight (8) inch depth shall be filled with good topsoil and seeded in accordance with these Specifications. Existing topsoil and sod may be used if properly separated and preserved.
7. The compacted aggregate base materials shall conform with the State Department of Transportation Standard Specifications, latest edition, for compacted Aggregate Base. In the event that suitable aggregate material, which conforms to the above specification is obtainable from the trench excavations and can be satisfactorily segregated, the Contractor may elect to use the material in lieu of purchased materials.

C. Method C – Backfill in Areas Subject to Vehicular Traffic (Flowable Fill)

1. In lieu of the mechanical compaction, the Contractor may use controlled, low strength flowable mortar.
2. The flowable fill mix shall contain for every cubic yard of batch material, no more than 50 lbs. of Portland Cement, no more than 500 lbs. of Type

F fly ash, no more than 500 lbs. of water, no more than 2850 lbs. of sand, and no more than 10% total air.

3. The compressive strength of the flowable fill shall not exceed 100 psi @ 28 days.
4. Standards: ASTM D4832
 ASTM D6023

3.02 Temporary Surfaces Subject to Traffic

- A. The Contractor shall open streets to traffic immediately after completing the backfill operation. The Contractor shall accomplish this by installing the compacted aggregate base immediately after granular backfill. When temporary asphalt pavement is required this shall also be installed immediately. The use of Class II backfill as a temporary surface is specifically prohibited.

3.03 Maintaining Trench Surfaces

- A. All surface settlement of the backfill along trenches located beneath streets, roads, alleys, driveways and parking lots which are subject to traffic shall be kept filled level with or slightly above the original paved surface at all times with compacted aggregate base material until the permanent pavement is satisfactorily restored. When temporary asphalt pavement is used, depressions and "pot holes" shall be promptly filled with the temporary asphalt material. Special attention shall be given by the Contractor to the timely and proper maintenance, leveling and grading of the surface of all backfilled trenches, especially those subject to traffic and especially following rains. The surface of streets, roads and alleys shall be maintained smooth and free of ruts and water trapping depressions by periodic power blading, scarifying; and/or filling settled areas, ruts, pockets, or holes with compacted aggregate base material or temporary asphalt where used.
- B. As a dust preventive, the Contractor shall apply, at his expense, calcium chloride over the surface of the compacted aggregate base in such amounts and at such times as are necessary to avoid or eliminate dust complaints from nearby residents. In event of any question regarding the existence or nonexistence of a dust nuisance, the Engineer's decision on the matter will govern. The material used shall be Regular Flake Calcium Chloride having a minimum chemical content of Calcium Chloride of seventy-seven percent (77%). Unless otherwise specified or ordered by the Engineer, the rate of application shall be one and one half (1 ½) pounds per square yard of surface covered.
- C. Wherever surface settlement is not important, unless otherwise specified or directed, the backfill shall be neatly rounded over the trench to a sufficient height to allow for settlement to grade after consolidation. Just prior to the completion of all work under the contract, any surface settlement below original ground surface shall be refilled in a satisfactory manner and reseeded as specified if required.

3.04 Backfill Around Structures

- A. For purposes of this specification, structures shall include but not be limited to footings, foundations, basements, grade beams, vaults, capsules, manholes, ducts, tanks, bridges, inlets, headwalls, anchors, and etc. Items specifically excluded from this definition of "structures" are pipe, conduits and their appurtenances except those listed herein.
- B. The material for backfill around structures shall meet the requirements of Class I, or II backfill materials, as defined in WM 3, Section 1.02 under the paragraph entitled "Backfill Materials". Class III materials could be considered in non-structural areas if the proper compaction can be achieved. Material removed from the project site may be used provided it meets this criteria. Materials classified as Class IV, clay balls, debris, topsoil, frozen or excessively wet or dry materials, weak soils or muck and other similar detrimental materials will not be put in place as backfill around structures.
- C. All excavations shall be backfilled to the original surface of the ground or such other grade as shown on the plans or directed by the ENGINEER. The backfilling shall be carried along as speedily as possible and as soon as the concrete, mortar and/or other masonry work and pipe joints have sufficient strength to resist the imposed load without damage. All appurtenances and attachments to structure walls shall be made and any wall coatings shall be in place and cured prior to backfilling at that elevation.
- D. Prior to backfilling, all formwork and construction debris will be removed. Any frozen, wet, or disturbed subsoil will be thawed or dried and compacted or removed prior to receiving backfill. During cold seasons, grades receiving backfill will be protected from frost during the work progress.
- E. Begin backfilling at the lowest elevation in the excavation. Place backfill in even, level layers. The thickness of the layer shall not exceed 75% of the compaction equipment manufacturer's rating for the equipment used when compacting the type of soil being placed for backfill, i.e. Class I, II, and/or III.
- F. Density tests will be made by the contractor, as directed by the Engineer, at no additional cost to the Owner. The tests are to be performed as described below and will be required as necessary to determine that uniform compaction throughout the depth of the lift has been achieved. Where backfill is required on both sides of structure or around the entire structure, backfill and compaction shall be done simultaneously on both sides or around the structure.
- G. The compaction equipment used for compacting backfill around structures shall be submitted for approval of the Engineer. In general, the equipment will be approved for use upon demonstration that it is capable of compacting the soil to the required density without damaging adjacent structures and appurtenances. Tread mounted equipment shall not be considered effective compacting equipment.

- H. The Contractor shall provide, when necessary, equipment and materials to moisten or aerate excessively wet or dry backfill to maintain optimum moisture content (+/- two percent (2%)) for the soil type being placed.
- I. Rainfall and/or groundwater trapped in the excavation during backfill operations shall be pumped out by the Contractor. Excessively wet soil, disturbed soil, or soil which has eroded into the excavation shall be removed or excavated and recompacted prior to placing additional backfill material.
- J. Openings in structures to receive pipe shall be temporarily plugged or bulkheaded during backfill operations. Backfill shall proceed to an elevation level with the invert of the pipe. The pipe shall then be bedded and backfilled in accordance with the applicable Detailed Specification and Workmanship and Materials Specifications. Backfill of pipe not in areas subject to vehicular traffic shall be with Class I, II or III (if compaction can be achieved) materials and in areas subject to vehicular traffic with Class I or II materials only.

3.05 General Fill Areas

- A. In areas where general site fill material is required and is not addressed in other parts of this section, Class IV material shall be acceptable, with the exception of materials with the USCS designations of silts (MH and ML) and fat clays (CH). For general fill areas, fill materials shall be spread in layers not to exceed nine (9) inches when in a loose condition and be compacted to the satisfaction of the engineer by appropriate grading and compaction equipment.

3.06 Compaction

- A. Density testing of backfill shall be the responsibility of the Contractor and shall be performed at no additional cost to the Owner. Testing shall be performed by an approved third-party commercial testing laboratory. Backfill shall be tested in accordance with AASHTO T99. Test reports shall indicate the location and elevation of the test. All testing results should be provided to the Engineer and Owner. Density testing shall be performed immediately prior to permanent pavement replacement and after the upper level of the compacted aggregate base or temporary pavement is removed to allow paving. When backfill has been placed using vibratory compaction, testing shall be made at the exposed surface one (1) time per location and not less than one (1) test per four hundred (400) feet. Density testing shall be made at frequent intervals along the backfill layer, at the surface and at mid-depth as determined by the Engineer. All test locations shall be determined by the Engineer. Should the results of the density test show a compaction of less than the required compaction, the area(s) represented by such test shall be immediately recompacted to achieve the specified density and at no additional cost to the Owner.
- B. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density, in accordance with AASHTO T99:
 - 1. Backfill in trenches: ninety-five percent (95%) of the maximum dry density.

2. Backfill below structures/foundations: one hundred percent (100%) of the maximum dry density.
 3. Within the upper two (2) feet below pavements: ninety-eight percent (98%) of the maximum dry density.
 4. Backfill supporting floor slabs and adjacent to foundations: ninety-five percent (95%) of the maximum dry density.
- C. Moisture Control:
1. Backfill shall be placed and compacted within +/- two percent (2%) of the optimum moisture content.
 2. Where subgrade or layer of soil material must be moisture-conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations.
 3. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
- D. Alternative Test Methods:
1. Alternative compaction tests methods, such as dynamic cone penetrometer (DCP) testing, could be consider upon approval by the Engineer.

3.07 Field Quality Control

- A. Quality Control Testing during Construction: Allow testing service to inspect and approve each subgrade and fill layer before further backfill or construction work is performed.

3.08 Maintenance

- A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.
- C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

- D. Settling: Where settling is measurable or observable at excavated areas during general Project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work and eliminate evidence of restoration to greatest extent possible.

(SECTION WM 5.1)

CONCRETE FORMWORK

PART 1 GENERAL

1.01 Description

- A. The work under this Section consists of furnishing all labor, equipment and services (including the design and detailing) required for Forms for all cast-in-place concrete indicated on the Drawings and subsequent removal of all such forms described in this Section.

- B. Related work described elsewhere:
 - 1. Concrete Reinforcement Section WM-6
 - 2. Cast-In-Place Concrete Section WM-5.2
 - 3. Structural Steel Section WM-18
 - 4. Miscellaneous Metals Section WM-19

1.02 Quality Assurance

- A. Qualifications of Workmen:
 - 1. Provide at least one experienced person who shall be present at all times during execution of this portion of the Work and who shall be thoroughly familiar with the type of materials being installed, the referenced standards, and the requirements of this Work, and who shall direct all work performed under this Section.

- B. Codes and Standards:
 - 1. "Recommended Practice for Concrete Formwork", publication ACI 347, latest edition of the American Concrete Institute.

1.03 Submittals

- A. Shop Drawings:
 - 1. Prior to starting field work, submit shop drawings to Engineer for approval. All shop drawings shall be checked and the formwork Contractor's stamp of approval shall be placed on each drawing prior to submittal to Engineer. All shop drawings shall be prepared under the supervision of a registered professional engineer.

 - 2. The shop drawings shall clearly show all concrete shapes, sizes, grade lines and dimensions indicated on the drawings. All door blockouts, recesses, sleeves, embedded items and any other items which affect exposed concrete visually shall also be shown.

3. Shop drawing review is for general conformance with the construction documents. The design of formwork for structural stability and efficiency is the responsibility of the formwork Contractor.

1.04 Design

- A. All formwork, including reshoring, shall be designed and detailed by the formwork Contractor who shall be solely responsible for this work. Design of formwork shall be prepared under the supervision of a registered professional engineer.
- B. Formwork for post-tensioned concrete shall be designed, taking into account the possibility of the member lifting off the formwork during the stressing operation.

PART 2 PRODUCTS

2.01 Form Materials & Accessories

- A. Form Lumber:
 1. All form lumber in contact with exposed concrete shall be new or of sufficient quality to insure an unblemished texture.
 2. All form lumber shall be one of the following or a combination thereof.
 - a. Forms for concealed concrete:
 - 1) Face Forms: B-B Plyform Class I or II, exterior, bearing APA grade stamp on each piece. Minimum thickness: 3/4".
 - b. Forms for exposed concrete:
 - 1) Face Forms: High Density Overlaid Plyform Class I or II, exterior, bearing APA grade stamp on each piece. Minimum thickness: 3/4".
- B. Steel Forms:
 1. Steel is an acceptable material for formwork.
 2. Steel forms shall be "like new" producing a clean, smooth, unblemished, texture for concrete exposed in the finished structure.
- C. Forms for Exposed Finish Concrete:
 1. 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.

- D. Forms for Unexposed Finish Concrete:
1. Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.
- E. Forms for Textured Finish Concrete:
1. Units of face design, size, arrangement and configuration to match designer's control sample. Provide solid backing and form supports to ensure stability of textured form liners.
- F. Forms for Cylindrical Columns and Supports:
1. Metal, fiberglass reinforced plastic, or paper or fiber tubes. Construct paper or fiber tubes of laminated plies using water-resistant adhesive with wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist loads imposed by wet concrete without deformation.
- G. Form Ties:
1. Factory fabricated, adjustable length, snap-off metal form ties, designed to prevent form deflection and to prevent spalling of concrete upon removal. The metal after breaking should be at least 1" from the face of the wall. Ties used on walls subject to hydrostatic pressure shall have approved waterstops.
 - a. Provide ties which, when removed, will leave holes not larger than 1" diameter in concrete surface.
- H. Form Release Agent:
1. A non-staining, neutral, barrier type which will not cause softening or impede curing.
 2. Standards - Release agent shall be similar to:
 - a. Symons Manufacturing Company Magic Kote, or Grace Construction Products Formshield Chemical Release Agent, or equal.
- I. Bracing/Shoring/Studs:
1. Such supports shall be selected for economy consistent with safety requirements and the quality required in the finished work. The formwork Contractor is responsible for the design, illustration, safety, and serviceability of all formwork.

2.02 Other Materials

- A. All other materials, not specifically described but required for proper completion of concrete formwork, shall be as selected by the formwork Contractor subject to the advance approval of the Engineer of record.

PART 3 EXECUTION

3.01 Surface Conditions

- A. Inspection:
 - 1. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is completed to the point where this installation may properly commence.
 - 2. Verify that forms are constructed in accordance with all pertinent codes and regulations, the referenced standards, and the original design.
- B. Discrepancies:
 - 1. In the event of discrepancy, immediately notify the Engineer of record.
 - 2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 Construction of Forms

- A. Construction of forms to be substantial, sufficiently tight to prevent leakage of concrete, and able to prevent excessive deflection when filled with wet concrete.
- B. Design, erect; support; brace, and maintain formwork to support vertical and lateral, static, and dynamic 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. Maintain formwork construction tolerances complying with ACI 347, latest edition.
- C. Design formwork to be readily removable without impact, shock, damage, or cutting to cast-in-place concrete surfaces and adjacent materials.
- D. 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.
 - 1. Earth Forms: If recommended by Soils Engineer and approved by Engineer, forms for footings may be earth. Increase width of footing by 4" when using earth forms.

- E. 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.
- F. 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.
- G. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- H. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Carefully examine the drawings and specifications and consult with other trades as required relative to size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.
- I. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Re-tightening forms and bracing after concrete placement is required to eliminate mortar leaks and maintain proper alignment.
- J. Set all required pipe sleeves, steel frames, angles, grilles, bolts, inserts, and other such items required to be anchored in the concrete before the concrete is placed.
- K. Bracing:
 - 1. Properly brace and tie the forms together so as to maintain position and shape and to ensure safety to personnel.
- L. Construct all forms straight, true, plumb and square within a tolerance as specified in ACI 301. Use a reference point on the ground to check plumbness and elevations.
- M. Keep forms sufficiently wetted to prevent joints opening up before concrete is placed.

3.03 Footing Forms

- A. Wood Forms:
 - 1. All footing and pile cap forms shall be wood unless otherwise specifically approved by the Engineer of record.

3.04 Preparation of Form Surfaces

- A. Clean re-used forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition.
- B. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.
- C. Thin form-coating compounds only with thinning agent of type, amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come in contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
- D. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.05 Shores and Supports

- A. Comply with ACI 347, latest edition, for shoring and reshoring in multilevel construction, and as herein specified.
- B. Extend shoring from ground to roof for structures 4 levels or less, unless otherwise permitted.
- C. Extend shoring at least 3 levels under floor or roof being placed for structures over 4 levels. Shore floor directly under floor or roof being placed, so that loads from construction above will transfer directly to these shores. Space shoring in stories below this level in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members where no reinforcing steel is provided. Extend shores beyond minimums to ensure proper distribution of loads throughout structure.
- D. Remove shores and reshore in a planned sequence to avoid damage to partially cured concrete. Locate and provide adequate reshoring to safely support work without excessive stress or deflection.
 - 1. Keep reshores in place a minimum of 15 days after placing upper tier, and longer if required, until concrete has attained its required 28-day strength and heavy loads due to construction operations have been removed.

3.06 Form Removal

- A. Forms shall be removed in an approved manner under competent supervision so as to avoid damage to the concrete. Particular care shall be taken to avoid spalling.
- B. Shores and other supports shall not be removed until concrete has attained sufficient strength to support without objectionable deflection under its own weight plus all anticipated construction loads.
- C. The concrete shall have attained, as indicated by the field-cured cylinders, at least 70 per cent of its specified 28-day strength before shores are removed. The Contractor shall bear full responsibility for this operation. Concrete damaged by too early removal of supports shall be repaired to the satisfaction of the Engineer or replaced.
- D. Forms for vertical elements (walls and columns) shall not be removed until 24 hours after the completion of concrete placement.

3.07 Maintenance

- A. Formwork shall be cleaned and reconditioned before each use. Any damage to formwork during placing, removal, or storage shall be completely repaired. Formwork with repairs or patches which would result in adverse effects to the concrete finish shall not be used.
- B. Storage of formwork and form materials shall be in a manner to prevent damage or distortion.

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(SECTION WM 5.2)

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 Scope

- A. Materials, equipment and labor required for placing, finishing and curing all cast-in-place concrete.
- B. Installation of all specified items to be embedded in cast-in-place concrete.

1.02 Products Installed But Not Furnished Under This Section

- A. Section WM-18 - Structural Steel: Anchor bolts and other items to be embedded in cast-in-place concrete.

1.03 Related Sections

- A. Section WM-5.1 - Concrete Formwork.
- B. Section WM-6 - Concrete Reinforcement.

1.04 Codes And Standards (latest edition)

- A. ACI 301 - Specifications for Structural Concrete for Buildings.
- B. ACI 302 - Guide for Concrete Floor and Slab Construction
- C. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete
- D. ACI 305 - Hot Weather Concreting.
- E. ACI 306 - Cold Weather Concreting.
- F. ACI 309 - Guide for Consolidation of Concrete.
- G. ACI 318 - Building Code Requirements for Reinforced Concrete.
- H. ACI 350 - Concrete Sanitary Engineering Structures.
- I. ASTM C31 - Making and Curing Concrete Test Specimens in the Field.
- J. ASTM C33 - Concrete Aggregates.
- K. ASTM C39 - Test for Compressive Strength of Cylindrical Concrete Specimens.
- L. ASTM C42 - Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- M. ASTM C94 - Ready-Mixed Concrete.

- N. ASTM C143 - Test for Slump of Portland Cement Concrete.
- O. ASTM C150 - Portland Cement.
- P. ASTM C171 - Sheet Materials for Curing Concrete.
- Q. ASTM C172 - Sampling Fresh Concrete.
- R. ASTM C173 - Test for Air Content of Freshly Mixed Concrete by the Volumetric Method.
- S. ASTM C231 - Test for Air Content of Freshly Mixed Concrete by the Pressure Method.
- T. ASTM C260 - Air-Entraining Admixtures for Concrete.
- U. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
- V. ASTM C494 - Chemical Admixtures for Concrete.
- W. ASTM C618 - Fly Ash and Raw or Calcined Natural Pozzolans for Use in Portland Cement Concrete.
- X. ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- Y. State Department of Transportation - Standard Specifications.

1.05 Submittals

- A. General: All submittals shall be in accordance with ACI 301 "Specifications for Structural Concrete for Buildings".
- B. Product Data: Submit data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry-shake finish materials, and others as requested.
- C. Concrete Mix Designs:
 - 1. Submit a mix design for each class of concrete required for the project per the General Conditions and including:
 - a. Standard deviation analysis, required average strength and documentation of average strength verifying compliance with Section 2.03 (Proportioning on the basis of field experience and/or trial mixtures) of ACI 318.
 - b. Mix proportions by weight, water-cement ratio, slump and air content.
 - c. Sieve analyses of fine and coarse aggregates.

- d. Results of tests for water soluble chloride ion content described in Paragraph 2.03H for concrete used in water retaining structures.
 - e. Complete list of materials specified in Article 2.01 with product information demonstrating compliance with all specified requirements.
 - 2. Submit with sufficient time allowed for review before concrete is required for the project.
- D. Shop Drawings:
 - 1. Submit complete shop drawings per the General Conditions and indicating:
 - a. Locations of all construction joints in walls and slabs.
 - b. Sizes and locations of all sleeves.
 - c. Locations of all waterstops.
- E. Product Information: Submit product information for all materials specified in Article 2.02 per the General Conditions and demonstrating compliance with specified requirements.
- F. Field Quality Control Test Reports: Submit to the Engineer of record per the General Conditions and within 3 days after completion of the 7-day and 28-day tests.
- G. Concrete Placement Records: Turn over to the Engineer of record after completion of the project.

1.06 Quality Assurance

- A. Perform work in accordance with ACI 301 and all codes and standards described in paragraph 1.04.
- B. Conduct field sampling and testing of concrete, including the making of test specimens, with personnel holding current certificates issued by the American Concrete Institute, State Chapter. All sampling and test specimens shall be made in accordance with applicable ASTM procedures.
- C. Materials and installed work may require testing and re-testing at any time during progress of work. Tests, including re-testing of rejected materials for installed work, shall be done at the Contractor's expense.
- D. The Contractor shall attend a preconstruction meeting to discuss submittals, concrete placement, and concrete testing. A responsible representative of the concrete placing/finishing contractor, the concrete supplier, and the testing laboratory shall be present.

1.07 Delivery, Storage And Handling

- A. Deliver concrete in accordance with ASTM C94. Do not use non-agitating transporting equipment.
- B. Deliver materials and equipment in undamaged condition.
- C. Store materials and equipment in designated areas and in accordance with manufacturer's instructions.
- D. Store materials and equipment off the ground, totally protected from ground splash, mud, weather separation, intrusion of foreign materials, and other damage.

1.08 Environmental Requirements

- A. Inclement Weather: Do not place concrete during rain, sleet or snow unless adequate protection is provided.
- B. Hot Weather: Perform work under provisions of Article 3.10.
- C. Cold Weather: Perform work under provisions of Article 3.11.
- D. Protection of Footings Against Freezing: Cover completed work at footing level with sufficient temporary or permanent cover as required to protect footings and adjacent subgrade against possibility of freezing; maintain cover for time period as necessary.
- E. Protect adjacent finish materials against spatter during concrete placement.

PART 2 PRODUCTS

2.01 Concrete Materials

- A. Portland Cement: ASTM C150.
 - 1. Structures not in contact with wastewater.
 - a. Type I or Type III.
 - 2. Structures in contact with wastewater.
 - a. Type I with a tricalcium aluminate content less than eight percent (8%).
 - b. Type II.
- B. Fly Ash: ASTM C618, Type C.
 - 1. Maximum loss on ignition: 1.50 percent.
 - 2. Maximum amount retained when wet-sieved on No. 325 sieve: 30 percent.

- C. Fine Aggregate: ASTM C33.
 - 1. Natural sand of clean, hard, durable particles.
 - 2. State Department of Transportation, Standard Specifications, Size #23.
- D. Coarse Aggregate: ASTM C33.
 - 1. Crushed stone or gravel of clean, sound, tough, durable particles.
 - 2. State Department of Transportation, Standard Specifications, Class A, Size 8, 3/4 inch maximum size.
- E. Water: Clean and free from injurious amounts of oil, acids, alkalis, salts, organic materials and other deleterious substances.
- F. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.
 - 1. Standards:
 - a. Micro-Air by Master Builders.
 - b. MB-VR by Master Builders.
 - c. Darex AEA by W. R. Grace & Co.
 - d. DarexII by W. R. Grace & Co.
 - e. Airalon by W.R. Grace & Co.
 - f. or Equal.
- G. Water-Reducing Admixture: ASTM C494, Type A.
 - 1. Standards:
 - a. Pozzoloth 122-N or LL-960 by Master Builders.
 - b. Pozzoloth 322-N or 220-N by Master Builders.
 - c. WRDA with Hycol by W. R. Grace & Co.
 - d. or Equal.
- H. Retarding Admixture: ASTM C494, Type B.
 - 1. Standards:
 - a. Pozzoloth 122-R by Master Builders.
 - b. Daratard-17 by W. R. Grace & Co.
 - c. or Equal.
- I. Accelerating Admixture: ASTM C494, Type C.
 - 1. Standards:
 - a. Pozzoloth 122-HE by Master Builders.
 - b. Pozzoloth 555-Accelerator by Master Builders (Non-chloride).

- c. Pozzutec 20 by Master Builders (Non-chloride).
 - d. Daraset by W. R. Grace & Co. (Non-chloride).
 - e. or Equal.
- J. Water-Reducing & Retarding Admixture: ASTM C494, Type D.
 - 1. Standards:
 - a. Pozzolith 122-R by Master Builders.
 - b. Daratard-17 by W. R. Grace & Co.
 - c. or Equal.
- K. Water-Reducing & Accelerating Admixture: ASTM C494, Type E.
 - 1. Standards:
 - a. Pozzolith 122-HE by Master Builders.
 - b. Daracel by W. R. Grace & Co.
 - c. or Equal.
- L. High Range Water-Reducing Admixture: ASTM C494, Type F.
 - 1. Standards:
 - a. Pozzolith 440-N by Master Builders.
 - b. Rheobuild 1000 Master Builders.
 - c. Daracem 100 by W. R. Grace & Co.
 - d. or Equal.
- M. Synthetic Fibers:
 - 1. Virgin (non-recycled), nylon fibers.
 - 2. 3/4 inch length.
 - 3. Denier less than 100.
 - 4. Use in strict accordance with manufacturer's instructions.
 - 5. Fibers shall be introduced into the concrete at the batch plant.
 - 6. Standards:
 - a. Fibermesh by Fibermesh, Inc.
 - b. Nycon by Nycon Inc.
 - c. or Equal.
- N. High Volume Grout:

Grout shall consist of a mixture of sulfate resistant cement, sand and water. Sand and cement shall be mixed in the proportion of one part cement to two parts sand by volume. The consistency of the grout shall be such as is suitable for the work

to be done but W/C ration shall not exceed 0.49. Strength shall be a minimum of 5000 psi in twenty-eight (28) days.

2.02 Related Materials

- A. Water Based Curing, Sealer and Dustproofer Compound: Liquid type membrane - forming curing, sealer and dustproofer compound complying with ASTM C309, Type 1, Class B and containing 30% solids in accordance with ASTM C4758.
 - 1. Non-staining acrylic type curing compound.
 - 2. Compatible with applied sealers and finishes specified for the concrete surfaces to be cured.

- B. Penetrating Sealer: ASTM C642, C672.
 - 1. A clear coating containing 30% solids by weight. One coat is required and shall be applied per manufacturer's directions.
 - 2. Curing shall be as directed by the manufacturer.
 - 3. Standards:
 - a. Hydrozo Clear 30M by Hydrozo Coatings Company, Waterban 90 (30%) by Lambert Corp, or approved equal.

- C. Moisture Retention Cover: ASTM C171.
 - 1. Waterproof paper, polyethylene film, or polyethylene-coated burlap.

- D. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. Per sq. ft., complying with AASHTO M 182, Class 2.

- E. Evaporation Retardant:
 - 1. Apply in accordance with manufacturer's instructions.
 - 2. Standards:
 - a. Confilm by Master Builders.
 - b. Euco-Bar by the Euclid Chemical Co.
 - c. or Equal.

- F. Epoxy Bonding Adhesive:
 - 1. Two-part structural epoxy adhesive, epoxy-polysulfide, 100 percent solids system.
 - 2. Use to bond freshly mixed plastic concrete or patching mortar to hardened concrete.

3. Standards:
 - a. Polytops 40 by Chem-Masters Corporation.
 - b. 42-45 Hi-Bond by Celtite, Inc.
 - c. Sikadur 32, Hi-Mod by Sika Corporation.
 - d. or Equal.
- G. Two-Component Epoxy Glue:
1. Dual-purpose, two-component, moisture insensitive epoxy adhesive.
 2. Use to anchor reinforcing steel or anchor bolts into hardened concrete.
 3. Standards:
 - a. Hilti HIT Doweling Anchor System with HIT HY-200 cartridge by Hilti Fastening Systems.
 - b. Sikadur 32, Hi-Mod by Sika Corporation; (vertical holes with bottoms).
 - c. Sikadur Injection Gel by Sika Corporation; (horizontal holes).
 - d. Sikadur 31, Hi-Mod Gel by Sika Corporation; (overhead application).
 - e. Approved equal; submit literature including depth of embedment to develop reinforcing bars/anchor bolts and spacing requirements.
 4. Drilled hole size and installation procedure shall conform to manufacturer's instructions.
 5. Use carbide bit drill to prevent damage to reinforcement.
- H. Patching Material:
1. Use to repair honeycombed and other defective concrete.
 2. Standards:
 - a. Five Star Structural Concrete by U.S. Grout Corporation, Weber Corp, or equal.
- I. Joint Filler: ASTM D1752, Type III.
1. Granulated cork particles, specially treated, dehydrated, and compressed to enable expansion in presence of moisture.
 2. Standards:
 - a. Self Expanding Cork by W. R. Meadows, Inc., A.P.S. Cork, or equal.

J. EVA Joint Filler:

1. The joint material shall be a preformed, resilient and nonextrudable material, produced as an impermeable closed-cell, cross-linked, ethylene vinyl acetate, low density polyethylene copolymer, nitrogen blown material which is weather and wear resistant. The joint material shall be installed in strict accordance to the manufacturer's recommendations, including joint preparation, dimensions, bonding agents and joint installation.
2. Standards:
 - a. EVAZOTE 50 as manufactured by E-POXY Industries, Inc., Ravena, New York.
 - b. THERMAL-CHEM E.V.A. expansion joint as manufactured by Thermal-Chem, Inc., Elk Grove Village, Illinois, or equal.

K. Waterstops: (see plans for application of different types)

1. Waterstop Coil - 1" X 3/4" flexible strip of bentonite waterproofing compound.
 - a. Standards:
 1. WATERSTOP-RX as manufactured by CETCO, Hydro-Flex Waterstop as manufactured by Henry Company, or equal.
 - b. Install in strict accordance with manufacturer's recommendations, including hydrating all in place material with potable water prior to exposure with wastewater.
 - c. Installation
 1. Vertical Surfaces - Adhesive Primer.
 2. Horizontal Surfaces - Adhesive Primer or nailing.
2. Extruded Polyvinyl Chloride (PVC).
 - a. Construction Joints
 1. At least 6" wide X 3/8" thick with longitudinal ribs and hollow centerbulb. Split-fin waterstops may be used for vertical wall joints. Smaller widths, as shown on the Plans, may be required for special conditions.
 - b. Expansion Joints
 1. At least 9" wide X 3/8" thick, unless otherwise shown, with a 3/4" ID hollow centerbulb.

- c. Provide all waterstop corner joints and tee joints in prefabricated assemblies. Only field joints shall be splice butt welds using a controlled indirect heating element per manufacturer's instructions.
 - d. Standards:
 - 1. Greenstreak Plastic Products Company.
 - 2. Vinylex Corporation.
 - 3. Wirestop, Paul Murphy Plastics Company.
 - 4. or Equal.
- L. Precompressed Expanding Sealant:
- 1. Will-Seal, precompressed expanding sealant, 250; by Will Seal Construction Foams, Dayton Superior, or Equal.

2.03 Proportioning Concrete Mixes

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method is used, use an independent testing facility for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.
- B. Establish concrete proportions to produce homogeneous, durable mixes with the required average strength based on the appropriate amount of overdesign as required by Section 5.3 of ACI 318.
- C. Proportion concrete mixes to provide workability and consistency to permit concrete to be worked readily into the corners and angles of the forms and around reinforcement by the methods of placement and consolidation to be employed, without segregation or excessive bleeding.
- D. Include a water-reducing or high range water-reducing admixture, used in strict accordance with manufacturer's instructions, in all mix designs. Specified minimum cement contents are based on the use of such admixtures.
- E. Include an air-entraining admixture in mix designs for all concrete exposed to wastewater, or freezing and thawing during service and for all concrete exposed to cold weather, as defined in Article 3.11, during construction, before attaining its specified compressive strength.
- F. Base mix design on saturated surface dry aggregates. Adjust the amount of mixing water added at the batch plant for the moisture condition of the aggregates.
- G. Flyash may be used as a cement substitute with a maximum 20 percent substitution rate on a pound for pound basis.

- H. Water Soluble Chloride Ion Content:
1. Maximum percent in concrete by weight of cement:
 - a. Prestressed or post-tensioned concrete - 0.06
 - b. Reinforced concrete retaining water - 0.10.
 - c. Reinforced concrete exposed to earth or weather - 0.15
 - d. Other reinforced concrete construction - 0.30
 2. Conduct tests for each class of concrete to verify compliance with the above requirements. Test samples of the hardened concrete for water soluble chloride ion content at an age of 28 to 42 days using the test procedure contained in AASHTO, method T-260.
- I. Slump:
1. Mixes containing high range water-reducing admixture: 5 to 8 inches.
 2. Mixes containing water-reducing admixture: 5 inches maximum.
- J. Concrete Mix Classes:
1. Class A Concrete (building footings):
 - a. Compressive strength at 28 days: 3000 psi.
 - b. Minimum cement content: 423 lb/cu yd.
 - c. Maximum water-cement ratio: 0.58.
 - d. Air content: Optional
 2. Class B & C Concrete (building foundation walls, interior: building columns, beams, supported slabs, walls, slabs-on-grade):
 - a. Compressive strength at 28 days: 4000 psi.
 - b. Minimum cement content: 517 lb/cu yd.
 - c. Maximum water-cement ratio: 0.48.
 - d. Air content: Optional
 - e. High range water-reducing admixture as required to properly place the concrete.
 3. Class D & E concrete (exterior: retaining walls, tank structural slabs, columns, beams, walls, slabs-on-grade, stoops, curbs and sidewalks exposed to de-icers):
 - a. Compressive strength at 28 days: 4500 psi.
 - b. Minimum cement content: 611 lb/cu yd.
 - c. Maximum water-cement ratio: 0.40.
 - d. Air content: 6± 1 percent.
 - e. High range water-reducing admixture as required to properly place the concrete.

- K. Submit written reports to Engineer of record of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed.
- L. Adjustment to Concrete Mixes: Mix design adjustment may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by Engineer of record. Laboratory test data for revised mix design and strength results must be submitted to and accepted before using in work.

2.04 Batching And Mixing

- A. Batch and mix concrete in accordance with ASTM C94.
- B. Mix concrete until there is a uniform distribution of materials.

PART 3 EXECUTION

3.01 Preparation

- A. Install all items to be embedded in concrete. Position accurately and secure against displacement.
 - 1. Do not embed aluminum items in concrete.
- B. Remove all wood scraps, ice, snow, frost, standing water and debris from areas in which concrete will be placed.
- C. Before fresh concrete is placed against hardened concrete, retighten forms and suitably clean and moisten the surface of the hardened concrete for bond to the fresh concrete.
- D. Thoroughly moisten subgrade on which concrete is to be placed. Do not place concrete on frozen subgrade.
- E. Thoroughly clean all conveying and handling equipment.

3.02 Surface Conditions

- A. Before concrete is placed, inspect the installed work of this and other Sections and verify that all such work is complete.
- B. Verify that concrete can be placed to the required lines and elevations with required cover for reinforcement.
- C. Prevent groupings of conduits, pipes and sleeves in concrete that would significantly impair the strength of the concrete. See General Structural Notes for additional requirements.

- D. Notify the Engineer of record when concrete placement is planned. Allow sufficient time for review of formwork, reinforcement and embedded items, and for any required corrective work.

3.03 Placing

- A. Addition of water to the concrete during transport or at the site is strictly prohibited.
- B. Convey concrete by methods and equipment capable of supplying concrete from mixer to place of final deposit without segregation and such that detectable setting of concrete does not occur before adjacent concrete is placed.
- C. Use pumping equipment with sufficient design and pumping capacity to ensure a practically continuous flow of concrete at the point of discharge without segregation.
 - 1. Do not add water or alter the mix design in any way to facilitate pumping.
 - 2. Pumping concrete through aluminum pipe is prohibited.
- D. Limit vertical drop of concrete to 3 feet unless appropriate equipment is used to prevent segregation.
- E. Do not bear concrete conveying equipment on fresh concrete or reinforcement.
- F. After concrete placing has started, provide continuous operation until placement of the section is complete. Do not place a greater section at one time than can be properly finished.
- G. Deposit concrete as nearly as practicable to its final position to avoid segregation due to rehandling or flowing.
- H. Place concrete at a rate such that the concrete is at all times plastic and flows readily between reinforcement and into corners of forms without segregation.
- I. Place concrete in all slabs, mats, and beams for the full depth of the member at one time in such a way as to prevent a horizontal cold joint from occurring.
- J. All concrete shall be discharged into the structure within 90 minutes after batching per ASTM C94.
- K. Do not place concrete that has partially hardened, been retempered or contaminated by foreign materials.

3.04 Consolidation

- A. Thoroughly consolidate all concrete with high frequency vibrators, working the concrete thoroughly around reinforcement and embedded items and into corners of forms.

- B. Use a sufficient number of vibrators, of appropriate size and type, to provide complete vibration throughout the concrete at the same rate it is placed.
 - 1. Provide at least one spare vibrator at the site for use in case of breakdown.
- C. Provide properly spaced vibration of duration sufficient to produce complete consolidation, but not long enough to cause segregation. Continue vibration until mortar just begins to puddle at the surface. Remove any excess free water that collects on the surface.
- D. Do not use vibrators to transport concrete within forms.
- E. Supplement internal vibration with manual consolidation methods and external form vibration as required to produce concrete free of voids, honeycomb and rough surfaces.
 - 1. Vibrate forms in such a way as to avoid form displacement.

3.05 Finishing Slabs

- A. Tolerances: Finish level slabs on grade to a true plane with a tolerance of 1/4 inch in 10 feet as determined by a 10 foot straightedge placed anywhere on the slab in any direction. Finish supported and sloped slabs with comparable precision unless otherwise specified.
- B. Screeding:
 - 1. Immediately after placing, strike off excess concrete with a straightedge to bring the top surface to proper grade, aligning it to the contours of screeds.
 - 2. Screed off edge forms, intermediate screed strips or pipe set accurately and firmly to the required elevations and contours for the finished surface.
 - 3. Move straightedge across the concrete surface with a sawing motion, advancing forward a short distance with each movement. There should be a surplus of concrete against the front face of the straightedge to fill in low areas as the straightedge passes over the surface.
 - 4. Complete screeding before any excess moisture or bleeding water is present on the surface.
- C. Bull Floating:
 - 1. Immediately after screeding, bull float the concrete surface, eliminating high and low spots, smoothing the surface and embedding the coarse aggregate.
 - 2. Avoid overworking the concrete. Do not close up or seal the surface of the concrete.

3. Complete bull floating before any excess moisture or bleeding water is present on the surface.
- D. Floating:
1. Begin floating operations when bleeding water has disappeared or been removed from the surface and when the surface has stiffened sufficiently to support the operation.
 - a. Do not use dry cement and sand to take up bleeding water.
 2. Hand or power float the concrete surface, removing slight imperfections and producing a relatively even and true surface with a uniform, sandy texture prepared for final finishing.
 3. Avoid overworking the concrete. Do not close up or seal the surface of the concrete.
- E. Final Finishing:
1. Hard Trowel Finish: All slabs unless otherwise specified.
 - a. Immediately after floating, use power trowel for first trowelling to produce a smooth surface relatively free of defects.
 - b. Use tilted hand trowel and heavy pressure for final trowelling after concrete has become hard enough to produce a ringing sound as the trowel is moved over the surface. Produce a smooth, hard, dense surface, uniform in texture and appearance and free of defects.
 - c. Use hand trowelling in areas inaccessible to power trowelling and for final trowelling of concrete slabs with exposed finishes.
 2. Broom Finish: Slip-resistant surfaces.
 - a. Immediately after floating, draw a broom across the concrete surface transversely to the main direction of traffic, producing a coarse, scored, slip-resistant texture.
 3. Rough Swirl Finish: Parking surfaces.
 - a. Modify the floating operation described in Paragraph 3.05D: Hand or power float the concrete surface, removing slight imperfections and producing a roughened surface with approximately 1/16 inch roughness amplitude.
 - b. Avoid overworking the concrete.
 - c. Finishing must not begin until any bleed water has disappeared.
 - d. Do not add water to concrete surface during the finishing operation.

3.06 Finishing Formed Surfaces

- A. Rough Form Finish: All formed concrete surfaces not exposed to public view.
 - 1. After being cleaned and thoroughly dampened, fill tie holes solid with patching mortar matching the color of the surrounding concrete.
 - 2. Patch defective areas in accordance with Article 3.07.
 - 3. Chip or rub off fins and projections exceeding 1/4 inch in height.
- B. Smooth Form Finish: All formed concrete surfaces exposed to public view.
 - 1. After being cleaned and thoroughly dampened, fill tie holes solid with patching mortar matching the color of the surrounding concrete.
 - 2. Patch defective areas in accordance with Article 3.07.
 - 3. Completely remove all fins and projections.
 - 4. Apply grout cleandown treatment to surface areas with light honey-combing and air holes, completely filling all voids. Match grout color with that of the surrounding concrete.
- C. Smooth Rubbed Finish: Formed concrete surfaces exposed to public view as specified.
 - 1. Follow smooth form finish described in Paragraph 3.06B (1, 2 and 3).
 - 2. Perform no later than one day after form removal.
 - 3. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
 - 4. Do not use cement grout other than the cement paste drawing from the concrete rubbing process.
- D. Finish concrete in accordance with the following schedule, unless specifically excepted.

<u>SURFACE</u>	<u>FINISH</u>
All exposed vertical surfaces from 8 inches below grade or <u>minimum</u> operating level	Smooth rubbed finish
Floor slabs of tanks and channel floors	Smooth floated finish

Floor slabs of tanks or channel floors which will receive leveling grout	Broomed finish
Interior building floors	Steel trowel finish w/Sealer
Leveling grout for tank slabs and channel floors	Screeded with steel trowel finish
Exterior horizontal traveled surfaces	Broomed finish
Exposed exterior horizontal surfaces except as listed above	Smooth rubbed finish

- E. Cement based or acrylic polymer compounds will be considered as an alternative to rubbing. Preparation and application shall meet the requirements of cement based and acrylic polymer compound manufacturers.

3.07 Repair Of Defective Areas

- A. Remove honeycombed and other defective concrete, exposing sound concrete. Cut and chip edges straight and perpendicular to the surface or slightly undercut. Feathered edges are not permitted.
- B. Dampen areas to be patched and surrounding areas. Patch with patching mortar or patching material.
1. Patching with patching mortar:
 - a. After surface water has evaporated from the area to be patched, brush an epoxy bonding adhesive onto the surface.
 - b. When the bonding coat begins to lose surface water, apply a patching mortar (1 part cement to 2½ parts sand with minimum mixing water required for handling and placing), matching the color of the surrounding concrete, to the surface.
 2. Patching with patching material:
 - a. After surface water has evaporated from the area to be patched, apply patching material to the surface.
 - b. Apply patching material in accordance with manufacturer's instructions.
- C. Thoroughly consolidate patching mortar or patching material into place and strike off so as to leave the patched area slightly higher than the surrounding surface.
- D. To allow initial shrinkage, leave the patched area undisturbed for at least one hour. After initial shrinkage has occurred, strike off with a straightedge spanning the patched area and finish to match the surrounding surface.

- E. Apply curing to the patched surface as soon as possible and maintain for a minimum of 2 days.

3.08 Curing

- A. Maintain all concrete in a moist condition for at least 5 days at temperatures above 70 F and at least 7 days at temperatures above 50 F.
- B. Curing Slabs: Curing Compounds or moisture retention covers (wet cure). Wet cure all slabs receiving tile floor covering.
 - 1. Apply curing compounds to the concrete surface, immediately after final finishing of the concrete, in accordance with manufacturer's instructions.
 - 2. Place moisture retention covers on the concrete surface immediately after final finishing of the concrete. Lap edges 6 inches and seal, creating a moisture barrier that must remain intact for the duration of the curing period.
- C. Curing Formed Surfaces:
 - 1. Formed surfaces may be cured by leaving forms in place. During hot, dry weather, keep forms moist by sprinkling.
 - 2. When forms are removed before the end of the curing period, apply curing compound to walls and columns.

3.09 Joints

- A. Construction Joints:
 - 1. Locate construction joints so as not to impair the strength of the structure.
 - 2. Continue all reinforcement across construction joints.
 - 3. Provide keys in all vertical construction joint surfaces.
 - 4. Thoroughly clean the concrete surface at construction joints and remove all laitance before placing adjoining concrete.
 - 5. In slabs on grade with control joints, locate construction joints at control joint locations.
- B. Slab on Grade Contraction Joints:
 - 1. Sawcut Contraction Joints: Sawcut joints as soon as possible after the concrete hardens. The concrete is hard enough when the blade does not dislodge aggregate and when the edges of the cut do not ravel. Complete saw-cutting before shrinkage stresses become sufficient to produce cracking. Sawcut joints in straight lines to avoid unsightly joints.

2. Hand-Tooled Contraction Joints: Tool joints with hand groovers in straight lines to avoid unsightly joints.

3.10 Hot Weather Concreting

- A. Follow the provisions of this Article and ACI 305 when the rate of evaporation of surface moisture from the concrete exceeds 0.18 lb/sq ft/hr (Figure 2.15, ACI 305).
- B. Control concrete setting time with the use of retarding admixtures or water-reducing & retarding admixtures as required to facilitate placing and finishing operations.
- C. Before placing concrete, spray the subgrade, forms and reinforcement with water to keep them cool and to prevent absorption of water from the concrete.
- D. Transport, place and finish concrete as quickly as practicable. Plan concrete delivery, placing techniques and consolidation methods to avoid cold joints.
- E. Maximum temperature of concrete during placing: 90 F.
- F. Apply evaporation retardant to the surface of the fresh concrete after screeding and as needed during finishing.
- G. Take additional precautions as necessary to prevent plastic shrinkage cracking.
- H. Start curing the concrete immediately after finishing operations have been completed.

3.11 Cold Weather Concreting

- A. Follow the provisions of this Article and ACI 306 when the average daily temperature (average of the highest and lowest temperature during the period from midnight to midnight) is less than 40 F.
- B. Control concrete setting time with the use of accelerating admixtures and water-reducing accelerating admixtures as required to facilitate placing and finishing operations.
 1. Do not use calcium chloride as an accelerating admixture.
- C. Temperature of concrete during placing: 55 F to 75 F.
- D. Provide heated enclosures or insulation to maintain the temperature at the concrete surface between 55 F and 75 F for a minimum of 7 days or until the concrete reaches its specified compressive strength.
 1. Construct weathertight enclosures, allowing the heated air to circulate around the outer edges of the concrete.
 2. Provide a sufficient number of heaters vented to the exterior to assure an even temperature within the enclosure and prevent dusting due to carbonation.

3. Add moisture to the heated air as required to maintain a minimum relative humidity of 40 percent within the enclosure. Do not allow any concrete surface to become dry during the protection period.
 4. Maintain enclosures for 24 hours after heating has been discontinued to allow the concrete to cool gradually.
 5. Lap insulating materials and cover the edges and corners of the concrete to provide complete and adequate protection.
 6. Wrap columns and walls with insulated blankets.
 7. Monitor the temperature of the concrete surface regularly with suitable thermometers throughout the protection period.
- E. Provide insulation or temporary backfill to protect all earth supported concrete from damage due to frost heaving.

3.12 Protection

- A. Protect all finished concrete surfaces from damage by construction equipment, materials or methods and by rain or running water.
- B. Do not load self-supporting members in such a way as to overstress the concrete.

3.13 Field Quality Control

- A. Testing Laboratory: Conduct testing and write reports as outlined in this Article per the requirements in the General Conditions.
- B. Strength Tests:
 1. During the progress of the work, take samples of concrete for strength tests in accordance with ASTM C172.
 2. Make and cure a minimum of 4 cylinders in accordance with ASTM C31 for each of the following:
 - a. Individual pours utilizing separate batches of concrete.
 - b. Each 50 cubic yards of concrete.
 - c. Each 3000 square feet of surface area for slabs and walls.
 - d. Each class of concrete placed in a day's work.
 3. Test each group of 4 cylinders in accordance with ASTM C39 as follows:
 - a. Two field cured cylinders to be tested at 7 days or just before anticipated time of form removal.
 - b. Two laboratory cured cylinders to be tested at 28 days.

4. A strength test is the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days.
 5. The strength level of an individual class of concrete will be considered satisfactory if both of the following requirements are met:
 - a. Average of all sets of three consecutive strength tests equal or exceed the specified compressive strength.
 - b. No individual strength test (average of two cylinders) falls below the specified compressive strength by more than 500 psi.
 6. If the strength level of an individual class of concrete is found to be unsatisfactory, conduct core testing in accordance with ASTM C42, impactometer testing or load testing on the area of concrete in question as required by the Engineer of record. If such additional testing does not produce acceptable results, corrective measures will be required to ensure structural adequacy.
 - a. Make appropriate adjustments to the concrete mix designs as required.
- C. Slump Tests:
1. Make one slump test in accordance with ASTM C143 with each group of 4 cylinders.
 2. When concrete is pumped, make the slump test at the point of discharge.
 3. Keep a slump cone available at the site for additional testing as required.
- D. Air Content Tests: Make one air content test in accordance with ASTM C173 or ASTM C231 with each group of 4 cylinders for air-entrained concrete mixes at point of discharge.
- E. Air-dry Density Tests:
1. Make one air-dry density test in accordance with ASTM C567 for each group of 4 cylinders.
- F. Rejection of Concrete:
1. Any concrete that does not meet the specified requirements for air-entrainment, concrete temperature, or slump shall not be placed until corrective measures have been taken, and the concrete has been re-tested to indicate compliance.
 2. The testing laboratory shall be responsible to furnish all testing data immediately to the Engineer of record. If tests fail to meet the specifications, the material shall be retested.

G. Field Quality Control Test Reports:

1. Include the following information in test reports:
 - a. Project identification and portion of structure represented.
 - b. Concrete mix class and specified compressive strength requirements.
 - c. Weather conditions and air temperature.
 - d. Concrete temperature, slump and air content test results.
 - e. Dates of placing and testing.
 - f. Method of curing (field or laboratory).
 - g. Strength test results.
 - h. Technician: name, certification number with expiration date.

3.14 Watertight Concrete

- A. When the concrete has attained sufficient strength and before the basins, tank, etc., which hold water, are placed in service, they shall be filled with water and tested for watertightness. Any imperfections, leaks or combination of leaks which cause the surface of the water to drop more than one-quarter (1/4) inch in twenty-four (24) hours shall be satisfactorily repaired. Any visible leaks shall be made watertight.

The Contractor shall make concrete in all structures watertight. Any cracks or imperfections developing at any point in the work shall be thoroughly repaired in a manner satisfactory to the Engineer of record. The Contractor shall take extraordinary precautions to prevent the possibility of water leakage along construction joints. All special treatment of the concrete and joints necessary to fulfill the specifications for water tightness shall be at the Contractor's expense.

3.15 Pipe Piers, Pump And Equipment Bases

- A. All concrete pipe piers, pump bases and equipment bases shall be constructed as a part of the concrete work. All pump and equipment bases or pads shall be securely anchored to the floor by means of the reinforcing steel dowels if the pads are poured separate from the floor. Special care shall be taken to accomplish a presentable finish on the pump and equipment bases, the surface of which shall be rubbed as specified under the heading of "Smooth Rubbed Finish". An approved nonshrinking grout shall be used for filling solid the void spaces between the bottoms of pump or equipment bases and the tops of the concrete pads.

(SECTION WM 6)

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 Description

- A. The work under this Section consists of furnishing all labor, equipment, materials and services required for the installation of all concrete reinforcement and associated items required and/or indicated on the Drawings or specified herein.

- B. Related work specified elsewhere:
 - 1. Concrete Formwork Section WM-5.1
 - 2. Cast-in-Place Concrete Section WM-5.2

1.02 Quality Assurance

- A. Provide at least one experienced person who shall be present at all times during execution of this portion of the Work and who shall be thoroughly familiar with the type of materials being installed and the best methods for their installation and who shall direct all work performed under this Section.

- B. Codes and Standards (latest editions):
 - 1. "Manual of Standard Practice for Detailing Reinforced Concrete Structures" ACI 315.
 - 2. "Building Code Requirements for Reinforced Concrete" ACI 318.
 - 3. "Specifications for Structural Concrete for Buildings", ACI 301.
 - 4. CRSI Manual of Standard Practice.
 - 5. ACI 311, "Standard Specifications for Tolerances for Concrete Construction and Materials".
 - 6. Portland Cement Association, "Positioning Welded Wire Fabric".
 - 7. ASTM C1116, Type III, "Standard Specifications for Fiber-Reinforced Concrete and Shotcrete".

- C. The Contractor shall attend a pre-construction meeting to discuss the review of reinforcement steel installation. The ironworker foreman shall be present.

1.03 Submittals

- A. Shop Drawings; Reinforcement: Submit original shop drawings prepared by registered Professional Engineer for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

B. Shop Drawings:

1. Submit the proposed Shop Drawing Submittal Schedule prior to submitting any of the shop drawings for review.
2. Shop drawings giving details of fabrication and placing shall be prepared by the supplier and submitted to the Engineer of record for his review.
3. Shop drawing action codes:
 - a. Shop drawings marked "no exception taken" require no corrections to be made. No re-submittal is required. Fabrication may commence leading to reinforcement installation.
 - b. Shop drawings marked "make corrections noted" require the marked corrections to be made. No resubmittal is required. Fabrication may commence leading to reinforcement installation.
 - c. Shop drawings marked "make corrections noted - revise and re-submit" require the marked corrections to be made. The drawings must be resubmitted for review. Fabrication may commence. Installation may not begin until the subsequent submission has been reviewed and returned for use in reinforcement installation.
 - d. Shop drawings marked "rejected - revise and re-submit" require shop drawings be re-evaluated to be in compliance with the construction documents. The drawings must be re-submitted for review. Fabrication may not commence.
4. Shop drawings will be checked by the Engineer for correct interpretation of the drawings but this check shall not relieve the Contractor of his primary responsibility to provide the correct number of properly detailed bars in all members.
5. Resubmitted shop drawings:
 - a. All information which is correct on the original submittal should not be changed in any way on the resubmitted shop drawings.
 - b. If information on a shop drawing must be changed, then cloud all the changes on the resubmitted shop drawings.
6. See the "General Notes" and the "Typical Details" of the structural drawings for extra reinforcing around openings, over beams and other general information for the detailer.
7. Shop drawing shall be prepared in accordance with the following:
 - a. Beams and Walls: 1/4-inch scale elevations of all walls and beams shall be provided with all the reinforcing shown on the elevations, not scheduled.
 - b. Slabs and Mats: Reinforcing for all concrete slabs shall be shown on a floor plan drawn exclusively for this use. Reinforcing shall not be scheduled.
 - c. Slabs and Mats: A support system plan for all slabs shall be provided. Supports for slab top and bottom bars shall be shown in number and location. The maximum spacing of support bars shall be 4'-0". The maximum overhang beyond a support bar or a slab bolster shall be 1'-0".
 - d. Bar bending diagrams shall be provided for all bent bars (within a submittal) in that same submittal.
 - e. Sections of walls, beams, joists and slabs shall be provided showing clearly bar positions and clearances to forms.

- f. On wall sections, indicate spacers used to maintain clearances for vertical wall steel.
 - g. Beam bolsters and joist chairs shall be indicated as to size and spacing on the sections and the elevations.
 - h. Shop drawings shall include all details, sections, and installation instructions indicated on the structural drawings that are required by the Contractor to place the reinforcement without using the structural drawings.
 - i. Grades of reinforcement shall be indicated on each shop drawing.
8. Submit the following regarding the mechanical tension butt splices, the end-bearing splices and the dowel bar replacement system to be used:
- a. Shop drawings indicating fabrication and placement details per this section.
 - b. Manufacturer's literature, product samples, and certified test reports substantiating compliance with the specification.

1.04 Product Handling

- A. Protection:
- 1. Use all means necessary to protect concrete reinforcement before, during and after installation and to protect the installed work and materials of all other trades.
 - 2. Store in a manner to prevent excessive rusting and fouling with dirt, grease, and other bondbreaking coatings.
 - 3. Use all necessary precautions to maintain identification after the bundles are broken.
- B. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer of record and at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 Concrete Reinforcement

- A. All concrete reinforcement materials shall be new, free from rust, and complying with the following reference standards:
- 1. Main reinforcing Bars: ASTM A-615 Grade 60, deformed
 - 2. Stirrups and Column tie Bars: ASTM A-615 Grade 60
 - 3. Wire Reinforcement: ASTM A- 82, plain, cold-drawn steel
 - 4. Welded Wire Fabric: ASTM A-185
 - 5. Weldable Reinforcing Bars: ASTM A706, Grade 60, weldable deformed
 - 6. Epoxy Coated Reinforcing Bars: ASTM A775

2.02 Accessories

- A. Provide bar supports, bolsters, chairs, spacers, ties, blocking, other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place and in accordance with CRSI "Manual of Standard Practice".
- B. Bar supports shall be stainless steel or protected with plastic in contact area. When underneath side of floor is to be exposed and painted, bar supports shall be stainless steel.
- C. Provide plastic spacers to properly maintain clearances for vertical wall reinforcement.
- D. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

2.03 Mechanical Butt Splices

- A. Mechanical butt splices shall conform to ACI318-89.
 - 1. Lenton Rebar Splicing - Erico.
 - 2. Grip Twist System - Dayton Barsplices, Inc.
 - 3. Cadweld, C-Series - Erico.
 - 4. or Equal.

2.04 Dowel Bar Replacement System

- A. Shall conform to ACI 318-89.
 - 1. Dowel Bar Substitution and Splice System-Richmond Screw Anchor Co.
 - 2. Dowel Bar Replacement System-Dayton Superior
 - 3. Stabox-Couplerbox Inc.
 - 4. or Equal.

PART 3 EXECUTION

3.01 Fabrication

- A. Fabrication, including bar bending shall comply with the requirements of ACI 318, ACI 315 and CRSI "Manual of Standard Practice".

3.02 Surface Conditions

- A. Inspection:
 - 1. Prior to installation of the Work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
 - 2. Verify that concrete reinforcement may be installed in strict accordance with all pertinent codes and regulations, the approved Shop Drawings, and the original design.

B. Discrepancies:

1. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved and approved by the Engineer of record.

3.03 Installation

- A. All reinforcement shall be held securely in design position by wiring to supports in accordance with CRSI standards and, in addition, any other supports needed to secure every bar against displacement shall be provided. Overhanging tails shall be supported positively. Walking on top slab bars shall be avoided. All bars bent and/or displaced during concrete placement shall be straightened and repositioned before they are encased in concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice and other materials which reduce or destroy bond with concrete.
- C. 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.
- D. 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.
- E. Install welded wire fabric in as long lengths as practicable in accordance with the Portland Cement Association. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction. Hooking welded wire fabric and lifting into position is not acceptable.
- F. Tolerances on reinforcing placement:

<u>Member</u>	<u>Top Steel</u>	<u>Bottom Steel</u>	<u>Side Steel</u>
Slabs	3/8"±	1/4"±	
Joists			
Beams	1/2"±	1/4"±	1/2"±

- G. Splicing of main reinforcement will not be permitted unless set out on the construction documents or approved by the Engineer of record.
- H. Concrete protection shall comply with the requirements of ACI 318 except as modified on the Structural Drawings.

- I. Avoid cutting or puncturing vapor retarder during reinforcement placement and concreting operation.
- J. Obstructions:
 - 1. In the event conduits, piping, inserts, sleeves or any other items interfere with placing reinforcement as indicated on the Drawings or as otherwise required, immediately consult the Engineer of record and obtain approval of new procedure before placing concrete.

3.04 Notification

- A. Contractor shall notify the Engineer of record when reinforcement for a pour is nearing completion so that reinforcing steel in place may be reviewed.
 - 1. Allow sufficient time for setters to make adjustments or corrections so that reinforcing steel correct in size, shape and position will be in place when concreting is started.

(SECTION WM 7)

SANITARY SEWER PIPE

PART 1 GENERAL

1.01 Description

- A. The Contractor shall furnish and lay, as required, sewer pipe, together with all bends, branches, or other specials as shown on the plans or specified and, necessary to complete the work, including necessary pieces of sewer pipe for purpose of physical tests. Sewers shall be constructed of the pipe materials as specified herein.
- B. All sewers to be furnished under this Contract shall conform to specifications of this section. Actual materials furnished for sanitary sewers shall be permitted only as indicated in the Detailed Specifications.
- C. The following specifications shall apply to bell and spigot sewer pipe with elastomeric seal joints together with all required bends, branches, fittings, and other specials required for installation; and to specimens of pipe and materials required for testing.
- D. Related work described elsewhere:
 - 1. Excavation WM-2
 - 2. Backfill WM-3

1.02 Quality Assurance

- A. Codes and Standards
 - 1. Each length of pipe shall be marked per the requirements of the respective ASTM Standard.
 - 2. All codes and standards shall be set forth in the latest ASTM Standard.
 - 3. Upon request by the Engineer, the Contractor at his own expense, shall furnish copies of all material tests required by the applicable ASTM Standard.

1.03 Submittals

- A. Shop Drawings
 - 1. Prior to ordering pipe material, submit shop drawings to the Engineer for approval. All submittals shall include certification of conformance with the applicable ASTM Pipe Standard, allowable ASTM bedding certification, and the manufacturer's installation recommendations based upon the application. No field work shall be started prior to shop drawing approval.

PART 2 PRODUCTS

2.01 Ductile Iron Pipe

A. Material

Ductile Iron Pipe shall be centrifugally cast and shall conform to ANSI Specifications A21.51 and AWWA C-151, latest revision. Ductile Iron Pipe shall be minimum Pressure Class 350, or meet thickness class requirements of project.

B. Coatings and Linings

1. Exterior Coatings

Exterior Coating shall be asphaltic in accordance with ANSI/AWWA C151/A21.51.

2. Internal Linings and Coatings

Pipe shall have either of the following internal lining configurations:

- a. Cement lined with Type V Cement and seal coated with an approved bituminous seal coat in accordance with AWWA Specification C-104 (ANSI A21.4).
- b. Ceramic epoxy lined with 40 mils minimum nominal dry film thickness.

C. Fittings

Fittings shall be standardized for the type of pipe and joint specified and shall comply with AWWA C-110 (ANSI A-21.10) or AWWA C-153 (ANSI A-21.53).

D. Joints

Mechanical joints or slip joints shall be provided.

Mechanical joints and accessories shall conform to AWWA Standard C-111, ANSI A-21.11. The bolts and nuts shall be corrosion resistant high strength alloy steel.

The O-ring gaskets sealing the slip joint shall be made of rubber of special composition having a texture to assure a watertight and permanent seal and shall be the product of a manufacturer having at least five (5) years experience in the manufacturer of rubber gaskets for pipe joints. The gasket shall be a continuous ring of flexible joint rubber of a composition and texture which is resistant to common ingredients of sewage, industrial wastes and groundwater, and which will endure permanently under the conditions likely to be imposed by this service. The gasket shall conform to the requirements of AWWA C-111 (ANSI A-21.11).

E. Markings

The class designations for the various classes of pipe and fittings, manufacturer's name and year of manufacture shall be marked in accordance with AWWA C151.

F. Certification

The Contractor shall furnish, upon request by the Engineer, certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable Standards.

2.02 Polyvinyl Chloride Pipe

A. Material

Polyvinyl chloride (PVC) gravity sanitary sewer pipe shall be the integral wall bell and spigot type with elastomeric seal joints and smooth inner walls meeting or exceeding all of the requirements set forth in ASTM D-3034 for pipe diameters 15-inches or less and meeting or exceeding all of the requirements set forth in ASTM F-679 for pipe diameters greater than 15-inches.

For diameters 15-inches or less, the pipe shall have a minimum cell classification of 12454-B and for diameters greater than 15-inches the pipe shall have a minimum cell classification of 12454-C; with all pipe having a minimum tensile strength of 34.50 Mpa as defined in ASTM D-1784.

PVC sanitary sewer pipe shall have a minimum pipe stiffness of 46 psi for each diameter when measured at 5% vertical ring deflection and tested in accordance with ASTM D-2412.

NOTE: *Polyvinyl Chloride (PVC) Ribbed Sewer Pipe meeting or exceeding all of the requirements set forth in ASTM F 949-86a or ASTM F 794 is acceptable. The minimum cell classification acceptable shall be 12454-B as defined in ASTM D-1784. PVC Ribbed Sewer Pipe shall have a minimum pipe stiffness of 50 psi when measured in accordance with ASTM D-2412 for 8-inch through 18-inch pipe and 46 psi for 21-inch and greater.*

B. Joints

Flexible gasket joints shall be compression type so that when assembled, the gasket inside the bell will be compressed radially on the pipe spigot to form a watertight seal. The assembly of joints shall be in accordance with the pipe manufacturer's recommendations and ASTM D-3212. The gaskets sealing the joint shall be made of rubber of special composition having a texture to assure a watertight and permanent seal and shall be the product of a manufacturer having at least five (5) years experience in the manufacture of rubber gaskets for pipe joints. The gasket shall be a continuous ring of flexible joint rubber of a composition and texture which is resistant to common ingredients of sewage, industrial wastes and groundwater and which will endure permanently under the conditions imposed by this service. The gasket shall conform to the requirements of ASTM F-477.

NO SOLVENT CEMENT JOINTS SHALL BE ALLOWED.

All field-cutting of pipe shall be done in a neat manner as per manufacturer's recommendations and the cut end shall be beveled using a file or wheel to produce a smooth bevel of approximately 15° and be a minimum depth of one-third the pipe wall thickness. Field cut pipe will only be allowed to be installed at manholes, at prefabricated tees and wyes, and at the connection of new sanitary sewer to existing sanitary sewer.

ONLY SMOOTH EXTERIOR PIPE SHALL BE USED AT MANHOLE CONNECTIONS.

C. Fittings

Only manufactured fittings made of PVC plastic having a cell classification of 12454-B as defined in ASTM D-1784 shall be used.

Tee/Wye service connections for sewers where existing or proposed grade (to sewer invert) as shown on plans, exceeds 15 feet shall be heavy wall.

SADDLE CONNECTIONS SHALL NOT BE ALLOWED FOR NEW CONSTRUCTION.

D. Design

The minimum wall thickness for PVC sewer pipe and lateral sewer pipe 15-inches or less in diameter shall conform to SDR-35 Type PSM as specified in ASTM D-3034. The minimum wall thickness for PVC sewer pipe greater than 15-inches in diameter shall conform to T-1 as specified in ASTM F-679.

E. Markings

The date of manufacture, class of pipe, specification designation, size of pipe, name or trademark of manufacturer, and identification of plant/location shall be legibly marked on the outside of each pipe section in accordance with the ASTM D-3034.

F. Certification

The Contractor shall furnish, upon request, certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable Standards.

2.03 Reinforced Concrete Pipe

A. Material

All reinforced concrete pipe shall be Class III, IV or V in accordance with ASTM C-76, latest edition; wall thickness "B" or "C" per site conditions and be manufactured from Portland Cement and aggregate as specified herein.

B. Portland Cement

Portland Cement for manufacture of concrete pipe and fitting shall be Type I or Type III and shall conform to ASTM C-150. Upon request, the Contractor shall furnish manufacturer's certificate stating the type of cement used in the manufacture of the pipe furnished.

C. Aggregate

The aggregate for manufacture of concrete pipe and fittings shall conform to ASTM C-33 except that the requirement for gradation shall not apply. Upon request the Contractor shall furnish manufacturer's certificate stating the type of aggregate used in the manufacture of the pipe furnished.

D. Steel Reinforcement

Steel reinforcement shall be in accordance with requirements of the applicable table in ASTM C-76. Reinforcement shall extend full into bell or spigot ends for pipes 36-inches and larger and shall extend full into the bell of rubber gasket pipes 12-inches and larger. Elliptical reinforcement shall not be permitted. Longitudinal reinforcement shall be continuous and all reinforcement shall have a minimum concrete cover of 1-inch.

E. Lift Holes

Lift holes shall not be permitted.

F. Joints

Concrete pipe shall be furnished with joints using either concrete bell or spigot or zinc coated steel bell and spigot rings or rubber seal and rings (Anderson Seal, Press Seal, or an approved equal). All types of joints shall have a groove on the spigot for a rubber "O" ring gasket. Pipe joints using concrete bell and spigot or zinc coated steel bell and spigot rings shall conform to ASTM C-361 except that the gaskets shall be as specified hereinafter. Pipe joints using rubber gaskets shall conform to ASTM C-443. Joints shall be adequate for hydrostatic pressures up to 13 psi (30 ft. of head). The joint shall be sealed with a rubber gasket conforming to ASTM C-443 so that the joint will remain watertight under all conditions of service. The steel bell shall be welded to the longitudinal reinforcing and a steel skirt (minimum 5-3/4-inches in length and fabricated from 16 gage metal) shall be continuously welded to the inside face of the steel spigot ring and to the longitudinal reinforcement.

Profile gasket type joints using a self-lubricated gasket (Forsheda Style 138, NPC Self-Lubricated Gasket for Concrete Pipe & Manhole, or approved equal) on a single offset spigot and formed bell are acceptable. Joints shall be sealed with a profile rubber gasket conforming to ASTM C-443 so that the joint will remain watertight under all conditions of service.

Only one style of joint system will be permitted between a manhole run of pipe.

G. Absorption Limits

Absorption of the reinforced concrete pipe shall not exceed 6% of the dry weight.

H. Markings

The date of manufacture, class of pipe and specification designation, size of pipe, name or trademark of the manufacturer, and identification of plant shall be legibly marked on each section of pipe per the ASTM requirement.

I. Specials

Specials shall conform to the specifications for straight pipe insofar as applicable. Special design or construction necessary for specials shall be subject to approval on a case by case basis.

J. Gaskets

The gaskets sealing the joint shall be made of rubber of special composition having a texture to assure a watertight and permanent seal and shall be the product of a manufacturer having at least five (5) years experience in the manufacturer of rubber gaskets for pipe joints. The gasket shall be a continuous ring of flexible joint rubber of a composition and texture which is resistant to common ingredients of sewage, industrial wastes and groundwater, and which will endure permanently under the conditions likely to be imposed by this service. The gasket shall conform to the requirements of ASTM C-443.

K. Sanitary Sewer Lateral Connections

Where lateral connections must be made to the RCP sewer, a rubber connector with stainless steel clamp KOR-N-SEAL, Fernco QuikSeal, or equal, shall be used. The connector shall be the sole element relied on to assure a flexible watertight seal of the pipe.

The rubber for the connector shall comply with ASTM C-923 and shall be resistant to ozone, weather elements, chemicals including acids and alkalis, animal and vegetable fats, oils, and petroleum products from spills.

The stainless steel elements of the connector shall be totally non-magnetic Series 305 stainless steel. The stainless steel clamp shall be capable of sustaining applied torque in excess of eighty (80) inch-pounds. It shall be the responsibility of the Contractor to submit details of the proposed connection for approval.

L. Certification

The Contractor shall furnish, upon request, certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable Standards.

M. Coatings

Where coatings are required the following interior coatings shall be provided:

1. Zebron Polyurethane system with minimum thickness of 40 mil.
2. PVC like Ameron T-Lock with a minimum thickness of 0.065 inches (1.65 mm).
3. or Equal.

2.04 Truss Pipe

A. Material

Truss pipe shall be the wall bell and spigot type with elastomeric seal joints and smooth inner walls meeting or exceeding all of the requirements set forth in ASTM D-2680 for pipe diameters 8-inches to 15-inches and ASTM D-1784 for a minimum bell classification of 12454B or 12454C or ASTM D-1788 for all classification of 2-2-3.

Truss pipe shall have a minimum pipe stiffness of 200 psi for each diameter when measured at 5% vertical ring deflection and tested in accordance with ASTM D-2412.

The fill material shall be Portland Cement, Perlite Concrete or other inert fill material exhibiting the same degree of performance.

B. Joints

Flexible gasket joints shall be compression type in accordance with ASTM-3212 so that when assembled, the gasket inside the bell will be compressed radially on the pipe spigot to form a watertight seal. The gaskets sealing the joints shall be made of rubber of special composition having a texture to assure a watertight and permanent seal and shall be the product of a manufacturer having at least five (5) years experience in the manufacture of rubber gaskets for pipe joints. Gasket shall be a continuous ring of flexible joint rubber of a composition and texture which is resistant to common ingredients of sewage, industrial wastes and groundwater, and which will endure permanently under the conditions likely to be imposed by this service. The gasket shall conform to the requirements of ASTM F-477.

NO SOLVENT CEMENT JOINTS SHALL BE ALLOWED.

All field-cutting of pipe shall be done in a neat, trim manner per manufacturer's recommendations. Care shall be taken to protect the filler material. All field cuts shall be sealed according to manufacturer's recommendations.

C. Fittings

Only manufactured fittings shall be used.

D. Certification

The Contractor shall furnish, upon request, certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable Standards.

E. Markings

The pipe barrel shall be marked at five (5) foot intervals per ASTM D-2680 with the following:

1. Manufacturer's Name, Tradename or Trademark
2. ASTM D-2680
3. PVC Composite Pipe
4. Extrusion Code, including date and location of manufacture
5. Nominal Pipe Size

PART 3 EXECUTION

3.01 General

- A. This Workmanship and Materials section on the Laying of Sewers shall be divided into three (3) classifications - rigid, semi-rigid and nonrigid pipe. Pipe materials such as concrete are considered rigid conduits. Thermoplastic (PVC) and shall be considered nonrigid or flexible conduits.
- B. The depths of the existing utilities (gas, water, telephone, etc.) are not shown on the plans unless they are otherwise noted on the plans as "field verified". The contractor should anticipate a certain number of vertical grade conflicts between the proposed sewer and the existing utility based on the depth and size of the sewers, the number of utilities shown on the plans and previous experience. The Contractor shall include the time and expense which is typically associated with this type of conflict in his bid including down time, loss of productivity, mobilization and remobilization but not the cost of relocating the existing utility if that is found to be necessary.
- C. Where horizontal and vertical separation from water lines cannot be met (10 ft. horizontal measured from outside edge to outside edge and 18" vertical), the sewer material shall be either ductile iron, SDR 21 PVC or C900 PVC for a distance of 10 ft. on either side of the crossing point.
- D. All pipe shall be constructed beginning from the lowest point and shall begin at either a new structure or connection to an existing structure.
- E. The Contractor shall certify to the Engineer in writing that the initial starting elevation is accurate and has been verified from at least two (2) benchmarks.

3.02 Rigid Conduit Installation (Concrete Pipe)

- A. All rigid conduit for sewer pipe shall be laid to the lines and grades shown on the plans, unless otherwise directed by the Engineer. All rigid pipe shall be laid in

accordance with Figure 9-27 for the First Class Pipe Laying Method. This First Class Pipe Laying Method may be achieved by Class B bedding methods as shown in the ASCE Manual of Practice No. 60, latest edition. Under this Class B bedding Method, the pipe shall be bedded in compacted granular material (Class I or Class II) placed on a flat trench bottom. All granular bedding material shall be placed in the trench in approximately six (6) inch layers. Compaction shall be accomplished by hand or mechanical tamping or by "walking" the material in to the halfway point on the pipe (Springline).

- B. The laying of pipe in finished trenches shall be commenced at the lowest point, proceeding upstream, with the spigot ends pointing the direction of flow.
- C. Except as otherwise specified, the excavation work for the sewers shall be performed in accordance with the Workmanship and Materials Specifications for "Excavation and Backfill."
- D. The practice of blocking pipe up to grade with bedding material, then backfilling under is prohibited. The entire length of the bed section is to be at proper grade before installing pipe.
- E. All pipes and specials shall be carefully inspected before being laid, and no cracked, broken or defective pipe or special shall be used in the work. All pipe shall be carefully inserted in the bell in such a manner that there will be no unevenness of any kind along the bottom half of the pipes and so that there is a uniform joint space all around.
- F. All pipe that is field cut shall have the homing-marks reestablished, insuring for proper seating depths. Pipes that are field cut shall have the cut ends retapered, by grinding or filing, as close to the original taper provided by the manufacturer as possible. When homing pipe with a spud-bar or other mechanical equipment, other than by hand, place a piece of wood between pipe and tool to prevent damage to bell end-section.
- G. Pipe laid in open cut shall have all trench spaces and voids solidly and completely filled with suitable earth materials from the excavations which shall be thoroughly and solidly rammed into place, unless otherwise specified.
- H. The joints shall be constructed as specified. The interior of the sewer shall, as the work progresses, be cleared of all dirt and superfluous materials of every description. Whenever pipe laying is discontinued, the unfinished end of the sewer shall be protected from displacement and cave-in or other injuries. During the process of the laying, care shall be taken to protect both pipes and joints from disturbance, and the trench shall be kept free from water until the joints shall have set. All surplus mortar or debris shall be promptly and completely removed from the interior of the pipes. On sewers twenty-four (24) inches in diameter and less, a disc mold or swab attached to a rod sufficiently long to pass two (2) joints from the end of the pipe last laid, shall be continuously worked through as the laying of the pipe proceeds.
- I. The ends of the pipes shall be protected to prevent the entrance of dirt or other foreign substances. Such protection shall be placed at night or whenever pipe

laying is stopped for any reason. Suitable plugs designed for use with the pipe material shall be provided and properly secured and used to cap all slants and branches. Pipe end protection and devices shall be included in the prices bid per linear foot of sewer.

3.03 Flexible Conduit Installation

- A. Plastic sewer pipe (PVC) and other flexible pipe shall be carefully installed in accordance with the above specification for Rigid Conduit Installation, except where the following paragraphs modify those specifications.
- B. Flexible conduit for sewer pipe shall be installed in accordance with "Underground installation of Flexible Thermoplastic Sewer Pipe" ASTM Designation D 2321.
- C. The First Class Pipe Laying Method for Flexible conduit may be achieved by Class B Bedding Methods as shown in the ASCE Manual of Practice No. 60, latest edition. Under this class B Bedding Method, the pipe shall be bedded in compacted granular material (Class I or II) as indicated in Figure 9-27 to twelve (12) inches above the crown of the pipe. All granular bedding material shall be placed in the trench in approximately six (6) inch layers.
- D. Compaction shall be accomplished by hand or Mechanical Tamping or by "Walking" the granular material in for Class I materials only. When Class II materials are used compaction shall be accomplished by hand or mechanical tamping only to a minimum eighty-five percent (85%) Standard Proctor Density.

3.04 Semi-Rigid Pipe Installation

- A. All semi-rigid pipe (PVC Truss and DI) shall be laid to the lines and grade shown on the plans. All semi-rigid pipe shall be laid in accordance with Figure 9-27 for the First Class Pipe Laying Method. This First Class laying method may be achieved by Class B Bedding Methods as shown in the ASCE Manual of Practice No. 60. Under this Class B Method the pipe shall be bedded in compacted granular material (Class I or II) placed on a flat trench bottom. All granular bedding material shall be placed in the trench in approximately six (6) inch layers. Compaction shall be accomplished by hand or mechanical tamping or by "walking" material in from halfway point on the pipe to the top of the pipe.

3.05 Testing Gravity Sanitary Sewers Less Than 36-inch Diameter

- A. Once constructed, all sanitary sewers and manholes shall be watertight and free from leakage. The rate of infiltration into the sanitary sewer system between any two adjacent manholes or the entire system shall not be in excess of 100 gallons per inch of pipe diameter per mile per day (100 gpd/in/mi). The Contractor shall be required to repair all visible leaks.
- B. Any leakage found during the infiltration test shall be corrected at Contractor's expense. Grouting of the joint or crack to repair the leakage shall not be permitted for flexible or semi-rigid pipe. If the defective portion of the sanitary sewer cannot be located, the Contractor shall remove and reconstruct as much of the work as is necessary to obtain a system that passes infiltration requirements.

- C. All gravity sanitary sewers constructed of flexible pipe and Truss pipe shall be deflection tested no sooner than thirty (30) days after installation.
- D. The Contractor shall bear the complete cost and supply all equipment necessary to perform the tests required.
- E. All tests shall be conducted under the observation of the Engineer. It shall be the Contractor's responsibility to schedule testing. The first 1,000 feet shall be leakage tested within fifteen (15) days after installation and deflection tested within forty-five (45) days after installation.

1. Low Pressure Air Test (All Approved Gravity Sanitary Sewer Pipe Materials Except Concrete)

All gravity sanitary sewers shall be tested for infiltration by means of a low pressure air test as generally described herein. Any other infiltration test procedure will only be allowed following the submittal of the procedure to the Engineer for review and upon written approval by the Engineer.

a. Equipment

The Contractor shall be responsible for providing all equipment and supplies necessary for the performance of a Low Pressure Air Test including but not limited to the following:

- Pneumatic Plugs
- Air Control Panel
- Shut-Off Valve, Pressure Regulative Valve, Pressure Relief Valve and Input Pressure Gauge — The pressure regulator or relief valve set shall be set no higher than 10 psig to avoid over pressurization
- Continuous monitoring pressure gauge having a range of 0 to 10 psi — The gauge shall be no less than 4 inches in diameter with minimum divisions of 0.10 psi and an accuracy of ± 0.04 psi.

To reduce the potential for sewer line over-pressurization, two (2) separate hoses shall be used to: connect the control panel to the sealed line for introducing low pressure air, and a separate hose connection for constant monitoring of air pressure buildup in the line.

If pneumatic plugs are utilized, a separate hose shall be required to inflate the pneumatic plugs.

b. Groundwater Elevation and Air Pressure Adjustment

Groundwater monitoring methods shall require the approval of the Engineer. Groundwater depth shall be determined in the field by the Contractor.

- Air Pressure Adjustment

The air pressure correction, which must be added to the 3.5 psig normal test starting pressure, shall be calculated by dividing the average vertical height, in feet of groundwater above the invert of the sewer pipe to be tested, by 2.31. The result give the air pressure correction in pounds per square inch to be added.

The allowable pressure drop of 1.0 psig and the timing in **Table 7-1** are not affected and shall remain the same.

- Maximum Test Pressure

In no case should the starting test pressure exceed 9.0 psig. If the average vertical height of groundwater above the pipe invert is more than 12.7 feet, the section so submerged may be tested using 9.0 psig as the starting test pressure. The 9 psig limit is intended to further ensure workman safety and falls within the range of the pressure monitoring gauges normally used.

2. Test Procedure

Following are general procedures to be employed in the performance of the test.

a. Plug Installation and Testing

After a segment of pipe has been backfilled to final grade, prepared for testing, and the specified waiting period has elapsed, the plugs shall be securely placed in the line at the ends of each segment to be tested.

The Contractor shall seal test all plugs before use. Seal testing may be accomplished by laying one length of pipe on the ground and sealing it at both ends with the plugs to be checked. The sealed pipe should be pressurized to 9 psig. The plugs shall hold against this pressure without bracing and without any movement of the plugs out of the pipe.

The Contractor shall plug the upstream end of the line first to prevent any upstream water from collecting in the test line. This is particularly important in high groundwater situations.

When plugs are being placed, the pipe adjacent to the manhole shall be visually inspected to detect any evidence of shear in the pipe due to differential settlement between the pipe and the manhole. A probable point of leakage is at the junction of the manhole and the pipe. This fault may be covered by the pipe plug and thus not revealed by the air test.

b. Line Pressurization

Low pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches the "starting air pressure" of 4.0 psig greater than the average back pressure of any groundwater above the pipe, but not greater than 9.0 psig. If groundwater is present, refer to Section 3.05.E.1.B. Groundwater Elevation and Air Pressure Adjustment to determine the internal pressure to be applied.

c. Pressure Stabilization

After the starting air pressure is reached, the air supply shall be throttled to maintain that internal pressure for at least 2 minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall.

d. Timing Pressure Loss

When temperatures have been equalized and the starting pressure stabilized, the air hose from the control panel to the air supply shall be shut off or disconnected. The continuous monitoring pressure gauge shall then be observed while the pressure is decreased to no less than 0.5 psig from the starting air pressure. At a convenient reading between 0.5 psig less than starting air pressure, timing shall commence with a stop watch.

A predetermined required time for a specified pressure drop shall be used to determine the lines acceptability. A pressure drop of 1.0 psig shall be used.

e. Determination of Line Acceptance

If the time shown in **Table 7-1**, for the designated pipe size and length elapses before the air pressure drops 1.0 psig, the section undergoing test shall have passed and shall be presumed to be free of defects. The test may be discontinued once the prescribed time has elapsed even through the 1.0 psig drop has not occurred.

f. Determination of Line Failure

If the pressure drops 1.0 psig before the appropriate time shown in **Table 7-1** has elapsed, the air loss rate shall be considered

excessive and the section of pipe shall be determined to have failed the test.

3. Test Times

a. Test Time Criteria

The Ramseier test time criteria requires that no test section shall be accepted if it loses more than “Q” cubic foot per minute per square foot of internal pipe surface area for any portion containing less than 625 square feet internal pipe surface area. The total leakage from any test section shall not exceed (625 x Q) cubic feet per minute.

b. Allowable Air Loss Rate

A “Q” value of 0.0015 cubic feet per minute per square foot shall be utilized to assure the OWNER of quality pipe materials, good workmanship, and tight joints.

c. Test Time Calculation

All test times shall be calculated using Ramseier’s equation:

$$T = 0.085 \frac{D \times K}{Q}$$

Where:

T = Shortest time, in seconds, allowed for the air pressure to drop 1.0 psig

K = 0.000419 DL, but not less than 1.0

Q = 0.0015 cubic feet/minute/square feet of internal surface

D = Nominal pipe diameter in inches, and

L = Length of pipe being tested in feet

For more efficient testing of long test sections and/or sections of larger diameter pipes, a timed pressure drop of 0.5 psig (**Table 7-2**) may be used in lieu of the 1.0 psig timed pressure drop upon approval of the Engineer. If a 0.5 psig pressure drop is used, the appropriate required test times shall be exactly half as long as those obtained using Ramseier’s equation for “T” cited above.

d. Testing Main Sewers with Building Sewers

In general, the Engineer will only approve the construction of the main line sewer and wye connections with the lateral stubbed-off to the property line. Building sewers will be allowed to be installed during the construction of the main line sewer only upon the written request to and written approval of the Engineer. This shall be

clearly delineated on the design plans and specifications submitted for approval by the Engineer.

If building sewers are approved for construction by the Engineer as part of the main line sewer, they shall be included in the test and their lengths may generally be ignored for computing the required test times. This can be done because in practice, ignoring the branch, lateral, or house sewers will normally increase the severity of the air test whenever the tested surface area is less than 625 square feet so that the total rate of rejection may only be increased about 2%. If the total tested surface area is greater than 625 square feet, ignoring the lateral sewers will only slightly decrease the severity of the test.

e. Specified Time Tables

To facilitate the proper use of this recommended practice for air testing, the following tables are provided. **Table 7-1** contains the specified minimum times required for a 1.0 psig pressure drop from a starting pressure of at least 3.5 psig greater than the average back pressure of any groundwater above the pipe's invert. **Table 7-2** contains specified minimum times for required for a 0.5 psig pressure drop from a starting pressure of at least 3.5 psig greater than the average back pressure of any groundwater above the pipe's invert.

4. Water Infiltration Test for Air Test Failures (and for Concrete Gravity Sanitary Sewer Pipes)

The Contractor may conduct a water infiltration test (weir test) when an air test fails to establish whether the 100 gal/in/mi/day maximum allowable infiltration rate is being exceeded. Water infiltration test may also be used for concrete pipe. If field conditions do not allow for infiltration test, an exfiltration test may be used upon written approval from the Engineer.

If the air test on the sewer system or any segment thereof fails, but the water infiltration or exfiltration test on the sewer system or any segment thereof passes; the sewer system or segment thereof shall be deemed acceptable. However, the Contractor shall be responsible for repairing all visible leaks regardless of ability of the sewer system or segment thereof to pass any established test criteria enumerated in these Standards.

The infiltration test shall not be considered a valid leakage test unless the top surface of the groundwater level is at least 2 feet above the pipe during the test measurement. The Contractor may simulate this condition by flooding the trenches.

The rate of infiltration of water into the sewer, including appurtenances, shall not exceed 100 gallons per day, per inch diameter, per mile of sewer. The infiltration between any two adjacent manholes shall not be greater than 250% of the allowable infiltration rate.

The infiltration allowance for manholes shall be computed using the total number of vertical feet of manhole expressed as the equivalent diameter sewer.

The maximum allowable infiltration, expressed in gallons per hour is shown below for various pipe and manhole sizes.

Dia. of Sewer (inches)	Infiltration Per Ft./Per Hr. (gals.)	Dia. of Sewer (inches)	Infiltration Per Ft./Per Hr. (gals.)
4	0.0032	48	0.0379
6	0.0048	54	0.0426
8	0.0063	60	0.0473
10	0.0079	66	0.0521
12	0.0095	72	0.0568
15	0.0119	78	0.0616
18	0.0142	84	0.0663
21	0.0166	90	0.0710
24	0.0189	96	0.0758
27	0.0213	102	0.0805
30	0.0237	108	0.0852
36	0.0284	114	0.0900
42	0.0332	120	0.0947

The infiltration allowance for manholes shall be computed using the total number of vertical feet of manhole expressed as the equivalent diameter sewer. For example, the infiltration allowance for a 48" diameter manhole = 0.0379 gal per vertical foot per hour.

5. Deflection Test for Select Pipe

Maximum ring deflection of the pipe line under load shall be limited to 5% of the vertical internal pipe diameter. The Contractor shall provide a proving ring that is ASTM certified to within 5% of the nominal diameter of the pipe installed on the project.

These pipes shall be mandrelled with a rigid device sized to pass five percent (5%) or less vertical deflection (or deformation) of the base inside diameter of the pipe. The mandrel test shall be conducted no earlier than thirty (30) days after reaching final trench backfill grade.

Each pipe material/type required to be Mandrel tested shall be tested with a mandrel approved by the pipe manufacturer and meeting the requirements of this Section.

The mandrel shall be pulled by hand through all sewer lines in a manner acceptable to the Engineer and any section of sewer not passing the mandrel shall be uncovered, replaced or repaired to the Engineer's satisfaction and retested.

The Contractor shall provide proving rings to check the mandrel. Drawings of mandrels with complete dimensions shall be furnished to the Engineer upon request for each diameter and specification type.

3.06 Testing Gravity Sanitary Sewers 36-inch and Larger

- A. Once constructed, all sanitary sewers and manholes shall be watertight and free from leakage. The rate of infiltration into the sanitary sewer system between any two adjacent manholes or the entire system shall not be in excess of 100 gallons per inch of pipe diameter per mile per day (100 gpd/in/mi). The Contractor shall be required to repair all visible leaks.
- B. Any visible leakage found after the pipe has been completely backfilled during construction or leakage found during the water infiltration test shall be corrected at Contractor's expense. Leakage shall be repaired using Avanti's AV-202 method if approved by the pipe manufacturer, or Engineer approved equal. If the defective portion of the sanitary sewer cannot be located, the Contractor shall remove and reconstruct as much of the work as necessary to obtain a system that passes infiltration requirements
- C. All gravity sanitary sewers constructed of flexible pipe and Truss pipe shall be deflection tested no sooner than thirty (30) days after installation.
- D. The Contractor shall bear the complete cost and supply all equipment necessary to perform the tests required.
- E. All tests shall be conducted under the observation of the Engineer. It shall be the Contractor's responsibility to schedule testing. The first 1,000 feet shall be water infiltration tested within fifteen (15) days after installation and deflection tested within forty-five (45) days after installation.

1. Pipe Joint Test

All pipe joints shall be tested in the field during construction using the joint air or water test in accordance with the procedures in ASTM C1103 or ASTM F3058. The following are the general procedures to be employed in the performance of the test.

a. Frequency of Testing

At no time shall pipe installation exceed 100 feet beyond the last joint tested.

b. Testing Apparatus

Follow the equipment manufacturer's recommendations when performing pipe joint tests. Only experienced technicians shall perform pipe joint tests.

c. Joint Air or Water Test

- Test shall be performed prior to the placement of backfill over the springline of the pipe and after the pipe has been locked in place. There shall be no groundwater acting on the pipe.
- Clean the joint and interior surface of the pipe to eliminate debris in accordance with the equipment manufacturer's recommendations.
- Position the testing apparatus over the joint and make sure the end element sealing tubes straddle both sides of the joint. For the water test, the bleed-off petcock must be located at the top dead center.
- Pressurize the void with air or water to 3.5 psig. Allow the pressure to stabilize before shutting off the air or water supply and start of test timing.
- If pressure holds, or drops less than 1 psig in 5 sec, the joint is acceptable.
- If the joint fails, it shall be retested or replaced if necessary and retested.
- Results of pipe joint tests shall be recorded and submitted to the Engineer.

2. Water Infiltration Test

The Contractor will conduct a water infiltration test in accordance with the method in WM-7, Section 3.05.

3. Deflection Test for Select Pipe

The Contractor shall conduct a mandrel deflection test in accordance with the method in WM-7, Section 3.05. If the pipe size does not allow for a mandrel test, laser profiling may be used upon written approval from the Engineer to verify that the pipe deflection does not exceed five percent (5%) or greater.

**TABLE 7-1
SPECIFICATION TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015**

Pipe Dia. (in)	Min. Time (min:sec)	Length for Min. Time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)								
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	
4	3:46	597	0.380L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854L	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:40
8	7:34	298	1.520L	7:34	7:34	7:34	7:34	7:34	7:34	7:34	7:34	7:34
10	9:26	239	2.374L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48	19:47
12	11:20	199	3.418L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38	28:29
15	14:10	159	5.342L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04	44:31
18	17:00	133	7.692L	17:00	17:00	25:38	32:03	38:27	44:52	51:16	57:41	64:10
21	19:50	114	10.470L	19:50	19:50	34:54	43:37	52:21	61:00	69:48	78:31	87:14
24	22:40	99	13.674L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33	113:57
27	25:30	88	17.306L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48	144:23
30	28:20	80	21.366L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15	178:03
33	31:10	72	25.852L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53	215:25
36	34:00	66	30.768L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46	256:24

TABLE 7-2
SPECIFICATION TIME REQUIRED FOR A 0.5 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015

Pipe Dia. (in)	Min. Time (min:sec)	Length for Min. Time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)								
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	
4	1:53	597	0.190L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	0.472L	2:50	2:50	2:50	2:50	2:50	2:50	2:50	2:50	2:50
8	3:47	298	0.760L	3:47	3:47	3:47	3:47	3:47	3:47	3:47	3:47	3:47
10	4:43	239	1.187L	4:43	4:43	4:43	4:43	4:43	4:43	4:43	4:43	4:43
12	5:40	199	1.709L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50	15:35
15	7:05	159	2.671L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02	22:26
18	8:30	133	3.846L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51	30:32
21	9:55	114	5.235L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16	43:38
24	11:20	99	6.837L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17	57:00
27	12:45	88	8.653L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54	71:13
30	14:10	80	10.683L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07	88:51
33	15:35	72	12.926L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57	107:43
36	17:00	66	15.384L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23	128:12

(SECTION WM 8)

PRESSURE PIPE - SANITARY

PART 1 GENERAL

1.01 Description

- A. The Contractor shall furnish and lay, as required, sanitary pressure pipe, together with all fittings, thrust blocking and other specials as shown on the plans or specified and, necessary to complete the work, including necessary pipe for purpose of tests. Sanitary pressure pipe shall be constructed of the pipe materials as specified herein.

- B. All sanitary pressure pipe to be furnished under this Contract shall conform to specifications of this section. Actual materials furnished for sanitary pressure pipe shall be permitted only as indicated in the Detailed Specifications.

- C. Related work described elsewhere:
 - 1. Excavation WM-2
 - 2. Backfill WM-3

1.02 Quality Assurance

- A. Codes and Standards
 - 1. Each length of pipe shall be marked per the requirements of the respective ASTM Standard.
 - 2. All codes and standards shall be set forth in the latest ASTM Standard.
 - 3. Upon request by the Engineer, the Contractor at his own expense, shall furnish copies of all material tests required by the applicable ASTM Standard.

1.03 Submittals

- A. Shop Drawings
 - 1. Prior to ordering pipe material, submit shop drawings to the Engineer for approval. All submittals shall include certification of conformance with the applicable ASTM Pipe Standard, allowable ASTM bedding certification, and the manufacturer's installation recommendations based upon the application. No field work shall be started prior to shop drawing approval.

PART 2 PRODUCTS

2.01 Ductile Iron Pipe

A. Material

Ductile Iron Pipe shall be centrifugally cast and shall conform to ANSI Specifications A-21.51 and AWWA C-151, latest revision. Ductile Iron Pipe shall be Pressure Class 350, 300, 250, 200 or 150.

B. Coatings and Linings

1. System 1

Pipe shall be sulphate resisting cement lined and seal coated with an approved bituminous seal coat in accordance with AWWA Specification C-104 (ANSI A21.4).

2. System 2

Pipe shall have either of the following interior coatings:

- a. polyurethane in accordance with ASTM D16 Type V (1000 microns minimum total thickness)
- b. epoxy (40 mils minimum)
- c. polyethylene (1500 microns minimum total thickness)

C. Fittings

Fittings shall be standardized for the type of pipe and joint specified and shall comply with AWWA C-110 (ANSI A-21.10) or AWWA C-153 (ANSI A-21.53).

D. Joints

Mechanical joints or slip joints shall be provided

Mechanical joints and accessories shall conform to AWWA Standard C-111, ANSI A-21.11. The bolts and nuts shall be corrosion resistant high strength alloy steel.

The O-ring gaskets sealing the slip joint shall be made of rubber of special composition having a texture to assure a watertight and permanent seal and shall be the product of a manufacturer having at least five (5) years experience in the manufacturer of rubber gaskets for pipe joints. The gasket shall be a continuous ring of flexible joint rubber of a composition and texture which is resistant to common ingredients of sewage, industrial wastes and groundwater; and which will endure permanently under the conditions likely to be imposed by this service. The gasket shall conform to the requirements of AWWA C-111 (ANSI A-2111).

Where indicated on plans, restrained joint pipe shall be provided. Restrained joints shall be designed in accordance with AWWA C-111 and shall permit

horizontal and/or vertical deflection after assembly, yet adequately restrain the joint at the full design pressure.

E. Markings

The class designations for the various classes of pipe and fittings, manufacturer's name and the year of manufacture shall be cast onto fittings in raised numerals, and cast or stamped on the outside of each joint of pipe.

F. Certification

The Contractor shall furnish, upon request, certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable standards.

2.02 High Density Polyethylene Pipe

A. Pipe

Materials used for the manufacture of polyethylene pipe shall be extra high molecular weight, high density ethylene/hexane copolymer PE 4710 polyethylene resin meeting the requirements of ASTM D-3350 with a cell classification of PE 445574C. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All material shall be listed by the Plastic Pipe Industry in the name of the pipe manufacturer and shall be based on ASTM D2837 and PPI TR-3 testing and validation for samples of the pipe manufacturer's production pipe. Pipe shall be in compliance with ASTM F714 DIPS minimum 200 psi (DR 11) for 3" and greater and ASTM D-3035 IPS minimum 160 psi (DR 13.5) for all mains less than 3" in diameter.

B. Joints

HDPE pipe shall be the joined into continuous lengths on the job-site above ground per ASTM F2620, Heat Joining Polyolefin Pipe and Fittings. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements, alignment, and interracial fusion pressure. Socket fusion shall not be used.

C. Pipe Packaging, Handling and Storage

The manufacturer shall package the pipe in a manner designed to deliver the pipe to the project site neatly, intact and without physical damage. The transportation carrier shall use appropriate method to insure the pipe is properly supported, stacked and restrained during transport. On-site the pipe shall be stored on clean, level ground to prevent undue scratching or gouging. When lining fused sections of pipe, chains or cable type chokers must be avoided,

nylon slings are preferred. Care must be exercised to avoid cutting or gouging the pipe.

D. Installation

Force main installation shall be in conformance with specifications for installation of flexible pipe as per all applicable ASTM requirements including F-412, D-2321, D-2412, D-3212 and D-3350.

E. Locator Tape

All HPDE pipe shall be installed with a metallic locator tape. Tape shall be color coded and installed above the pipe in accordance with the tape manufacturer's instructions.

F. Certification

The Contractor shall furnish, upon request, certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable standards.

G. Markings

During the extrusion production, the HDPE pipe shall be continuously marked with durable printing noting the nominal pipe size, dimension ratio, pressure rating, trade name, material classification, certification bases and date.

H. Fittings

Fittings shall be ductile iron per Section 2.01.C, Fittings.

2.03 Polyvinyl Chloride Pipe

A. Pipe

1. PVC force main pipe shall conform to ASTM Specification D-2241, Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe (SDR PR). The material used shall conform to ASTM Specification D-1784, Standard Specification of Rigid Polyvinyl Chloride and Chlorinated Polyvinyl Chloride compounds, Class 12454-B (PVC 1120). The minimum pressure class/SDR rating acceptable shall be Class 200/SDR 21.

The pipe fittings shall be pressure rated in accordance with recommendations of the Plastic Pipe Institute. Pressure class and standard dimension ratios (SDR) shall be as follows:

Class 160	SDR 26 for smaller than 4" diameter
Class 200	SDR 21
Class 250	SDR 17
Class 315	SDR 13.5

2. PVC force main shall be in compliance with AWWA C-900 for 4" through 12" and AWWA C-905 for 14" and greater as specified in WM-14 Pressure Pipe (Potable Water), Part 2.05. Minimum of DR18 (235 psi).

All plastic pipe and couplings shall bear identification markings in accordance with Section 2.5.2 and 2.5.3 of AWWA C-900, which shall include the National Sanitation Foundation (NSF) seal of approval. In addition, the plain end of each pipe length shall have two (2) rings, one inch (1") apart, painted around the pipe at the proper location to allow field checking of the correct setting depth of the pipe in the bell or coupling.

B. Joints

1. Joints shall be bell end or coupling push-on type.
2. The push-on joint and joint compounds shall meet the requirements for ASTM Specification D-3139, Joint for the Plastic Pipe, using flexible elastomeric seals. The joint shall be designed so as to provide for the thermal expansion and contraction experienced with a total temperature change of seventy-five (75) degrees F in each joint of pipe. Details of the joint design and assembly shall be in accordance with joint manufacturer's standard practice.
3. The lubricant shall have no deteriorating effects on the gasket or the pipe. The lubricant containers shall be labeled with manufacturer's name.
4. The gaskets sealing the joint shall be made of rubber of special composition having a texture to assure a watertight and permanent seal and shall be the product of a manufacturer having at least five (5) years experience in the manufacture of rubber gaskets for pipe joints. The gasket shall be a continuous ring of flexible joint rubber of a composition and texture which is resistant to common ingredients of sewage, industrial wastes and groundwater and which will endure permanently under the conditions imposed by this service. The gasket shall conform to ASTM F-477. Gaskets shall meet all applicable requirements of ANSI Standard A-21.11.

C. Fittings

Iron fittings shall be in compliance with Section 2.01.C of these specifications with joints and gaskets to properly fit the PVC pipe for 4" and larger. For pipe smaller than 4" diameter, PVC fittings shall be used.

D. Locator Tape

1. All PVC pipe shall be installed with a metallic locator tape. Tape shall be color coded and installed above the pipe bedding in accordance with the tape manufacturer's instructions.

2. Locator tape shall be brought to service no less than every 800 L.F. on PVC riser and cap.

E. Markings

The date of manufacture, class of pipe, specification designation, size of pipe, name or trademark of manufacturer, and identification of plant/location shall be legibly marked on the outside of each pipe section in accordance with the ASTM D-3034.

F. Certification

The Contractor shall furnish, upon request, certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable standards.

PART 3 EXECUTION

Pressure sewer mains shall be installed in accordance with AWWA/ASTM D-2774 standards and manufacturer's recommendations and Uni-Bell PVC Pipe Association Standard Uni-B-3. If any conflict between these standards, manufacturer's recommendations and these standard specifications, the manufacturer's recommendations shall take precedence.

3.01 Alignment and Grade

The pressure sewer mains shall be laid and maintained to lines and grades established by the plans and specifications, with fittings and valves at the required locations unless otherwise approved by the Engineer. Valve operating stems shall be oriented in a manner to allow proper operation.

A. Clearance

1. When crossing existing pipelines or other structures, alignment and grade shall be adjusted as necessary with the approval of the Engineer, to provide clearance as required by federal, state, and local regulations or as deemed necessary by the Owner to prevent future damage or contamination of either structure. Horizontal separation from water mains shall be 10' measured horizontally from outside edge of water main to the outside edge of the proposed pressure sewer. When installation closer than 10' is required or when crossing water mains the pressure sewer main shall be installed at least 18" below the bottom of the water main.
2. Installations not meeting the above requirements shall be as shown on plans and in accordance to state regulations.

3.02 Trenching

A. Width

The width of the trench at the top of the pipe shall be the same as that afforded by the single-pass capabilities of normally available excavating equipment, and shall be ample to permit the pipe to be laid and joined properly and to allow the backfill to be placed as specified. The minimum width of trench for mains shall be w (inches) = 1.25 (O.D. (inches)) + 12 . Trenches shall be of such extra width, when required, to permit the placement of timber supports, sheeting, bracing, and appurtenances as required by the safety requirements of the agency having jurisdiction.

B. Bell Holes

1. Holes for the bells shall be provided at each joint but shall be no longer than necessary to allow joint assembly and to ensure that the pipe barrel will lie flat on the trench bottom. Push-on type joints require only minimum depressions for bell holes.
2. Other than noted previously, 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 withdrawal of pipe slings or other lifting tackle without damaging coating or polyethylene encasement.

C. Rock Conditions

1. When excavation of rock is encountered, all rock shall be removed to provide a clearance below and on each side of all pipe, valves, and fittings of at least 6" for pipe sizes 24" or smaller and 9" for pipe sizes 30" and larger. When excavation is completed, a layer of appropriate backfill material shall be placed on the bottom of the trench to the previously mentioned depths, leveled, and tamped.
2. This installation procedure shall be followed when gravel formations containing loose boulders greater than approximately 8" (200 mm) in diameter are encountered.
3. In all cases, the specified clearances shall be maintained between the bottom of all pipe and appurtenances and any part, projection, or point or rock, boulder, or stone of sufficient size and placement that, in the opinion of the Engineer, could cause a fulcrum point or pointload.

3.03 Pipe Laying

Proper implements, tools, and facilities shall be provided and used for the safe and convenient performance of the work. All pipe, fittings and valves shall be lowered carefully into the trench by means of a derrick, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to water main materials and protective coatings and linings. Under no circumstances shall pressure sewer main

materials be dropped or dumped into the trench. Where practical, the trench should be dewatered prior to installation of the pipe.

A. Examination of Material

All pipe, fittings and valves and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for inspection by the Engineer, who may prescribe corrective repairs or reject the materials.

B. Pipe Ends

All lumps, blisters, and excess coating shall be removed from the socket and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be wiped clean and dry and be free from dirt, sand, grit or any foreign materials before the pipe is laid.

C. Pipe Cleanliness

Foreign material shall be prevented from entering the pipe while it is being placed in the trench. No debris, tools, clothing, or other materials shall be placed in the pipe at any time.

D. Pipe Placement

As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material.

E. Pipe Plugs

1. At times when pipe-laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Engineer. The plug shall be fitted with a means for venting. When practical, the plug shall remain in place until the trench is pumped completely dry. Care must be taken to prevent pipe flotation, should the trench fill with water.
2. Prior to removal of the plug for extending the line or for any other reason, air and/or water pressure in the line shall be released.

F. Ductile Iron Encasement

Polyethylene encasement for ductile iron pipe shall be installed in accordance with ANSI/AWWA C105/A21.5.

3.04 Joint Assembly

Joints shall be assembled in accordance with the manufacturer's instructions.

A. Assembly

After placing a length of pipe in the trench, the manufacturer's lubricant shall be properly applied. Spigot end shall then be centered in the bell and the pipe pushed home and brought to correct line and grade. Pipe and fittings which do not allow a sufficient and uniform space for joints shall be removed and replaced with pipe of proper dimensions to insure such uniform space. Precautions shall be taken to prevent dirt from entering the joint space.

B. Joint Deflection

When it is necessary to deflect pipe from a straight line in either the horizontal or vertical plane, the amount of joint deflection shall not exceed 80% of the allowance recommended by the manufacturer.

C. Pipe Cutting

1. Cutting pipe for insertion of valves, fittings, or closure pieces shall be done in conformance with all safety recommendations of the manufacturer of the cutting equipment. Cutting shall be done in a safe, workmanlike manner without creating damage to the pipe lining. An oxyacetylene torch shall not be used.
2. Cut ends and rough edges shall be ground smooth, and for push-on joint connections the cut end shall be beveled by methods recommended by the manufacturer and approved by the Engineer.

3.05 Bedding for Pressure Sewer Main

- A. Bedding material shall be Class II or Class III as required for the various laying conditions. Excavated material may be re-used if native soil meets the Class II or III designation.
- B. Where rock excavation is required, a minimum of 6" of Class II or Class III bedding is required for mains up to 24" diameter and 9" for 30" and larger.
- C. Where non-granular backfill is to be consolidated to the top of pipe, earth or loam free of rocks or other debris, shall be placed by hand or carefully by equipment to prevent horizontal movement of the pipe. This material shall be hand tamped or spaded to firmly support the pipe haunches.
- D. Backfilling shall be in accordance with Section WM-3.
- E. Where granular backfill is required, granular fill shall be placed by hand or carefully by equipment. This material shall be hand tamped or spaded to firmly support the pipe haunches.

3.06 Thrust Restraint

A. Fittings

All plugs, caps, tees, reducers and bends, unless otherwise specified, shall be provided with thrust blocks and suitably restrained joints.

B. Design

1. The design pressure is the maximum pressure to which the pipeline will be subjected, with consideration given to the vulnerability of the pipe soil system when the pressure is expected to be applied. In most cases, this will be the test pressure of the pipe, applied shortly after installation, when the pipe-soil system is normally most vulnerable.
2. For buried pipelines, thrust restraint is achieved by transferring the thrust force to the soil structure outside the pipe. The objective of the design is to distribute the thrust forces to the soil structure in such a manner that joint separation will not occur in unrestrained joints.

C. Concrete Thrust Blocks

Vertical and horizontal thrust blocks shall be made of concrete having a compressive strength of not less than 3000 psi after 28 days. The blocks shall be placed between solid ground, and the fitting to be anchored. The mass of the block and/or the area of bearing on the pipe and on the ground in each instance shall be that shown on the plans. The blocking shall, unless otherwise shown or directed, be so located as to contain the resultant thrust force in such a way that the pipe and fitting joints will be accessible for repair. Concrete for thrust blocks shall be properly mixed by truck or portable mixer. At no time shall pipe be restrained with bags of premixed concrete unless properly mixed with a portable mixer.

D. Restraining mechanisms for push-on or mechanical joints may be used in concert with concrete blocking. Tie rods, clamps, or other components of dissimilar metal shall be protected against corrosion by hand application of a suitable coating or by encasement of the entire assembly with 8-mil loose polyethylene film in accordance with ANSI/AWWA C105/A21.5.

1. Glands shall be manufactured of ductile iron conforming to ASTM A536-80, Grade 60-42-10. Set screws shall be hardened ductile iron. These devices shall have pressure rating with a safety factor of 281. Glands shall be listed with UL and Factory Manual.

3.07 Testing

A. All pipe shall be pressure tested in accordance with Section WM -15, Hydrostatic Testing of these WM Specifications.

3.08 Piping Under Structures

- A. All piping located under concrete structures shall be of the highest pressure class ductile iron for the specific diameter.

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(SECTION WM 9)

STANDARD MANHOLES

PART 1 GENERAL

1.01 Description

- A. Standard manholes shall be constructed complete, ready for use, including excavation, backfill, concrete work, cast iron frames and covers, manhole steps, walls of alternate construction, and pertinent work as shown on the plans, and as specified. All manholes shall be made watertight, and the Contractor shall furnish all materials and perform all work necessary for watertight construction.

- B. All proposed castings set in paved areas shall match (be flush with) the final pavement elevations unless the casting is to be depressed in order to create a sump. All proposed castings to be set in non-paved areas shall match (be flush with) the final ground elevations unless they are shown to be set higher. This requirement may supersede casting elevations shown on the plans. Confirm with the Engineer prior to ordering and installing final structures and castings.

1.02 Product Handling

- A. Store and protect miscellaneous items at the Project site. All precast structures must be delivered to job site by means which will adequately support them, and not subject it to undue stresses and are not damaged by crushing. The structures shall be unloaded carefully and strung or stored as close to the final point of placement as is practical.

1.03 Submittals

- A. Submit shop drawings for all structures and other appurtenances.

- B. Include all performance data such as strengths for concrete and steel and other material items. Reinforcing shall be detailed on the shop drawings.

- C. Shop drawings with supportive documentation for all prefabricated manholes other fittings or integral components shall be submitted to the engineer prior to fabrication.

1.04 Related Specifications

- A. Comply with applicable portions of the following WM Specifications:

WM-2	Excavation
WM-3	Backfill, Fills and Embankments
WM-5.2	Cast-in-Place Concrete
WM-6	Concrete Reinforcement

PART 2 PRODUCTS

2.01 Reinforced Concrete Manholes and Accessories

- A. Manholes shall be constructed in accordance with the ASTM Specifications for "Precast Reinforced Concrete Manhole Risers and Tops", Designation C 478. The minimum wall thickness shall be five (5) inches for manholes four (4) feet in diameter.
- B. The precast tops shall be of the eccentric cone type. Precast flat covers shall be not less than eight (8) inches thick and reinforced with two layers of steel with a minimum area of 0.39 square inches per linear foot in both directions in each layer. Precast flat bottoms of manholes shall also be reinforced the same as specified herein for precast flattop. Hoisting lugs or hooks shall be cast in place for handling and setting of the rings. Openings of proper sizes and suitable design shall be cast in place for receiving the sewer and/or drop pipes and connections. Adjusting riser rings shall be provided as approved by the Owner.
- C. All manhole joints shall be tongue and groove and they shall be sealed with an O-ring and joint sealer conforming to Federal Specifications SS-S-00210 and similar to "Kent-Seal No. 2" as manufactured by the Hamilton Kent Manufacturing Co., of Kent, Ohio; "RAM-NEK" as manufactured by the K.T. Snyder Co. of Houston, Texas, or equal. Cracked or damaged barrel joints shall be rejected. All joints shall also have an exterior joint collar.
- D. Manhole Steps. Steps shall be provided and manufactured of reinforced plastic and shall be twelve (12) inches wide and one (1) inch square.
- E. Manhole Bases. Manhole bases shall be of cast-in-place monolithic concrete or precast concrete. Where sewer lines pass through or enter manholes, the invert channels shall be smooth and semi-circular in cross section and shall be formed directly in the concrete of the manhole base. Changes of direction of flow within the manholes shall be made with a smooth curve with as long a radius as possible. The floor of the manhole outside the channels shall be smooth and slope toward the channel not less than one (1) inch per foot.
- F. No mortar or concrete shall be placed in water, and no water shall be allowed to flow over or against the concrete before it has set for a period of time deemed sufficient by the Owner to prevent damage to the structure. The invert channel through manholes shall be provided and constructed to conform in shape and slope to that of the sewer. All invert channels are to have a properly mortared apron on either side, sloped to prevent solids deposition. Changes of direction of flow within the manhole shall be made with a smooth curve with as long a radius as possible.
- G. Adjusting Rings. Where one (1) solid riser or barrel section cannot be used, final adjustments in elevation of the frame and cover shall only be accomplished by the use of precast concrete adjusting rings conforming to ASTM C 478. Rings shall be of a nominal thickness of not less than four (4) inches. Not more than twelve (12) inches total of adjusting rings shall be allowed for adjustment of the manhole frame and cover to required elevation.

- H. All exterior manhole joints shall have a joint collar equal to MacWrap Exterior Joint Sealer, RUBR-NEK External Joint Wrap, or equal. Collar shall be a minimum of 9" wide.

2.02 Sewer Pipe to Manhole Connections

- A. To connect a sanitary sewer to a manhole, either a flexible boot KOR-N-SEAL 1 or 2, flexible connector, cast-in-place Dura-Seal gasket, "A"-lock gasket or an approved equal shall be used. Connections to an existing manhole shall be a flexible boot seal.
- B. If the flexible boot connection is used, it shall be placed in the reinforced concrete manhole base and secured to the pipe by a stainless steel clamp. Flexible connectors shall conform to ASTM C 923.
- C. The cast-in-place inflatable gasket shall conform to ASTM C 923.
- D. All connections shall provide for a watertight seal between the pipe and manhole. The connector shall be the sole element relied upon to assure a flexible watertight seal of the pipe to the manhole.
- E. The rubber for the connector shall comply with ASTM C 923 and shall be resistant to ozone, weather elements, chemicals, including acids and alkalis, animal and vegetable fats, oils and petroleum products.
- F. The stainless steel elements of the connector shall be totally non-magnetic Series 305 stainless steel. The stainless steel clamp shall be capable of sustaining applied torque in excess of eighty (80) inch-pounds. It shall be the responsibility of the Contractor to submit details of the proposed connection to the Owner for approval. Connections not approved by the Owner shall be subject to removal and replacement with an approved adapter.
- G. New connections made to any existing structure shall be drilled in the direction of flow and shall be accomplished by coring entirely through the wall and base of the structure. The connector boot shall be appropriately sized to fit the opening and shall be KOR-N-SEAL® by NPC, Inc., A-Lok Products, Inc., or approved equal.

2.03 Castings

- A. Standard manholes shall have a R-1772-B frame and lid by Neenah Foundry, 1022-Z1 by East Jordan Iron Works, or approved equal. Material shall be in compliance with ASTM A 48, CL 35B. Each lid shall have 2 inch high letters indicating "Sanitary Sewer".
- B. Where watertight castings are required, the manholes shall have a R-1916F frame and lid by Neenah Foundry, 1045 HD by East Jordan Iron Works, or approved equal. The frame shall be anchored to through the riser rings (if provided) to the cone section with four (4) galvanized rods.

2.04 Frame Chimney Seal

- A. An internal or external rubber seal shall be installed on all sanitary manholes. A rubber seal extension, to cover any additional heights of chimney not covered by the seal itself, shall be used when required. The internal and external rubber seal and seal extensions shall be as manufactured by Cretex Specialty Products, NPC Specialty Products Mega-A-Lug (Oni-Flange), or equal.
- B. The sleeves shall be extruded from a high grade rubber compound conforming to the applicable requirements of ASTM C 923. The bands used for compressing the sleeve and extension against the manhole shall be fabricated from 16 gauge stainless steel conforming to ASTM A 240 type 304, any screws, bolts or nuts used on this band shall be stainless steel conforming to ASTM F 593 and 594, type 304.
- C. The joint between the manhole frame and chimney or cone shall be 3/4" thick and made using cement mortar. Any sealant used between the adjustment or grade rings of the chimney shall not be used in this joint. Installation of these rubber seals shall be in accordance with the manufacturer's recommendation.

PART 3 EXECUTION

3.01 Installation

- A. All manholes, inlets and similar drainage structures shall be installed so that the top of the inlet casting and frame (at the lowest point where surface water can enter) is flush with the final ground elevation.
- B. All structures shall be bedded on a minimum of 6 inches of compacted aggregate consisting of granular or crushed aggregate materials. No structure shall be set on soft or yielding soils.

PART 4 SANITARY MANHOLE TESTING

4.01 Testing

- A. All manhole vacuum tests shall be conducted in the presence of a representative of the Engineer and in accordance with ASTM C1244, Standard Test Method for concrete Sewer Manholes by Negative Air Pressure (vacuum) Test.
- B. The vacuum test equipment shall consist of: inflatable plugs for all incoming and outgoing sewer lines; an inflatable test collar to seal the manhole at the manhole frame; and a vacuum pump. A vacuum gauge shall be located in-line between the test collar and the pump to accurately indicate the vacuum in inches of mercury within the manhole. The vacuum gauge shall have a range to no more than thirty (30) inches of mercury, with scale markings of no greater than one-half (1/2) inch of mercury vacuum and an accuracy to within \pm two percent (2%) of true vacuum.
- C. Initial test manhole shall not be backfilled.

- D. The vacuum test shall be conducted by plugging all incoming and outgoing sewer lines in the manhole at a location beyond the connection of the sewer pipe with the manhole. All plugs shall be blocked in place so as not to move during the test. The vacuum testing collar shall be inflated in the frame in accordance with the equipment manufacturer's recommendations. A vacuum of ten (10) inches of mercury shall be drawn and the vacuum pump turned off and the valve between the vacuum pump and the vacuum gauge shall be turned off.
- E. The time period which is taken for the vacuum to fall from ten inches (10") of mercury to nine inches (9") of mercury shall be determined. If the time taken for the vacuum to reduce the ten inches (10") of mercury to nine inches (9") of mercury is less than the time indicated in the following Table, then the manhole work shall be considered not acceptable and shall be rejected. If the time is equal to or exceeds the time indicated below, the manhole work shall be accepted.

Manhole Depth (ft.)	Diameter =	Time (sec)		
		48"	60"	72"
8		20	26	33
10		25	33	41
12		30	39	49
14		35	46	57
16		40	52	65
18		45	59	73
20		50	65	81
22		55	72	89
24		59	78	97
26		64	85	105
28		69	91	113
30		74	98	121
For each add'l 2' add:		5	7	8

- F. Contractor shall submit to the Engineer the results of each manhole vacuum test. Such reports shall include a description of the location of the manhole, the time, date and weather of the test, a list of all persons present, the diameter and depth of the manhole and the allowable test results, and the actual test results.
- G. All manholes shall be repaired by Contractor and retested as described above until a successful test is made. After each test, the temporary plugs shall be removed.

4.02 Final Acceptance

- A. Once all manholes have been tested, the manholes will be given a field visual inspection. The inspection shall be performed at the discretion of the Owner and Engineer during the warranty period. All leakage problems determined by this inspection shall be corrected by the Contractor within an agreed upon time to the satisfaction of the Owner. Where necessary to complete the work, the Contractor shall be responsible for the bypassing and/or blocking of the flow in

the manholes and must have prior approval by the Owner. It will be the Contractor's responsibility to supply his own traffic control as required by the particular location and/or jurisdiction.

(SECTION WM 10)

HORIZONTAL DIRECTIONAL DRILLING & PIPING (4" – 12")

PART 1 GENERAL

1.01 Work Included

- A. Furnish all labor, materials and equipment required to install the required pressure main pipe using directional drilling method of installation, all in accordance with the requirements of the Contract Documents. Work shall include and not be limited to proper installation, testing, restoration of underground utilities and environmental protection and restoration.

- B. Soil borings as required for certain subsurface soil conditions shall be provided by the Directional Drilling Contractor within the scope of this project.

- C. The work shall include all pressure main using the directional drilling method, clearing and grubbing, valve pit excavation, removal and disposal of any rock and water, disposal of excess material, fittings, thrust blocking, granular backfill, any saw cutting of permanent pavement surfaces for boring and receiving pits to install pressure mains, replacement/repair of any landscaping, sidewalks, fences, curbs, guttering, cable basins, drainage pipes, field tiles and other surface or sub-surface structures, pipes, conduits, cable, etc. sheeting and shoring, protection of existing structures, trees, shrubs, bushes, cleaning up and surface restoration, testing, and all other operations necessary to complete the work as shown on the plans and specified.

1.02 Scope

This specification covers the use of HDPE and thrust-restrained Poly-Vinyl Chloride (PVC) pipe by horizontal directional drilling (HDD).

1.03 Reference Documents

American Society for Testing Materials (ASTM)

ASTM F714: Specification for Polyethylene Plastic Pipe Based on Outside Diameter

ASTM D1784: Standard for Rigid PVC Compounds and Chlorinated PVC Compounds

ASTM F1804: F1804-97 Standard Practice for Determining Allowable Tensile Load for PE Gas Pipe during Pull-In Installation

ASTM D2837: Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials

ASTM D3139: Standard Specification for Joints for Plastic Pipes Using Flexible Elastomeric Seals

ASTM D3261: Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene Plastic Pipe and Tubing

ASTM D3350: Standard Specifications for Polyethylene Plastic Pipe and Fitting Materials

ASTM F477: Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

American Water Works Association (AWWA)

AWWA C900: Standard for PVC Pressure Pipe Fabricated Fittings, 4" through 12", for Water Distribution

AWWA C901: Polyethylene (PE) Pressure Pipe and Tubing ½ in. through 3 in. for Water Service

AWWA C905: Polyvinyl Chloride (PVC) Water Transmission Pipe (4" – 36")

AWWA C906: Polyethylene (PE) Pressure Pipe and Fittings 4 in. through 63 in. for Water Distribution

AWWA C909: Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe 4 in. through 12 in. for Water Distribution

National Sanitation Foundation (NSF)

NSF14: Plastic Pipe System Components and Related Materials

NSF 61: Drinking Water System Components – Health Effects

1.04 Submittals

- A. Data supporting the directional drilling contractor's qualifications and experience. This shall include a list of all project references of similar size.
- B. Work plan: Prior to beginning work, the Contractor must submit to the Engineer and the Owner a work plan detailing the procedure and schedule to be used to execute the project. The work plan should include a description of all equipment to be used, down-hole tools, a list of personnel and their qualification and experience (including backup personnel in the event that an individual is unavailable), list of subcontractors, a schedule of work activity, a safety plan (including MSDS of any potentially hazardous substances to be used), an environmental protection plan approved by local and State agencies where necessary, and contingency plans for possible problems. Work plan should be comprehensive, realistic and based on actual working conditions for this particular project. Plan should document the thoughtful planning required to successfully complete the project.
- C. Bore plan: Prior to beginning work, the Contractor must submit to the Engineer and the Owner a signed and certified by a Professional Engineer, scaled drawing

of the pilot bore plan for review and approval. (Max. Vertical Scale 1" = 5') and Max. Horizontal Scale 1" = 20'). The plan shall show finished grade, deflection and radiuses of the pilot bore, and all existing utilities with minimum vertical and horizontal clearances. The plan shall also address the location of the drill rig setups and for multiple bores, the lengths of each bore based on soil condition, equipment used, topography, etc. The proposed vertical and horizontal clearances between the bored pipe and any existing/proposed conflicting pipes, conduits or obstructions shall exceed the guidance system accuracy tolerance by a minimum of 100%.

- D. Material: Specifications on material to be used shall be submitted to Engineer. Material shall include the pipe, fittings and any other item that is to be an installed component of the project.
- E. Equipment: Submit specifications on directional drilling equipment to be used to ensure that the equipment will be adequate to complete the project. Equipment list shall include, but not be limited to: drilling rig, mud system, mud motors (if applicable), downhole tools, guidance system, and rig safety systems. Calibration records for guidance equipment shall be included. Specifications for any drilling fluid additives that Contractor intends to use or might use shall also be submitted.

1.05 Quality Assurance

- A. All directional drilling operations shall be performed by a qualified directional drilling Contractor with at least three (3) years experience involving work of a similar nature to the work required of this project. The Contractor must have installed a minimum of 50,000 linear feet of pipe (4-inch diameter or greater) using directional drilling operations. A list of project references is required prior to job commencement.
- B. All work shall be scheduled through the Engineer and the Owner. Notify Engineer and Owner a minimum of three (3) days in advance of the start of work.
- C. All work shall be performed in the presence of the Owner or the Owner's Representative.
- D. All applicable permits and applications must be in place prior to start of work.

PART 2 PRODUCTS

2.01 Polyvinyl Chloride (PVC) Pipe

- A. The pipe material to be used shall meet AWWA C900 standards for Polyvinyl Chloride pressure pipe and fittings with a dimension ratio of DR18. PVC pipe that is intended for use as a casing for a finished product pipe shall have a minimum dimension ratio of 18. The pipe shall be Eagle Loc 900 by JM Eagle or Certa-Lok C900/RJ as manufactured by CertainTeed Corporation, or approved equal.

- B. The pipe shall be joined using a separate PVC coupling, built in sealing gaskets and restraining grooves. The restraining splines shall be square and made from Nylon 101.
- C. Exposed splines shall be cut 3/4 " from coupling to reduce soil drag.
- D. Couplings shall be beveled on leading edges to minimize soil friction.
- E. Using C900/RJ pipe, the Contractor shall adhere to the pipe manufacturer's most current data regarding tensile load limitations for trenchless application. Generally, the maximum pull-in force shall not exceed the following values.

Pipe Dia.	SDR	Class	Pipe O.D.	Coupling O.D.	Max. Pull-In Force Tightest Bending	Max. Pull-In Force Straight Pull (no bending)
4"	18	150 psi	4.800"	5.964"	6,700 lbs.	8,200 lbs.
6"	18	150 psi	6.900"	8.366"	9,000 lbs.	12,800 lbs.
8"	18	150 psi	9.050"	10.947"	18,000 lbs.	25,200 lbs.
10"	18	150 psi	11.100"	13.361"	25,600 lbs.	35,200 lbs.
12"	18	150 psi	13.200"	15.836"	26,440 lbs.	41,100 lbs.
4"	14	200 psi	4.800"	5.964"	8,000 lbs.	10,300 lbs.
6"	14	200 psi	6.900"	8.366"	9,300 lbs.	14,700 lbs.
8"	14	200 psi	9.050"	10.947"	18,900 lbs.	28,800 lbs.
10"	14	200 psi	11.100"	13.361"	25,600 lbs.	35,200 lbs.
12"	14	200 psi	13.200"	15.836"	26,440 lbs.	41,100 lbs.

- F. Contractor shall adhere to the following data regarding radius of curvature for restrained joint pipe used for trenchless application. The confirmation of proposed radius of each bore shall be part of the required submittal prior to work.

Pipe Diameter	Min. Radius of Curvature	Offset per 20' Length	Deflection per 20' Length
4"	125'	19"	10.0%
6"	188'	13"	6.7%
8"	250'	9"	5.0%
10"	313'	7"	4.0%
12"	375'	6"	3.3%

In any case, the deflection radius shall not exceed 75% of the maximum allowable curvature allowed for standard C-900 PVC pipe.

- G. The pipe shall be joined using non-metallic couplings, which have been designed as an integral system for maximum reliability and interchangeability. High-strength flexible thermoplastic splines shall be inserted into mated, precision-machined grooves in the pipe and coupling to provide joint restraint with evenly distributed loading.

Couplings shall be designed for use at the rated pressure of the pipe with which they are utilized, and shall incorporate twin elastomeric sealing gaskets meeting

the requirements of ASTM F477. Joints shall be designed to meet the leakage test requirements of ASTM D3139.

2.02 High Density Polyethylene (HDPE) Pipe

- A. HDPE pipe shall be as manufactured by Phillips Driscopipe, Inc., Chevron Chemical Company, Rinker Materials, or approved equal. The Contractor shall refer to pipe manufacturer for appropriate handling, unloading and storage of pipe.

All sanitary pipe shall be black in color with a green strip. Potable water pipe shall be black in color with a blue strip.

- B. HDPE pipe (PE 3408) shall meet the requirements of ASTM D3350/F714. Cell classifications shall be 34544C. Minimum pressure class and Standard Dimension Ratios (SDR) shall be as follows:

Class 100 – DR 17

- C. Fittings shall be manufactured in accordance with the reference standards listed in Part 1 of these specifications and the material types and design pressure and temperature ranges specified.

Fittings shall be manufactured by the same manufacturer as the pipe to which fusion bonding is intended, using identical materials and meeting the same pressure requirements.

Tapping sleeves shall not be acceptable.

Fittings shall not be field fabricated.

- D. Flange backup rings shall be of the type and pressure rating as required by the applicable standards and manufacturer for the pipe.

Ductile iron backup rings shall be of the convoluted type, fabricated from ductile iron per ASTM A 536, grade range 60/40/18 to 65/45/12. Ductile iron flange backup ring bolting dimension shall conform with ANSI B16.5 Class 150.

Backup rings shall be finished and cast with flash removed from all edges and bolt holes to the specified dimensions. Additional finish requirements, if any, shall be as noted on the plans and in accordance with the following:

1. Epoxy coated with bitumastic 300M high build coal tar epoxy or equal per manufacturer's recommendations.
2. Gasket materials shall be compatible with the service of the piping system. Asbestos gaskets are not allowed.

E. Fusion Bonding Procedure

Piping joints other than those shown as flanged or otherwise mechanically connected shall be butt fusion bonded in accordance with a written bonding procedure specification (BPS) as required by ANSI (ASME B31.3, Chapter VII, paragraph A-328). BPS shall include cutting and facing requirements.

Materials to be fusion bonded shall be from the same manufacturer and as recommended by manufacturer.

Bonders and bonding operators shall be qualified in the use of the BPS as required by ANSI/ASME B31.3, Chapter VII, paragraph A-328. Qualification records certifying that bonders and bonding operators employed to complete fusion bonding are qualified in the BPS shall be submitted prior to commencement of fusion bonding work.

Bonding equipment specified in the BPS shall be in proper operating condition. Equipment heater performance shall be tested and certified prior to use for fusion bonding. Bonders and bonding operators shall be qualified for the specific bonding equipment utilized in the fusion bonding work.

F. Quality Assurance

The pipe and fittings manufacturer shall have an established quality control program responsible for inspecting incoming materials and outgoing pipe, fittings and components. Incoming polyethylene materials shall be inspected for density per ASTM D1505 and melt flow rate per ASTM D1238 and contamination. All incoming materials shall be certified by the supplier. Certificates shall be verified by the pipe manufacturer and submitted to the Engineer.

G. Deflection Limits

The Contractor shall limit the deflection as follows:

Design Deflection Limits of Buried Polyethylene Pipe, Long Term, %*

DR or SDR	21	17	15.5	13.5	11	9	7.3
Deflection Limit (%Dia) Non-pressure applications	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Deflection Limit (%Dia) Pressure applications	7.5	6.0	6.0	6.0	5.0	4.0	3.0

* Deflection limits for pressure applications are equal to 1.5 time the short-term deflection limits given in Table X2.1 of ASTM F-714.

2.03 Directional Drilling Equipment Requirements

A. General: The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pull back the pipe, a drilling fluid mixing, delivery and recovery system of sufficient capacity to successfully complete the installation, a drilling fluid recycling system to remove solids from the drilling fluid so that the fluid can be reused (if required), a Magnetic Guidance

System (MGS) or “walkover” system to accurately guide boring operations, a vacuum truck of sufficient capacity to handle the drilling fluid volume, trained and competent personnel to operate the system. All equipment shall be in good, safe condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project.

- B. Drilling Rig: The directional drilling machine shall consist of a hydraulically powered system to rotate and push hollow drilling pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the installation. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system shall be free of leaks. Rig shall have a system to monitor and record maximum pull-back pressure during pull-back operations. There shall be a system to detect electrical current from the drill string and an audible alarm that automatically sounds when an electrical current is detected.
- C. Drill Head: The drill head shall be steerable by changing its rotation and shall provide necessary cutting surfaces and drilling fluid jets.
- D. Mud Motors (if required): Mud motors shall be of adequate power to turn the required drilling tools.
- E. Drill Pipe: Shall be constructed of high quality 4130 seamless tubing, grade D or better, with threaded box and pins. Tools joints should be hardened to 32-36 RC.

2.04 Guidance System

- A. General: An electronic “walkover” tracking system or a Magnetic Guidance System (MGS) probe or proven (non-experimental) gyroscopic probe and interface shall be used to provide a continuous and accurate determination of the location of the drill head during the drilling operation. The guidance system shall be capable of tracking at all depths up to fifty feet and in any soil condition, including hard rock. It shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction). The guidance system shall be accurate and calibrated to manufacturer’s specifications of the vertical depth of the borehole at sensing position at depths up to fifty feet and accurate to 2 feet horizontally.
- B. Components: The Contractor shall supply all components and materials to install, operate, and maintain the guidance system.
- C. The Magnetic Guidance System (MGS) shall be set up and operated by personnel trained and experienced with the system. The Contractor shall be aware of any geo-magnetic anomalies and shall consider such influences in the operation of the guidance system.

2.05 Drilling Fluid (Mud) System

- A. **Mixing System:** A self-contained, closed, drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid composed of bentonite clay, potable water, and appropriate additives. The mixing system shall be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure thorough mixing. The drilling fluid reservoir tank shall be minimum of 1,000 gallons. Mixing system shall continually agitate the drilling fluid during drilling operations.
- B. **Drilling Fluids:** Drilling fluid shall be composed of potable water and bentonite clay. Water shall be from an authorized source with a pH of 8.5 – 10. Water of a lower pH or with excessive calcium shall be treated with the appropriate amount of sodium carbonate or equal. No additional material may be used in drilling fluid without prior approval from Engineer. The bentonite mixture used shall have the minimum viscosity's as measured by a March funnel:

Rocky Clay	- 60 seconds
Hard Clay	- 40 seconds
Soft Clay	- 45 seconds
Sandy Clay	- 90 seconds
Stable Sand	- 80 seconds
Loose Sand	- 110 seconds
Wet Sand	- 110 seconds

These viscosities may be varied to best fit the soil conditions encountered, or as determined by the operator.

- C. **Delivery System:** The drilling fluid pumping system shall have a minimum capacity of 35-500 GPM and be capable of delivering the drilling fluid at a constant minimum pressure of 1200 psi. The delivery system shall have filters in-line to prevent solids from being pumped into drill pipe. Used drilling fluid and drilling fluid spilled during operations shall be contained and conveyed to the drilling fluid recycling system or shall be removed by vacuum trucks or other methods acceptable to Engineer and Owner. A berm, minimum of 12-inches high, shall be maintained around drill rigs drilling fluid mixing system, entry and exit pits and drilling fluid recycling system to prevent spills into the surrounding environment. Pumping equipment and/or vacuum truck(s) of sufficient size shall be in place to convey drilling fluid from containment areas to storage and recycling facilities or disposal.

2.06 Other Equipment

- A. **Pipe Rollers:** Pipe rollers shall be used for pipe assembly during final product pull back.
- B. **Restrictions:** Other devices or utility placement systems for providing horizontal thrust other than those defined in this specification shall not be used unless approved by the Engineer and Owner prior to commencement of the work. Consideration for approval will be made on an individual basis for each specified location. The proposed device or system will be evaluated (by Engineer and

Owner) without undue delay and shall maintain line and grade within the tolerances prescribed by the particular conditions of the project.

2.07 Personnel Requirements

- A. All personnel shall be fully trained in their respective duties as part of the directional drilling crew and in safety. Each person must have at least two years directional drilling experience.
- B. A competent and experienced supervisor representing the Contractor and Drilling Subcontractor shall be present at all times during the actual drilling operations. A responsible representative who is thoroughly familiar with the equipment and type of work to be performed must be in direct charge and control of the operation at all times. In all cases, the supervisor must be continually present at the job site during the actual directional bore operation. The Contractor and subcontractor shall have a sufficient number of competent workers on the job at all times to insure the directional bore is made in a timely and satisfactory manner.
- C. Personnel who are unqualified, incompetent or otherwise not suitable for the performance of this project shall be removed from the job site and replaced with suitable personnel.

PART 3 EXECUTION

3.01 General Requirements

- A. The Engineer and the Owner must be notified a minimum of 3 days in advance of starting work. All necessary permits and approvals must be in place prior to commencement of work. The directional bore shall not begin until the Engineer is present at the job site and agrees that proper preparations for the operation have been made. The Engineer's approval for beginning the installation shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the work as authorized under the contract. It shall be the responsibility of Engineer to provide inspection personnel at such time as appropriate without causing undue hardship by reason of delay to the Contractor. A copy of the construction drawing must be on the job site during construction and used for field marking "as built" information on a daily basis. If the field "as built" data is not maintained by the Contractor the Engineer shall recommend that the Owner withhold payment(s) until the field data is up dated.
- B. All work under this specification affecting the State Department of Transportation property, right-of-way or facilities shall be carried out to the full satisfaction of the State Department of Transportation authorized representative. The Contractor shall fully inform himself of all requirements of the State Department of Transportation as they pertain to the project and shall conduct all his work accordingly. In addition, compliance with all County and City/Town shall be the responsibility of the Contractor.

- C. All equipment used by the Contractor on Owner's property and right-of-ways may be inspected by the Owner or the Owner's Representatives and shall not be used if considered unsatisfactory by the Owner or Owner's Representative.
- D. The Contractor shall be fully responsible for all damages arising from his failure to comply with all applicable regulations and the requirements of these specifications.
- E. Where the pressure main is shown to be constructed parallel and close to any existing utility line, the exact location of which is not shown, the Engineer may allow the Contractor to shift the location of the new pressure main, where possible, to avoid interference with the existing utility lines, should such interference develop during the course of construction. No additional compensation will be allowed for this shifting of the pressure main to avoid such interference other than unit prices provided in this contract for quantity of items actually installed.
- F. Sewers shall be laid 10 feet horizontally from any water line, measured edge to edge. Sewers shall also be laid 18-inches vertically from any water line, measured from centerline of pipe to centerline of pipe.
- G. The Contractor shall be responsible for contacting all property owners regarding the location of all existing service lines, water wells, septic tanks, and septic lines, etc. and for contacting all utilities for the determination of the location of all existing underground lines, cables, pipes, valves, vaults, etc. The Contractor shall be responsible for restoring existing service connections damaged during installation of the new pressure main.
- H. The directional drill shall be accomplished by first drilling a pilot hole as shown on the approved pilot bore plan and then enlarging the pilot hole no larger than 1.5 times the outer diameter to accommodate the pull back of the pipe through the enlarged hole.

3.02 HDPE Connections and Thrust Blocking

- A. Connections from plain end HDPE pipe to other pipe materials or mechanical joint fittings shall be properly restrained by the following method:

Plain end HDPE shall be internally reinforced by use of a stainless steel stiffener. The end of the pipe shall be cut square and any jagged edges removed. The stiffener shall be placed into the inside diameter of the pipe and driven into place by the wedge provided so that it expands and seats properly inside the carrier pipe. Any part of the wedge that is not flush with the end of the pipe shall be removed. Once the HDPE pipe is properly stiffened it shall be inserted into the mechanical joint fitting or other transition fitting and properly restrained with approved fittings such as Mega-Lug restrainers for plastic pipe or a grip ring and appropriately sized gasket.

If HDPE pipe transitions to a gasket pipe joint product, the Contractor shall restrain the gasket joint pipe with the recommended joint restrainer a minimum of three joints immediately after the transition.

Approved polyethylene mechanical joint adaptors such as those engineered by Central Plastics Inc., Independent Pipe Products Inc., or equal, may also be used by fusing the mechanical joint adapter to the HDPE carrier pipe and restraining it to transitions by methods specified above. In the case where a mechanical joint adapter fitting is used, the stainless steel insert shall be used if required by the Detailed Specifications or contract drawings.

- B. A polyethylene thrust anchor fitting such as a branch saddle or thrust anchor manufactured by Central Plastics Inc., Independent Pipe Products, Inc., or equal shall also be attached to the outside diameter of the HDPE carrier by butt fusion or electrofusion. The area shall be encased in concrete not more than five (5) feet before the transition and as indicated in the contract drawings.

3.03 Directional Drilling Operation

- A. The Contractor shall provide all material, equipment, and facilities required for directional drilling. Proper alignment and elevation of the bore hole shall be consistently maintained throughout the directional drilling operation. The method used to complete the directional drill shall conform to the requirements of all applicable permits. The Engineer will supply copies of all permits to the Contractor except under conditions of Part 3., Section 3.01.E.
- B. The entire drill path shall be accurately surveyed by the Contractor with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings. If Contractor is using a magnetic guidance system, drill path shall be surveyed for any surface geo-magnetic variations or anomalies. Survey information shall be maintained daily on Contractor's as-built drawings.
- C. Contractor shall place silt fence between all drilling operations and any drainage, well-fields, wetland, waterway or other area designated for such protection if required by the drawings, state, federal and local regulations. Additional environmental protection necessary to contain any hydraulic or drilling fluid spills shall be put in place, including berms, liners, turbidity curtains and other measures. Contractor shall adhere to all applicable environmental regulations. Fuel may not be stored in bulk containers within 200 feet of any water body or wetland.
- D. Readings shall be recorded after advancement of each successive section of drill pipe (no more than 10') and the readings plotted on a scaled drawing of 1" = 2' vertical and 1" = 20' horizontal. Access to all recorded readings and plan and profile information shall be made available to the Engineer, or his Representative, and the Owner at all times. At no time shall the deflection radius of the drill pipe exceed the deflection limits of the carrier pipe as specified herein.
- E. All drilling fluids and loose cuttings shall be contained in pits or holding tanks for recycling or disposal, no fluids shall be allowed to enter any unapproved areas, drainage-ways, or natural waterways. Upon completion of the directional drill project, the drilling mud and cuttings shall be disposed of by the Contractor in accordance with applicable environmental laws and regulations.

- F. The pilot hole shall be drilled on bore path with no deviations greater than 5% of depth over the length of the bore unless previously agreed to by the Engineer and Owner. In the event that pilot does deviate from the bore path more than 5% of depth over the length of the bore, Contractor will notify Engineer, and Owner may require Contractor to pull-back and re-drill from the location along bore path before the deviation. In the event of a drilling fluid fracture, inadvertent returns, or returns loss during pilot hole drilling operations, Contractor shall cease drilling, wait at least 30 minutes, inject a quantity of drilling fluid with a viscosity exceeding 120 seconds as measured by a Marsh funnel and wait another 30 minutes. If mud fracture or returns loss continues, Contractor will discuss additional options with the Engineer and Owner and work will then proceed as agreed.
- G. Upon completion of the pilot hole phase of the operation, a complete set of “as built” records shall be submitted in duplicate to the Engineer and Owner. These records shall include copies of the pilot bore path plan and profile record drawing, as well as directional survey reports as recorded during the drilling operation.
- H. Upon approval of the pilot hole location by the Engineer and Owner, the hole opening or enlarging phase of the installation shall begin. The bore hole diameter shall be increased to accommodate the pull-back operation of the required size of carrier pipe. The type of hole opener or back reamer to be utilized in this phase shall be determined by the types of subsurface soil conditions that have been encountered during the pilot hole drilling operation. The Contractor shall select the proper reamer type with the final hole opening being a maximum of 1.5 times the largest outside diameter pipe system component to be installed in the bore hole.
- I. The open bore hole shall be stabilized by means of bentonite drilling slurry pumped through the inside diameter of the drill rod and through openings in the reamer. The drilling slurry must be in a homogenous/flowable state serving as an agent to carry the loose cuttings to the surface through the annulus of the bore hole. The volume of bentonite mud required for each pull-back shall be calculated based on soil conditions, largest diameter of the pipe system component, capacity of the bentonite mud pump, and the speed of pull-back as recommended by the bentonite drilling fluid manufacturer. The bentonite slurry is to be contained at the exit or entry side of the directional bore in pits or holding tanks. The slurry may be recycled at this time for reuse in the hole opening operation, or shall be hauled by the Contractor to an approved dumpsite for proper disposal.
- J. The pipe section shall be joined together according to manufacturer’s specifications. The gaskets and the ends of pipe must be inspected and cleaned with a wet cloth prior to each joint assembly so they are free of any dirt or sand. The pipe must be free of any chips, scratches, or scrapes. A pulling eye will be attached to the pulling head on the lead stick of pipe which in turn will be attached to a swivel on the end of the drill pipe. This will allow for a straight, smooth pull of the product pipe as it enters and passes through the bore hole toward the drill rig and original entrance hole at the directional bore. The product pipe shall be elevated to the approximate angle of entry and supported by means of a sideboom with roller arm, or similar equipment, to allow for the “free stress”

situation as the pipe is pulled into the exit hole toward the drill rig. The product pull-back phase of the directional operation shall be carried out in a continuous manner until the pipe reaches the original entry side of the bore.

3.04 Pipe Handling

- A. Care shall be taken during transportation of the pipe such that it will not be cut, kinked or otherwise damaged.
- B. Ropes, fabrics or rubber protected slings and straps shall be used when handling pipes. Chains, cables or hooks inserted into the pipe ends shall not be used. A minimum of two slings spread apart shall be used for lifting each length of pipe. Pipe or fittings shall not be dropped onto rocky or unprepared ground.
- C. Pipes shall be stored on level ground, preferably turf or sand, free of sharp objects that could damage the pipe. Stacking of the pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions. Where necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.
- D. The handling of the assembled pipeline shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. Slings for handling the pipeline shall not be positioned at pipe joints. Sections of the pipes with cuts and gouges or excessive deformation shall be removed and replaced.

3.05 Testing Pipe

- A. Cleaning and flushing are to be done by the Contractor in order to remove all debris. Only potable water shall be used for flushing and pressure testing.
- B. Each segment of directional drilling pipe shall be tested by the Contractor after pull-back. The average pressure shall be maintained at 150 psi for two hours. The test pump and water supply shall be arranged to allow accurate measurements of the water required to maintain the test pressure. Any material showing seepage or the slightest leakage shall be replaced as directed by the Engineer at no additional expense to the Owner.
- C. The pipe manufacturer's recommendations on pipe stretch allowances, bending radius, tensile strength, allowable test leakage allowance, and magnitude and duration of test pressure shall be observed.
- D. Pipeline shall be tested end to end.
- E. All new service lines connected to the new main and installed with new pipe shall be pressure tested along with the newly installed main.
- F. Pressure testing shall not be required for the drilled pipe if the pipe is intended to be used as a casing for a finished product pipe.

3.06 Tracer Wire

- A. All main line and service pressure lines shall be provided with two (2) continuous type TW insulated #10 solid tracer wires. The wire shall be installed along the pipe, fastened to the pipe at 20 ft. intervals. Insulation shall be in accordance with ASTM – D1248 30 volt rating minimum.
- B. The wire shall be brought up to ground level every 400 feet through a vinyl coated aluminum riser pipe with cap and/or at all line valve boxes. The tracer wires will be connected using DBR Direct Burial Splice Kit manufactured by 3M Electrical Products Division, Austin, TX, Baro-Splice Direct Burial Connectors, or equal. The riser pipe and cap shall not be placed in areas, which are subject to vehicular traffic. Each tracer wire shall be capable of, and demonstrated to be, continuous transmission of tracing signal along the full length of pressure main and laterals.

3.07 Site Restoration

- A. Following drilling operations, Contractor shall remove drilling equipment and restore the work site to the original conditions or better. All excavations will be backfilled and compacted according to the specifications.
- B. Surface restoration shall be completed in accordance with the current State Department of Transportation Standards Manual or permits to a condition as good or better than existing prior to construction.

3.08 Record Keeping and As Built

- A. Contractor shall maintain a daily project log of drilling operations and a guidance system log with a copy given to the Engineer and Owner at completion of project.
- B. The guidance system data shall be recorded per Section 3, Execution, during the actual crossing operation. The Contractor shall furnish to the Engineer and Owner “as built” plan and profile drawings based on these recordings showing the actual location horizontally and vertically of the installation, and all utility facilities found during the installation. The guidance data shall be certified accurate by the Contractor to the capability of the guidance system.
- C. “As built” drawings shall be completed and mapped at Contractor’s expense in a form as required by the Engineer and Owner, including signed plans and electronic data files, if available.

(SECTION WM 12)

STORM SEWER STRUCTURES

PART 1 GENERAL

1.01 Description

- A. Storm sewer structures include:
 - 1. Manholes
 - 2. Inlets
 - 3. Special drainage structures including, but not limited to:
 - a. Special manholes
 - b. Drop pipe connections
 - c. Cleanouts
 - d. Catch basins
 - e. End sections
 - f. Grated box end sections
 - g. Pipe anchors
 - h. Headwalls
 - i. Slotted drains
 - j. Other similar drainage structures
- B. Storm sewer structures shall be constructed complete, ready for use, including excavation, backfill, concrete work, ductile/cast iron frames and covers, manhole steps, walls of alternate construction, and other incidental work as shown on the plans, and as specified.
- C. Structures shall be constructed of precast concrete, or Class A poured-in-place concrete. All manholes shall be made watertight, and the Contractor shall furnish all materials and perform all work necessary for watertight construction. Optional materials will be considered on a case-by-case basis but will not be acceptable without the expressed written permission of the Engineer.
- D. If monolithic manholes are to be used, the Contractor shall submit drawings showing all reinforcement, dimensions, and connections for Owner approval. A registered Professional Engineer shall certify all drawings submitted for approval.
- E. No less than five (5) feet of 6-inch perforated corrugated HDPE pipe shall extend out of all enclosed structures such as manholes, inlets, catch basins etc. in order to help drain groundwater, excavation areas and provide for future connections. The ends of the pipe shall be capped off with a watertight cap from the pipe manufacturer or as approved by the Engineer. The cost for this pipe, cap and coring shall be included in the cost of the structure, so no separate payment will be made, even when there may be a separate pay item for such pipe in the bid schedule.

- F. All proposed castings set in paved areas shall match (be flush with) the final pavement elevations unless the casting is to be depressed in order to create a sump. All proposed castings to be set in non-paved areas shall match (be flush with) the final ground elevations unless they are shown to be set lower than existing in order to improve drainage for side ditches or off-street parking. This requirement may supersede casting elevations shown on the plans. Confirm with the Engineer prior to ordering and installing final structures and castings.
- G. All manhole and inlet installations in non-paved areas receiving storm water flow into the castings shall include no less than 10 feet of linear grading in each direction in order to create a positive flow to the inlet, unless otherwise shown on the plans.

1.02 Product Handling

- A. Store and protect miscellaneous items at the Project site. All precast structures must be delivered to job site by means which will adequately support them, and not subject it to undue stresses and are not damaged by crushing. The structures shall be unloaded carefully and strung or stored as close to the final point of placement as is practical.

1.03 Submittals

- A. Submit shop drawings for all structures and other appurtenances.
- B. Include all performance data such as strengths for concrete and steel and other material items. Reinforcing shall be detailed on the shop drawings.
- C. Shop drawings with supportive documentation for all prefabricated manholes other fittings or integral components shall be submitted to the engineer prior to fabrication.

1.04 Related Specifications

- A. Comply with applicable portions of the following WM Specifications:

WM-2	Excavation
WM-3	Backfill, Fills and Embankments
WM-5.2	Cast-in-Place Concrete
WM-6	Concrete Reinforcement
WM-13	Storm Sewer Pipe

PART 2 PRODUCTS

2.01 Reinforced Concrete Manholes

- A. Manholes shall be constructed in accordance with the ASTM Specifications for "Precast Reinforced Concrete Manhole Risers and Tops", Designation C 478. The minimum wall thickness shall be five (5) inches for manholes four (4) feet in diameter.

- B. The precast tops shall be of the eccentric cone type. Precast flat covers shall be not less than eight (8) inches thick and reinforced with two layers of steel with a minimum area of 0.39 square inches per linear foot in both directions in each layer. Precast flat bottoms of manholes shall also be reinforced the same as specified herein for precast flattop. Hoisting lugs or hooks shall be cast in place for handling and setting of the rings. Openings of proper sizes and suitable design shall be cast in place for receiving the sewer and/or drop pipes and connections. Adjusting riser rings shall be provided as approved by the Owner.
- C. The castings shall be as indicated on the plans. Both the frame and cover shall be heavy duty as manufactured by Neenah, East Jordan, or approved equal. The inlet and castings shall be capable of supporting H-20 traffic loadings.
- D. A minimum 6-inch adjusting ring shall be used in all turfed areas in order to provide a minimum 6 inches of topsoil at inlet areas.
- E. All manhole joints shall be tongue and groove and they shall be sealed with an O-ring and joint sealer conforming to Federal Specifications SS-S-00210 and similar to "Kent-Seal No. 2" as manufactured by the Hamilton Kent Manufacturing Co., of Kent, Ohio; "RAM-NEK" as manufactured by the K.T. Snyder Co. of Houston, Texas, or equal. Cracked or damaged barrel joints not meeting ASTM C478 shall be rejected.
- F. Manhole Steps. Steps shall be provided and manufactured of reinforced plastic and shall be twelve (12) inches wide and one (1) inch square.
- G. Manhole Bases. Manhole bases shall be of cast-in-place monolithic concrete or precast concrete. Where sewer lines pass through or enter manholes, the invert channels shall be smooth and semi-circular in cross section and shall be formed directly in the concrete of the manhole base. Changes of direction of flow within the manholes shall be made with a smooth curve with as long as a radius as possible. The floor of the manhole outside the channels shall be smooth and slope toward the channel not less than one (1) inch per foot.
- H. No mortar or concrete shall be placed in water, and no water shall be allowed to flow over or against the concrete before it has set for a period of time deemed sufficient by the Owner to prevent damage to the structure. The invert channel through manholes shall be provided and constructed to conform in shape and slope to that of the sewer. All invert channels are to have a properly mortared apron on either side, sloped to prevent solids deposition. Changes of direction of flow within the manhole shall be made with a smooth curve with as long as a radius as possible.
- I. Adjusting Rings. Where one (1) solid riser or barrel section cannot be used, final adjustments in elevation of the frame and cover shall only be accomplished by the use of precast concrete adjusting rings conforming to ASTM C 478. Rings shall be of a nominal thickness of not less than four (4) inches. Not more than twelve (12) inches total of adjusting rings shall be allowed for adjustment of the manhole frame and cover to required elevation.

2.02 Reinforced Concrete Inlets

- A. All inlets shall be constructed of reinforced pre-cast concrete sections with plain joints and 2" extrudable gasket to produce soil tightness (minimum). Inlets shall have tops as shown on the plans. Joints between sewer pipe and inlet walls shall be sealed with grout.
- B. Precast concrete inlets shall be constructed in accordance with ASTM Standard C-478 (round) or ASTM Standard C-913 (square or rectangular). Adjustment to final grade of inlet casting shall be accomplished by utilizing pre-cast concrete adjusting rings. Adjusting rings when required should be sized to adjust to Final Grade by using a maximum of three (3) adjusting rings. Adjusting rings shall be limited to less than one (1) foot of inlet depth. All inlet joints, along with the adjusting rings and top casting are to be sealed with 2-inch extrudable gasket (Kent Seal, Rub'R Nek LTM by Henry Co., or approved equal) to produce soil-tight joint (minimum).
- C. Where sewer lines pass through or enter inlets, the invert channels shall be smooth and semi-circular in cross section and shall be formed directly in the concrete of the inlet base. Changes of direction of flow within the inlets shall be made with a smooth curve with as long a radius as possible. The floor of the inlet outside the channels shall be smooth and slope toward the channel not less than one (1) inch per foot.
- D. The castings shall be as indicated on the plans. Both the frame and cover shall be heavy duty as manufactured by Neenah, East Jordan, or approved equal. The inlet and castings shall be capable of supporting H-20 traffic loadings.

2.03 Poly (Vinyl Chloride) PVC Surface Drainage Inlets (Must be Approved by Owner for Use)

- A. PVC surface drainage inlets, if approved by the Owner for use in writing, shall include inline drains or drain basins as indicated on the contract drawings and referenced within the contract specifications. The ductile iron grates for each of these fittings are to be considered an integral part of the surface drainage inlet. The surface drainage inlets shall be as manufactured by Nyloplast, Harco Fittings, Inc., or approved equal.
- B. The inline drains and drain basins shall be manufactured from PVC pipe stock, utilizing a thermomolding process to reform the pipe stock to the furnished configuration. The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the piping system specified. This joint tightness shall conform to ASTM D3212.
- C. Surface drainage products shall meet the mechanical property requirements for fabricated fittings as described in ASTM F794, F949 and F1336.
- D. The grates furnished for all surface drainage inlets shall be ductile iron and shall be made specifically for each fitting. Grates for 12" and larger drain basins and inline drains shall be capable of supporting H-20 wheel loading for standard grates and solid covers. Grates for drain basins and inline drain inlets smaller

than 12" shall be capable of supporting light wheel load traffic. Metal used in the manufacture of the castings shall conform to ASTM A-48-83 Class 30B for cast iron or A536 grade 70-50-05. The castings shall be furnished with a black paint.

2.04 Other Structures

- A. Other structures provided for a project shall generally conform to the requirements of the above manhole and inlet specifications. Structures such as cleanouts, end sections, grated box end sections, pipe anchors, headwalls, slotted drains and other similar drainage structures are generally covered in the latest edition of the State Department of Transportation Standard Details and Specifications. These are readily available through State Department of Transportation by purchasing a hard copy or CD from State Department of Transportation or by accessing their web page. Therefore, State Department of Transportation information is not repeated herein and is the responsibility of the Contractor/Bidder.
- B. If a structure is not completely detailed in the specifications or the plans, the State Department of Transportation standard details for that item shall be used. If no such details are available, the Contractor shall be required to detail out a structure and submit it to the Engineer for approval as part of the shop drawing process. In such latter cases, the Contractor shall submit shop drawings certified by a State Registered Professional Engineer.

2.05 Pipe Connections

- A. Joints between a manhole or inlet and a sewer pipe may be sealed with high strength, non-shrink grout or a flexible boot KOR-N-SEAL 1 or 2, flexible connector, cast-in-place Dura-Seal gasket, "A"-lock gasket or an approved equal. All connections shall provide for a watertight seal between the pipe and manhole or inlet.

PART 3 EXECUTION

3.01 Installation

- A. All manholes, inlets and similar drainage structures shall be installed so that the top of the inlet casting and frame (at the lowest point where surface water can enter) is flush with the final ground elevation.
- B. All structures shall be bedded on a minimum of 6 inches of compacted aggregate consisting of granular or crushed aggregate materials. No structure shall be set on soft or yielding soils.
- C. PVC surface drainage inlets shall be installed using conventional flexible pipe backfill materials and procedures. For traffic rated installations H-20 the inline drain or drain basin shall be installed conforming to the manufacturer's installation guidelines for traffic rated (H-20) installations. The backfill material shall be crushed stone or other granular material meeting the requirements of Class 1 or 2 material as defined in ASTM D2321. The surface drainage inlets shall be bedded and backfilled uniformly in accordance with ASTM D2321.

For all PVC castings installed in traffic areas a minimum 6-inch thick by 4-foot diameter concrete collar shall be poured around the inlet to support the casting. Installation procedures shall be in accordance with the manufacturer's requirements.

PART 4 PROJECT CLOSE-OUT

4.01 Inspection

- A. All structures shall be given a field visual inspection. The inspection will be performed at the discretion of the Owner and Engineer during the warranty period. The Contractor shall correct all leakage problems determined by this inspection within an agreed-upon time to the satisfaction of the Owner. Where necessary to complete the work, the Contractor shall be responsible for the bypassing and/or blocking of the flow in the structures, provide necessary traffic control, and must have prior approval by the Owner.

(SECTION WM 13)

STORM SEWER PIPE

PART 1 GENERAL

1.01 Description

- A. The Contractor shall furnish all materials, equipment and labor to install storm sewer and culvert pipe, end sections and related fittings. Other items of work include:

Concrete encasement and caps; Earth and rock excavation; Removal and disposal of water; Sheeting and shoring; Protection of trees, shrubs, bushes, and other landscaping; Protection of existing structures; Protection of existing utilities; Temporary and permanent bulkheads or stoppers as noted or as required; Disposal of excess excavated material; Backfilling, including all aggregate/granular material necessary to meet the bedding requirements; Maintaining trench surfaces; Dust control; Deflection testing (mandrel testing) of flexible storm sewer pipe; Replacement and repair of sidewalks, curbs, gutters, catch basins, drainage pipes, field tiles; and other items of work needed to complete the work as shown on the plans.

- B. Utility Conflicts

1. It shall be recognized by all parties that the exact location or type of utilities may not be known at the time a project is bid, whether it is due to the utility owner not having adequate records or not providing such information to the Engineer at all or in a timely manner. As such, it may be impossible for the Plans to accurately indicate all existing utility types and locations. Therefore, the Contractor has a responsibility to allow sufficient float time in his schedule and locate all existing utilities, both horizontally and vertically in the proximity of the work area well in advance of starting any construction. The Contractor shall notify the Engineer of any utility conflicts prior to beginning work.

2. Where storm sewers may be constructed parallel to and close to any buried or exposed utility (ie. existing water or sewer or gas line, cable or telecommunication cables etc.), the exact location of which is not shown:
 - a. Before construction begins, the Contractor shall locate the utility(s) to determine the extent of the actual conflict.
 - b. The Engineer may shift the location of the new storm sewer where possible to avoid interference with the existing conflict if encountered during construction.
 - c. No equitable adjustment will be allowed for the shifting of the storm sewer line to avoid such interferences.
 - d. The Contractor shall be required, at his own expense, to do everything necessary to protect, support and sustain all utilities including sewers, tiles, cables, water and gas pipes, conduits,

poles and other fixtures laid across or along the limits of the project in accordance with the Utility Owner's direction.

- e. The Company or Corporation owning said pipes, poles or conduits must be notified prior to the work by the Contractor.
 - f. If any such utilities are damaged, they shall be repaired by the Contractor to original condition as directed by the Utility Owner and said repairs shall be at no additional costs to the Owner.
3. In the event the storm sewer cannot be relocated to avoid interferences as mentioned above and it becomes necessary to relocate or move:
 - a. Either permanently or temporarily, any pipes, poles or conduits, not already specified to be moved on the plans or specifications a change order may be prepared and issued to the Contractor.
 - b. Work done by the Contractor on such relocations until the Owner and the Engineer have approved the change order shall be at the Contractor's risk.

C. Drain Tile Conflicts

1. The Contractor will be required to connect to the new storm sewer system any existing storm drainage pipe or tile encountered during construction whether or not it is shown on the plans.
2. Payment under Change Orders for connecting unknown storm drainage lines to a new storm sewer system will not be allowed unless the number of connections exceeds that specified in the Plans or the Specifications. If the estimated number of unknown connections is not specified in the Plans or Specifications, a quantity of no less than one (1) per 500 feet of storm sewer installed shall be included in the cost for installing storm sewers.
3. Generally speaking, all such connections may be made directly to the new storm sewer without an additional structure using a tee fitting or insert-type-tee connection designed to work with the type of sewer pipe used.
4. If a structure is located at the point of connection, the line should be connected to the structure.
5. The Owner or Owner's Representative must be immediately notified when any existing storm drainage pipe or tile is located and must be present during all connections of same to the new storm sewer system.
6. All construction methods and materials to complete connections shall be per the Plans and Specifications. Where connections cannot be completed in accordance with details, the Engineer shall approve the materials and methods of such connections prior to the work.

D. **Combination Sewers**

1. If the Contractor encounters any existing line carrying both sanitary waste and stormwater, whether or not it is shown on the plans or located through previous inspection, the Contractor shall:
 - a. be required to install a separate stormwater and sanitary line into the new storm or sanitary sewer for future connection of separated storm water or sanitary flow by the property owner.
 - b. reroute lines to the right-of-way or permanent easement edge at a location chosen by the Owner and Engineer.
 - c. comply with construction methods and materials specified in applicable sections of these Plans and Specifications.
 - d. notify the Owner and Engineer immediately if this situation arises and shall be present during all work.

1.02 Product Handling

- A. Store and protect all products and materials at the Project site. Pipe must be delivered to job site and stored by means, which will adequately support it and not subject it to undue stresses. In particular, the load shall be supported such that crushing does not damage the bottom rows of pipe. The pipe shall be unloaded carefully and strung or stored as close to the final point of placement as is practical.

1.03 Soil Borings

- A. It will be the Contractor's responsibility to conduct a prebid inspection of the site to determine all additional characteristics of soils that may be present at a project site. This includes reviewing record soils information from previous contracts. Soils borings may be included in other portions of the Plans and Specifications.

1.04 Metric Units

- A. State Department of Transportation details may be shown in metric units (e.g. millimeters, mm). The conversion is 304.80 mm per foot (25.40 mm per inch); however, the State Department of Transportation uses 300 mm per foot in order to simplify the difference. Therefore, 12-inch pipe is generally shown as 300 mm and 15- inch pipe as 375 mm. Should there be any questions regarding this format, the Contractor shall obtain a clarification from the Engineer.

1.05 Submittals

- A. Submit shop drawings for all pipe, connections, and end sections and other appurtenances. This includes connections to end sections.
- B. Include all performance data such as strengths for concrete and other pipe material items.

- C. Shop drawings with supportive documentation for all wyes, tees, elbows, adapters, reducers, bulkheads, or other fittings or integral components shall be submitted to the Engineer prior to fabrication.
- D. Prior to ordering pipe material, submit shop drawings to the Engineer and obtain Engineer's approval. All submittals shall include certification of conformance with the applicable ASTM Pipe Standard and allowable ASTM bedding certification. No fieldwork shall be started prior to shop drawing approval.

1.06 Related Specifications

Comply with applicable portions of the following WM Specifications:

WM-2	Excavation
WM-3	Backfill, Fills and Embankments
WM-4	Restoration of Surfaces
WM-7	Sanitary Sewer Pipe
WM-8	Pressure Pipe - Sanitary
WM-14	Pressure Pipe - Water
WM-12	Storm Sewer Structures

1.07 Quality Assurance

A. Codes and Standards

- 1. Each length of pipe shall be marked per the requirements of the respective ASTM Standard.
- 2. All codes and standards shall be set forth in the latest ASTM Standard.
- 3. Upon request by the Engineer, the Contractor as standard procedure shall furnish copies of all tests required by the applicable ASTM Standard.

PART 2 PRODUCTS

2.01 General

- A. A number of different pipe materials may be accepted for the various sizes shown in the following Table No. 13-1. However, the Contractor shall use only the pipe materials specified in the Detailed Specifications. If no pipe material is specified in the Detailed Specifications or indicated on the drawings, then only the pipe shown in Table No. 13-1 may be used unless approved by the Engineer. The Contractor may choose different materials for each size, but may not mix materials used between structures. All pipe shall be constructed using water tight (minimum) joints and methods.
- B. A deflection test shall be performed on each flexible pipe following the elapse of thirty (30) days after the placement of the final backfill. No pipe shall exceed a deflection of five percent (5%) or greater.

- C. The diameter of the rigid ball or mandrel used for a deflection test shall be no less than ninety-five percent (95%) of the base inside diameter of the pipe to be tested dependent on what is specified in the corresponding ASTM standard. The Contractor shall be responsible for proving an ASTM approved proving ring to verify the correct diameter of the rigid ball or mandrel. The test shall not be performed with the aid of a mechanical pulling devise.

Table No. 13-1										
Acceptable Pipe Material for Each Pipe Size (Shaded Box w/"X")*										
PIPE SIZE	ALUM. STEEL TYPE 2 ASHTO M274 & ASTM A929	REING. CONC. (RCP) CLASS III ASTM C76	PVC					HDPE		
			SOLID WALL			PROFILE WALL		HANCOR "Sur-Lok" ASTM D3350	ADS "N-12" ASTM D3350	HANCOR/ADS "HEAVY DUTY" TUBING ASTM F405
			SDR 35 ASTM D3034	SDR 35 ASTM F679	CONTEC-H/ DIAMOND Plastics CORP CORR 21 "A-2000" ASTM F949	UPONER "ULTRA-COR" ASTM F949	UPONER "ULTRA-RIB" ASTM F794			
18"-54"	X	X		X	X	X	X	X	X	
15"	X	X	X		X	X	X	X	X	
12"	X	X	X		X	X	X	X	X	
6"	X		X							X

*Note: The pipe materials specified in the Detailed Specifications and indicated on the Drawings shall supersede this table.

2.02 Reinforced Concrete Pipe (RCP)

- A. The drainpipe may be Reinforced Concrete Pipe (RCP), of various diameters. The pipe shall be Class III and Wall Type B, except where otherwise indicated. All RCP shall be considered "rigid" and shall be installed as such. The joint shall be tongue and groove or bell and spigot. The manufacturer's recommendation to provide a water-tight joint shall be followed.
- B. Fittings shall be of the same class as the pipe they are installed along and shall be manufactured by the pipe manufacturer, or approved equal. Fittings shall meet the same ASTM requirements as the pipe. Plain end joints will not be allowed.

2.03 Poly (Vinyl Chloride) Pipe (PVC)

- A. General

All PVC pipe shall be considered "flexible" and shall be installed as such. PVC pipe shall not be installed where exposed to sunlight unless current material certifications guarantee that it will not be subject to ultraviolet degradation.

1. Solid Wall

- a. The drain pipe may be PVC SDR 35, solid wall pipe.

- b. Fittings shall be of the same class and size as the pipe they are installed along and shall be manufactured by the pipe manufacturer. Fittings shall meet the same ASTM requirements as the pipe.

2. Profile Wall

- a. The drainpipe may be PVC profile wall pipe of various diameters.
- b. Acceptable profile wall pipe includes:
 - 1) A-2000 as manufactured by Contech Construction Products, Inc. of Middletown, Ohio or "Ultra-Cor" by Uponer ETI Company (Extrusion Technologies) of Denver, Colorado. The pipe shall have a minimum constant, non-variable pipe stiffness of 46 psi and shall meet the requirements of ASTM F949, D-2412, and AASHTO M304. Minimum cell classification shall be 12454B or 12454C per ASTM D-1784. Bedding shall be Class I or II only per ASTM D-2321. Elastomeric seals shall meet the requirements of ASTM F477.
 - 2) Ultra Rib, as manufactured by Uponer ETI Company (Extrusion Technologies, Inc.) of Denver, Colorado. It shall have a minimum constant, non-variable pipe stiffness of 46 psi and shall meet the requirements of ASTM F794, D2152, D2444, D3212 and D2412. Cell classification shall be 12454B as defined by ASTM D1784. Bedding shall be Class I or II only as described in ASTM D-2321.
 - 3) Vylon, as manufactured by Lamson Vylon Pipe of Cleveland, Ohio. It shall have a minimum, non-variable pipe stiffness of 46 psi per ASTM D-2412 and shall also meet the requirements of ASTM F-794, closed profile, ASTM D-1784, D-3212, F-477, D-2444, D-2152 and Uni-Bell Pipe Association Uni-B-9. Minimum cell classification shall be 12364-A as in ASTM D-1784. Bedding shall be Class I or II only as described in ASTM D-2321.
 - 4) Or approved equal.
- d. Fittings shall be of the same class as the pipe they are installed along and shall be manufactured by the pipe manufacturer. Fittings shall meet the same ASTM requirements as the pipe.

2.04 High Density Polyethylene Pipe (HDPE)

A. General

All HDPE pipe shall be considered "flexible" and shall be installed as such. HDPE pipe shall not be installed where exposed to sunlight unless current material certifications guarantee that it will not be subject to ultraviolet degradation.

- B. The drain pipe for the various pipe diameters may be "Sure-Lok" High Density Polyethylene (HDPE) pipe as manufactured by Hancor of Findlay, Ohio, N-12 High Density Polyethylene Pipe (HDPE) as manufactured by ADS, Inc. of

Columbus, Ohio, or approved equal. Bedding shall be Class I or II only as described in ASTM D-2321.

C. Production and Material Standards for HDPE

1. Corrugated High Density Polyethylene (HDPE) pipe shall be manufactured in accordance with AASHTO M 294 Type S. Pipe manufactured under this specification shall have a minimum cell class of 335420C in accordance with ASTM D-3350.
2. Ribbed Polyethylene pipe shall be in accordance with ASTM F-894 for the specified sizes, meeting the requirements for RSC 160. Pipe manufactured under this specification shall have a minimum cell class of 335420C in accordance with ASTM D-3350.
3. Smooth wall Polyethylene pipe shall be in accordance with ASTM F-714 for the specified sizes. Pipe manufactured under this specification shall have a minimum cell class of 335420C in accordance with ASTM D-3350.
4. All polyethylene pipe and fittings shall be made from high molecular weight high density polyethylene material meeting the application cell class requirements. All polyethylene material used in drain pipe manufacture shall be virgin resin.

D. HDPE Joints

1. High-density polyethylene pipe shall possess male and female pipe ends or molded HDPE or PVC couplers that allow the construction of overlapping, gasketed pipe joints in accordance with the requirements of ASTM D-3212 for a gasketed joint. The gasket material shall conform to all requirements of ASTM F-477.

E. Rejection of Damaged HDPE Pipe and Fittings

1. High density polyethylene pipe and fittings possessing the following defects may be rejected for installation: variations from straight centerline; elliptical shape in pipe intended to be round; illegible or improper markings as required herein; deep or excessive gouges or scratches on the pipe wall; fractures, punctures, or cracks; damaged or cracked ends where such damage would prevent making a satisfactory joint.

F. HDPE Pipe Markings

1. For high density polyethylene pipe products, each length of pipe shall be clearly marked with the following information as a minimum: manufacturer's name or identification symbol; nominal pipe size; and production/extrusion code.

2.05 High Density Polyethylene Tubing

- A. 6" HDPE tubing shall be manufactured by Hancor of Findlay, Ohio, ADS, Inc., of Columbus, Ohio, or approved equal, and shall meet all applicable standards of ASTM F405.
- B. The perforated pipe for subsurface drains shall be installed within the bedding of the pipe trench as indicated on the plans. All manufacturer's recommended installation procedures shall be followed. Due to the nature of the soils, a geotextile fabric sock shall be provided with the pipe when recommended by the manufacturer for the given soil.

2.06 End Sections

- A. End sections shall be precast concrete or galvanized steel as indicated by the Detail Specifications or Drawings unless otherwise approved by the Engineer. Where differing materials are used, an appropriate water-tight connection shall be made to join the pipe to the end section.

2.07 Ductile Iron Pipe

- A. Material
 - 1. Ductile Iron Pipe shall be centrifugally cast and shall conform to ANSI Specifications A21.51 and AWWA C-151, latest revision. Ductile Iron Pipe shall be Pressure Class 350, 300, 250, 200 or 150.
- B. Coatings and Linings
 - 1. Pipe shall be standard cement lined and seal coated with an approved bituminous seal coat in accordance with AWWA Specification C-104 (ANSI A21.4).
- C. Fittings
 - 1. Fittings shall be standardized for the type of pipe and joint specified and shall comply with AWWA C-110 (ANSI A-21.10) or AWWA C-153 (ANSI A-21.53).
- D. Joints
 - 1. Mechanical joints or slip joints shall be provided.
 - 2. Mechanical joints and accessories shall conform to AWWA Standard C-111, ANSI A-21.11. The bolts and nuts shall be corrosion resistant high strength alloy steel.
 - 3. The O-ring gaskets sealing the slip joint shall be made of rubber of special composition having a texture to assure a watertight and permanent seal and shall be the product of a manufacturer having at least five (5) years experience in the manufacturer of rubber gaskets for pipe

joints. The gasket shall be a continuous ring of flexible joint rubber of a composition and texture which is resistant to common ingredients of sewage, industrial wastes and groundwater, and which will endure permanently under the conditions likely to be imposed by this service. The gasket shall conform to the requirements of AWWA C-111 (ANSI A-21.11).

E. Markings

1. The class designations for the various classes of pipe and fittings, manufacturer's name and year of manufacture shall be cast onto fittings in raised numerals, and cast or stamped on the outside of each joint of pipe.

F. Certification

1. The Contractor shall furnish, upon request by the Engineer, certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable Standards.

2.08 Poly (Vinyl Chloride) Pipe

A. Material

1. Poly (Vinyl Chloride) (PVC) gravity storm sewer pipe shall be the integral wall bell and spigot type with elastomeric seal joints and smooth inner walls meeting or exceeding all of the requirements set forth in ASTM D-3034 for pipe diameters 15-inches or less and meeting or exceeding all of the requirements set forth in ASTM F-679 for pipe diameters greater than 15-inches.
2. For diameters 15-inches or less, the pipe shall have a minimum cell classification of 12454-B and for diameters greater than 15-inches the pipe shall have a minimum cell classification of 12454-C; with all pipe having a minimum tensile strength of 34.50 psi as defined in ASTM D-1784.
3. PVC storm sewer pipe shall have a minimum pipe stiffness of 46 psi for each diameter when measured at 5% vertical ring deflection and tested in accordance with ASTM D-2412.
4. NOTE: Poly (Vinyl Chloride) (PVC) Ribbed Sewer Pipe meeting or exceeding all of the requirements set forth in ASTM F 949-86a or ASTM F 794 is acceptable. The minimum cell classification acceptable shall be 12454-B as defined in ASTM D-1784. PVC Ribbed Sewer Pipe shall have a minimum pipe stiffness of 50 psi when measured in accordance with ASTM D-2412 for 8-inch through 18-inch pipe and 46 psi for 21-inch and greater.

B. Joints

1. Flexible gasket joints shall be compression type so that when assembled, the gasket inside the bell will be compressed radially on the pipe spigot to form a watertight seal. The assembly of joints shall be in accordance with the pipe manufacturer's recommendations and ASTM D-3212. The gaskets sealing the joint shall be made of rubber of special composition having a texture to assure a watertight and permanent seal and shall be the product of a manufacturer having at least five (5) years experience in the manufacture of rubber gaskets for pipe joints. The gasket shall be a continuous ring of flexible joint rubber of a composition and texture which is resistant to common ingredients of sewage, industrial wastes and groundwater and which will endure permanently under the conditions imposed by this service. The gasket shall conform to the requirements of ASTM F-477.
2. **NO SOLVENT CEMENT JOINTS SHALL BE ALLOWED.** Connections at manholes shall be water-tight.
3. All field-cutting of pipe shall be done in a neat manner as per manufacturer's recommendations and the cut end shall be beveled using a file or wheel to produce a smooth bevel of approximately 15° and be a minimum depth of one-third the pipe wall thickness. Field cut pipe is only allowed at manholes, at prefabricated fittings, and at the connection of new storm sewer and other structures to existing storm sewer pipe.

C. Fittings

1. Only manufactured fittings made of PVC plastic having a cell classification of 12454-B as defined in ASTM D-1784 shall be used.
2. Tee/Wye service connections for storm sewers where existing or proposed grade (to sewer invert), exceeds 15 feet shall be heavy wall.
3. **SADDLE CONNECTIONS SHALL NOT BE ALLOWED FOR NEW CONSTRUCTION.**

D. Design

1. The minimum wall thickness for PVC sewer pipe and lateral sewer pipe 15-inches or less in diameter shall conform to SDR-35 Type PSM as specified in ASTM D-3034. The minimum wall thickness for PVC sewer pipe greater than 15-inches in diameter shall conform to T-1 as specified in ASTM F-679.

E. Markings

1. The date of manufacture, class of pipe, specification designation, size of pipe, name or trademark of manufacturer, and identification of plant/location shall be legibly marked on the outside of each pipe section in accordance with the ASTM D-3034.

F. Certification

1. The Contractor shall furnish, upon request, certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable Standards.

2.09 Aluminized Type 2 Steel Pipe

- A. Storm sewers for pipe diameters 15" or larger may be Aluminized Steel Type 2 ULTRA FLO spiral rib pipe. Gravity storm sewers for pipe arches shall be Aluminized Steel Type 2, HEL-COR. Pipe shall be manufactured by Contech Construction Products, Inc. of Middletown, Ohio, Lane Enterprises, or an equal manufacturer approved by the engineer in writing.
- B. The Aluminized Steel Type 2 material used in the pipe shall be manufactured to conform to the current AASHTO M36 (and ASTM A760) specification. The pipe shall be formed from an Aluminized Steel Type 2 coil and conform to the current AASHTO M274 (and ASTM A929) material specification. Round pipe shall conform to the type IR pipe classification: culvert pipe, circular section, single thickness of sheet, helical ribs projecting outwardly. The pipe shall be of the diameter as specified on the plans. The minimum metal thickness shall be sixteen (16) gage material. This is based on an H 20 live load design using 3/4" x 3/4" x 7 1/2" corrugations.
- C. The manufacturer of the pipe shall provide certification of compliance with AASHTO M36 and M274 specifications.
- D. Pipes may be joined by either of two (2) methods, 1) with re-rolled annular ends joined with H.S. bands with flat gaskets and lug and band connection assemblies; or 2) with metal sleeve stab joint if size is available. Joints shall be manufactured by Contech Construction Products, Inc. of Middletown, Ohio, Lane Enterprises, or an approved equal manufacturer. The bands shall be manufactured in accordance with the current AASHTO M36 (and ASTM A760) specification.
- E. Fittings are to be manufactured by the pipe manufacturer and shall meet the same specification as the pipe. Integral bends with integral manholes may be permitted with sufficient documentation and certification by a State Registered Professional Engineer.
- F. Pipe found to be defective, damaged or excessively out of round or which does not match other similar pipe joints from joint to joint, or which cannot provide a reasonably tight joint may be cause for rejection.
- G. All steel pipe coming in contact with concrete shall first be coated with a coal tar epoxy coating or other generally accepted bitumastic materials, or polyethylene sheet wrap materials.
- H. Manufactured wyes, tees, elbows, or adapters may be accepted for use in place of precast storm sewer manholes and box inlets; however, precast manholes and

box inlets shall be required within the public right-of-way. In all cases the Contractor shall provide supportive documentation from the manufacturer. Adequate stiffeners shall be installed as required by the manufacturer.

- I. Shop drawings with supportive documentation for all wyes, tees, elbows, adapters, reducers, bulkheads, prefabricated manholes or other fittings or integral components shall be submitted to the engineer prior to fabrication.
- J. Handling and assembly shall be in accordance with the National Corrugated Steel Pipe Association (NCSPA) Standards.
- K. Installation shall be in accordance with AASHTO Standard Specifications for Highway Bridges, Section 26, Division II or ASTM A 798 and in conformance with the drawings and specifications. Note that construction loads may be higher than final loads and should be incorporated into the design and submittals. The Contractor shall also follow the manufacturer's or NCSPA's guidelines with respect to this.

PART 3 EXECUTION

3.01 General Pipe Installation

- A. Storm sewers shall be laid and tested in accordance with the Workmanship and Materials Specifications, Section WM 3, "Backfill, Fills and Embankments". All sewer pipe shall be laid to the lines and grades shown on the plans, unless otherwise directed by the Engineer. The jetting alternative, Method C of said Section WM 3 shall not be permitted in traffic areas but may be permitted in non-traffic areas when the existing groundwater elevation is lower than the sewer bedding elevation and the natural soils are free draining.
- B. All storm sewers shall be jointed in the trench in accordance with the instructions and recommendations of the manufacturer of the joint system and/or pipe. The joints shall be of a design that will permit flexibility, promote water tightness, and prevent soil from entering the storm sewer system.
- C. The Contractor shall be required, at his own expense, to protect, support and sustain all existing drains, tiles, cables, water and gas pipes, conduits, poles and other fixtures encountered across or along the site of the work. The Company or Corporation owning said pipes, poles or conduits must be notified by the Contractor before any such fixtures are disturbed in any way. They shall be supported as needed during construction. If any sewer, gas or water pipes, poles, conduits or other fixtures are damaged, they shall be repaired by the Contractor to their original condition or better and said repairs shall be at no additional cost to the Owner.
- D. The Contractor shall remove the existing street pavements to the minimum width necessary to accommodate the pipe construction work. The pavement shall be saw cut and removed to straight lines parallel to the trench. The existing stone, or slag, or gravel aggregate base material which is satisfactorily removed and segregated may be salvaged and used at the Contractor's option for constructing

the compacted aggregate base under a compacted aggregate surface located over the sewer trench.

- E. Any existing soft or yielding base material will not be considered satisfactory for reuse in any new pavement base. Unless otherwise permitted, the quality requirements of the reused base material shall meet the State Department of Transportation Standard Specifications requirements for Class B or better coarse aggregate.
- F. The satisfactorily removed base material may be directly incorporated into the work or it may be stockpiled and subsequently reused as conditions permit. Said salvaged base material will be considered to take the place of the specified new base material; however, where necessary or desirable in the opinion of the Engineer, the thickness of the reused salvaged based material shall be spread thinner than the specified thickness and then topped off with a layer of new aggregate material to make up the required total thickness.
- G. Bedding material for all types of pipe shall be hand or mechanically tamped aggregate placed in 6-inch layers and as shown on the drawings.
- H. Installation of storm sewer pipe by the directional drilling method will be considered on a case-by-case basis only. Directional drilling of storm sewers will require both real-time horizontal and vertical monitoring equipment.
- I. Installation of culvert pipe shall be consistent with the State Department of Transportation Specifications, Section 716 "Jacked Pipe" and all such related State Department of Transportation sections.

3.02 Rigid Conduit Installation (Concrete Pipe)

- A. All rigid pipe shall be laid in accordance with the Manufacturer's instructions except that it shall have no less than three (3) inches of compacted granular bedding material (Class I or Class II) placed on a flat trench bottom and compacted granular haunching material up to no less than the halfway point on the pipe (Spring line). Pipe Laying may be achieved by "Class B" bedding method as shown in the ASCE Manual of Practice No. 37, latest edition and the American Concrete Pipe Association, Concrete Pipe Handbook, latest edition for granular foundations. All granular bedding material shall be placed in the trench in approximately six (6) inch layers. Compaction shall be accomplished by hand or mechanical tamping. The granular material may also be "walked in" to the pipe spring line by forcing the material below the haunch of the pipe up to the spring line by either mechanical or hand means. Subsequent compaction shall be provided by the Contractor.
- B. The laying of pipe in finished trenches shall be commenced at the lowest point, proceeding upstream, with the spigot ends pointing the direction of flow.
- C. Except as otherwise specified, the excavation work for the sewers shall be performed in accordance with the Workmanship and Materials Specifications for "Excavation and Backfill."

- D. The practice of blocking pipe up to grade with bedding material, then backfilling under is prohibited. The entire length of the bed section is to be at proper grade before installing pipe.
- E. All pipes and specials shall be carefully inspected before being laid, and no cracked, broken or defective pipe or special shall be used in the work. All pipe shall be carefully inserted in the bell in such a manner that there will be no unevenness of any kind along the bottom half of the pipes and so that there is a uniform joint space all around.
- F. The Contractor is prohibited from adding patching compounds to the ends of damaged or cracked pipe without written instructions from the manufacturer and only while the inspector is present.
- G. All pipe that is field cut shall have the homing-marks reestablished, insuring for proper seating depths. Pipes that are field cut shall have the cut ends retapered, by grinding or filing, as close to the original taper provided by the manufacturer as possible. When homing pipe with a spud-bar or other mechanical equipment, other than by hand, place a piece of wood between pipe and tool to prevent damage to bell end-section.
- H. Pipe laid in open cut shall have all trench spaces and voids solidly and completely filled with suitable earth materials from the excavations, which shall be thoroughly and solidly rammed into place, unless otherwise specified.
- I. The joints shall be constructed as specified. The interior of the sewer shall, as the work progresses, be cleared of all dirt and superfluous materials of every description. Whenever pipe laying is discontinued, the unfinished end of the sewer shall be protected from displacement and cave-in or other injuries. During the process of the laying, care shall be taken to protect both pipes and joints from disturbance, and the trench shall be kept free from water until the joints shall have set. All surplus mortar or debris shall be promptly and completely removed from the interior of the pipes. On storm sewers twenty-four (24) inches in diameter and less, a disc mold or swab attached to a rod sufficiently long to pass two (2) joints from the end of the pipe last laid, shall be continuously worked through as the laying of the pipe proceeds.
- J. The ends of the pipes shall be protected to prevent the entrance of dirt or other foreign substances. Such protection shall be placed at night or whenever pipe laying is stopped for any reason. Suitable plugs designed for use with the pipe material shall be provided and properly secured and used to cap all slants and branches. Pipe end protection and devices shall be included in the prices bid per linear foot of sewer.

3.03 Flexible Conduit Installation

- A. Plastic sewer pipe (PVC) and other flexible pipe shall be carefully installed in accordance with the above specification for Rigid Conduit Installation, except where the following paragraphs modify those specifications.

- B. Flexible conduit for sewer pipe shall be installed in accordance with "Underground installation of Flexible Thermoplastic Sewer Pipe" ASTM Designation C 2321.
- C. Pipe Laying for Flexible pipe may be achieved by the Class B Bedding Method as shown in the ASCE Manual of Practice No. 37, latest edition for granular bedding. Under this class B Bedding Method, the pipe shall be bedded in compacted granular material (Class I or II) to a point no less than twelve (12) inches above the crown of the pipe. All granular bedding material shall be placed in the trench in approximately six (6) inch layers and compacted.
- D. Compaction shall be accomplished by hand or Mechanical Tamping or by "Walking" the granular material in for Class I materials only. When Class II materials are used compaction shall be accomplished by hand or mechanical tamping only to a minimum eighty-five percent (85%) Standard Proctor Density.

3.04 Semi-Rigid Pipe Installation

- A. All semi-rigid pipe shall be laid in the same way as flexible pipe as described above.

3.05 Testing Gravity Storm Sewers

- A. A deflection test shall be performed on each flexible pipe following the elapse of thirty (30) days after the placement of the final backfill. No pipe shall exceed a deflection of five percent (5%) or greater.
- B. The diameter of the rigid ball or mandrel used for a deflection test shall be no less than ninety-five percent (95%) of the base inside diameter of the pipe to be tested dependent on what is specified in the corresponding ASTM standard. The Contractor shall be responsible for proving an ASTM approved proving ring to verify the correct diameter of the rigid ball or mandrel. The test shall not be performed with the aid of a mechanical pulling devise.

3.06 Restoration Work

- A. The sections of trenches located outside the limits of the road driving surfaces shall be restored to original shape and grade, except as otherwise noted, by backfilling with excavated material and finishing with no less than 4-inches of topsoil (not subsoil) except where there are existing pavements or pavements specified to be replaced or reconstructed.
- B. All excavations beneath pavements (including hard surfaced and compacted aggregate pavements) including those areas below curbs and sidewalks shall be backfilled with compacted granular backfill. The backfill shall be placed in a manner to minimize lumps and voids, and shall be compacted with mechanical tampers unless otherwise justified in writing by a geotechnical engineer or professional geologist. Equipment for compaction may be run over backfill after there is a minimum of two (2) feet of backfill over a pipe barrel unless justified otherwise by the manufacturer in writing. Completion of backfill to finished grade for temporary restoration prior to final pavement restoration shall be with

compacted aggregate. Compacted aggregate shall conform to the State Department of Transportation Standard Specifications for Compacted Aggregate Base. The aggregate shall be thoroughly compacted. Any settlement that occurs shall be immediately refilled with compacted aggregate. The Contractor shall apply an approved dust preventative as necessary to avoid or eliminate dust complaints from nearby residents.

- C. Any curbs, sidewalks, sewers, drains, catch basins, mailboxes, street signs and miscellaneous structures damaged or removed shall be immediately restored to original or better condition and in accordance with the American Disabilities Act (ADA) requirements. The Contractor shall be responsible to comply with applicable State Department of Transportation Standards and Specifications.
- D. Restoration work related to pavement repair shall comply with this and other related Workmanship and Materials and Detailed Specifications.
- E. Final seeding, grading, and sodding shall comply with the applicable Workmanship and Materials sections. The Contractor must keep disturbed areas to a minimum.

3.07 Drain Tile Repair

- A. When excavating in, across, or through an existing tile, the Contractor shall follow the following procedures:
- B. Tile drains shall be repaired using perforated polyethylene corrugated drainage tubing. Existing intact drain line shall be supported during excavation. A "Fernco" type coupling shall be used for connection of new tile to existing tile. The Contractor shall backfill and compact the area around drain tile by hand until the new tile is completely covered.
- C. The Contractor will be required to connect any existing drainage pipe or tile encountered during construction if in direct conflict unless directed otherwise by the Engineer. The Owner or Owner's Representative must be immediately notified when any existing drain pipe or tile is located and must be present during all connections of same to the new storm sewer system. All construction methods and materials to accomplish this shall be in accordance with applicable sections of the Workmanship and Materials and as indicated on the drawings.

(SECTION WM 14)

PRESSURE PIPE - WATER

PART 1 GENERAL

1.01 Description

- A. The Contractor shall furnish and lay, as required, water pressure pipe, together with all fittings, thrust blocking, service taps, service lines or other specials as shown on the plans or specified and, necessary to complete the work, including necessary pipe for purpose of tests. Water pressure pipe shall be constructed of the pipe materials as specified herein.

- B. All water pressure pipe to be furnished under this Contract shall conform to specifications of this section. Actual materials furnished for water pressure pipe shall be permitted only as indicated in the Detailed Specifications.

- C. Related work described elsewhere:
 - 1. Excavation WM-2
 - 2. Backfill WM-3

1.02 Quality Assurance

- A. Codes and Standards
 - 1. Each length of pipe shall be marked per the requirements of the respective ASTM Standard and/or AWWA.
 - 2. All codes and standards shall be set forth in the latest ASTM and AWWA Standards.
 - 3. Upon request by the Engineer, the Contractor at his own expense, shall furnish copies of all material tests required by the applicable Standards.

1.03 Submittals

- A. Shop Drawings
 - 1. Prior to ordering pipe material, submit shop drawings to the Engineer for approval. All submittals shall include certification of conformance with the applicable ASTM and AWWA Pipe Standards. No field work shall be started prior to shop drawing approval.

PART 2 PRODUCTS

2.01 Ductile Iron Pipe

A. Material

Ductile Iron Pipe shall be centrifugally cast and shall conform to ANSI Specifications A-21.51 and AWWA C-151, latest revision, and shall include the National Sanitation Foundation (NSF) seal of approval. Ductile Iron Pipe shall be Pressure Class 350, 300, 250, 200 or 150.

B. Coatings and Linings

Pipe shall be standard cement lines and seal coated with an approved bituminous seal coat in accordance with AWWA Specification C-104 (ANSI A21.4).

Pipe shall be installed with 4 mil high density cross linked polyethylene encasement material, inclusive of fittings. The material shall be furnished and installed in accordance with AWWA Specification C-105 (ANSI A21.5) to provide the pipe with a protective enclosure.

C. Fittings

Fittings shall be standardized for the type of pipe and joint specified and shall comply with AWWA C-110 (ANSI A21.10) or AWWA C-153 (ANSI A-21.53).

D. Joints

Mechanical joints or slip joints shall be provided.

Mechanical joints and accessories shall conform to AWWA Standard C-111, ANSI A21.11. The bolts and nuts shall be corrosion resistant high strength alloy steel. The O-ring gaskets sealing the slip joint shall be made of rubber of special composition having a texture to assure a watertight and permanent seal and shall be the product of a manufacturer having at least five (5) years experience in the manufacture of rubber gaskets for pipe joints. The gaskets shall be a continuous ring of flexible joint rubber of a composition and texture which is resistant to common ingredients of sewage, industrial wastes and groundwater; and which will endure permanently under the conditions likely to be imposed by this service. The gasket shall conform to the requirements of AWWA C-111 (ANSI A-2111).

Where indicated on plans for submerged crossings of rivers, lakes or streams, pipe shall be furnished with boltless ball and socket type joints, pipe pressure class shall be 350 psi.

Where indicated on plans, restrained joint pipe shall be provided. Restrained joints shall be designed in accordance with AWWA C-111 and shall permit horizontal and/or vertical deflection after assembly, yet adequately restrain the joint at the full design pressure.

E. Markings

The class designations for the various classes of pipe and fittings shall be cast onto fittings in raised numerals, and cast or stamped on the outside of each joint of pipe.

F. Certification

The Contractor shall furnish certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable AWWA and ANSI Specifications.

G. Locate Wire

Locate wire shall be #12 standard copper wire with thermoplastic insulation and capable of carrying 600 Volts. The wire shall be temporarily held in place during initial backfilling of the pipe using duct tape. The wire shall be brought to the ground surface at 1000 foot intervals through a cast iron valve box. A minimum of 2 feet extra wire shall be left in the valve box for future connection to utility locate equipment. Each box shall be marked with a pipe line locate marker manufactured by Carsonite, Buckeye Partners, L.P., or equal. Labels selected by the Owner shall be affixed to the marker. Marker will be required at all riser locations unless instructed differently by the Engineer. Cast iron valve boxes shall be in accordance with WM-16, Paragraph 2.02, Valve Boxes.

2.02 High Density Polyethylene Pipe (4" and larger)

A. Pipe

Materials used for the manufacture of polyethylene pipe shall be extra high molecular weight, high density ethylene/hexane copolymer PE 3408 or PE 4710 polyethylene resin meeting the requirements of ASTM D-3350 with a cell classification of PE 345434C or 4454746 or higher. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All material shall be listed by the Plastic Pipe Industry in the name of the pipe manufacturer and shall be based on ASTM D2837 and PPI TR-3 testing and validation for samples of the pipe manufacturer's production pipe.

All High Density Polyethylene Pipe shall include the National Sanitation Foundation (NSF) seal of approval.

Pipe shall be designed and manufactured in accordance with AWWA C-906. The pipe shall be pressure rated in accordance with AWWA C-906, Pressure Class and Dimension Ratios (DR) shall be as follows:

Class 160	DR 13.5
Class 200	DR 11
Class 250	DR 9
Class 335	DR 7

B. Joining

HDPE pipe shall be joined into continuous lengths on the job-site above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements, alignment, and interracial fusion pressure. Socket fusion shall not be used.

C. Pipe Packaging, Handling, Storage

The manufacturer shall package the pipe in a manner designed to deliver the pipe to the project site neatly, intact and without physical damage. The transportation carrier shall use appropriate method to insure the pipe is properly supported, stacked and restrained during transport. On-site the pipe shall be stored on clean, level ground to prevent undue scratching or gouging. When lining fused sections of pipe, chains or cable type chokers must be avoided, nylon slings are preferred. Care must be exercised to avoid cutting or gouging the pipe.

D. Installation

Water main installation shall be in conformance with Specifications for Installation of Flexible Pipe as per all applicable ASTM requirements, including F-412, D-2321, D-2412, D-3212 and D-3350.

Where indicated on plans for submerged crossing of rivers, lakes or streams, pipe shall be furnished with an adequate number of concrete collars properly spaced to overcome pipe buoyancy.

E. Locator Tape and Wire

All HPDE pipe shall be installed with a metallic locator tape. Tape shall be color-coded and installed above the pipe in accordance with the tape manufacturer's instructions.

Locate wire shall be #12 standard copper wire with thermoplastic insulation and capable of carrying 600 Volts. The wire shall be temporarily held in place during initial backfilling of the pipe using duct tape. The wire shall be brought to the ground surface at 1000 foot intervals through a cast iron valve box. A minimum of 2 feet extra wire shall be left in the valve box for future connection to utility locate equipment. Each box shall be marked with a pipe line locate marker manufactured by Carsonite, Buckeye Partners, L.P., or equal. Labels selected by the Owner shall be affixed to the marker. Marker will be required at all riser locations unless instructed differently by the Engineer. Cast iron valve boxes shall be in accordance with WM-16, Paragraph 2.02, Valve Boxes.

F. Markings

During the extrusion production, the HDPE pipe shall be continuously marked with durable printing noting the nominal pipe size, dimension ratio, pressure rating, trade name, material classification, certification bases and date in accordance with AWWA C-906.

G. Certifications

The Contractor shall furnish upon request a certificate of conformance to the required AWWA and ASTM Standards.

2.03 Polyvinyl Chloride Pipe SDR Rated Pipe (SDR) (3" - 12")

A. Pipe

PVC water main pipe rated by SDR shall conform to ASTM Specification D-2241, Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe (SDR PR). The material used shall conform to ASTM Specification D-1784, Standard Specification of Rigid Polyvinyl Chloride and Chlorinated Polyvinyl Chloride compounds, Class 12454-B (PVC 1120). Pipe larger than 12" diameter shall conform to AWWA C905.

The pipe shall be pressure rated in accordance with recommendations of the Plastic Pipe Institute. Pressure class and Standard Dimension Ratios (SDR) shall be as follows:

Class 160	SDR 26
Class 200	SDR 21
Class 250	SDR 17
Class 315	SDR 13.5

All plastic pipe shall bear identification markings in accordance with Sections 2.5.2 and 2.5.3 of AWWA C-900, which shall include the National Sanitation Foundation (NSF) seal of approval. In addition, the plain end of each pipe length shall have two (2) rings, 1" apart, painted around the pipe at the proper location to allow field checking of the correct setting depth of the pipe in the bell or coupling.

B. Joints

Joints shall be bell end or coupling push-on type.

The push-on joint and joint compounds shall meet the requirements for ASTM Specification D-3139, Joint for the Plastic Pressure Pipe, using Flexible Elastomeric Seals. The joint shall be designed so as to provide for the thermal expansion and contraction experienced with a total temperature change of seventy-five (75) degrees F in each joint of pipe. Details of the joint design and assembly shall be in accordance with joint manufacturer's standard practice.

The lubricant shall have no deteriorating effects on the gasket or the pipe. The lubricant containers shall be labeled with manufacturer's name.

Gaskets shall meet all applicable requirements of ASTM F477.

C. Fittings

Fittings shall be furnished in accordance with AWWA C-110 (ANSI A-21.10) and AWWA C-153 (ANSI A-21.53).

D. Locator Tape and Wire

All PVC pipe shall be installed with a metallic locator tape. Tape shall be color coded and installed above the pipe in accordance with the tape manufacturer's instructions.

Locate wire shall be #12 standard copper wire with thermoplastic insulation and capable of carrying 600 Volts. The wire shall be temporarily held in place during initial backfilling of the pipe using duct tape. The wire shall be brought to the ground surface at 1000 foot intervals through a cast iron valve box. A minimum of 2 feet extra wire shall be left in the valve box for future connection to utility locate equipment. Each box shall be marked with a pipe line locate marker manufactured by Carsonite, Buckey Partners, L.P., or equal. Labels selected by the Owner shall be affixed to the marker. Marker will be required at all riser locations unless instructed differently by the Engineer. Cast iron valve boxes shall be in accordance with WM-16, Paragraph 2.02, Valve Boxes.

E. Markings

The date of manufacture, class of pipe, specification designation, size of pipe, name or trademark of manufacturer, and identification of plant/location shall be legibly marked on the outside of each pipe section in accordance with the ASTM D-3034.

F. Certification

The Contractor shall, upon request, furnish manufacturer's certification stating that the pipe supplied meets or exceeds all requirements of the applicable ASTM and AWWA (where applicable) Standards.

2.04 Polyvinyl Chloride Pipe C-900 Rated (4" - 12")

A. Pipe

PVC water main rated C-900 shall conform to standards for polyvinyl chloride plastic pipe AWWA C-900. The material used shall conform to ASTM Specification D-1784 Standard Specification of rigid polyvinyl chloride and chlorinated polyvinyl chloride compounds. Class 12454-B (DOC 1170) and the National Sanitation Foundation Standard No. 61.

The pipe shall be pressure rated in accordance with AWWA C-900.

Class 235
Class 305

DR-18
DR-14

All plastic pipe shall bear identification markings in accordance with AWWA C-900, which shall include the National Sanitation Foundation (NSF) seal of approval. In addition, the plain end of each pipe length shall have two (2) rings 1" apart painted around the pipe at the proper location to allow field checking of the correct setting depth of the pipe in the bell or fitting.

B. Joints

Joints shall be bell end or coupling push-on type.

The push-on joint and joint components shall meet the requirements for ASTM Specification D-3139, Joint for the Plastic Pressure Pipe, using Flexible Elastomeric Seals (ASTM F-477). The joint shall be designed so as to provide for the thermal expansion and contraction experienced with a total temperature change of seventy-five (75) degrees F in each joint of pipe. Details of the joint design and assembly shall be in accordance with joint manufacturer's standard practice.

The lubricant shall have no deteriorating effects on the gasket or the pipe. The lubricant containers shall be labeled with manufacturer's name.

Gaskets shall meet all applicable requirements of ANSI Standard A-21-11.

C. Fittings

Fittings shall be furnished in accordance with AWWA C-110 (ANSI A-21.10) and AWWA C-153 (ANSI A-21.53).

D. Locator Tape and Wire

All PVC pipe shall be installed with a metallic locator tape. Tape shall be color coded and installed above the pipe in accordance with the tape manufacturer's instructions.

Locate wire shall be #12 standard copper wire with thermoplastic insulation and capable of carrying 600 Volts. The wire shall be temporarily held in place during initial backfilling of the pipe using duct tape. The wire shall be brought to the ground surface at 1000 foot intervals through a cast iron valve box. A minimum of 2 feet extra wire shall be left in the valve box for future connection to utility locate equipment. Each box shall be marked with a pipe line locate marker manufactured by Carsonite, Buckeye Partners, L.P., or equal. Labels selected by the Owner shall be affixed to the marker. Marker will be required at all riser locations unless instructed differently by the Engineer. Cast iron valve boxes shall be in accordance with WM-16, Paragraph 2.02, Valve Boxes.

E. Markings

Each section of pipe shall be marked with size and O.D. Base, PVC, DR ratio, AWWA pressure class, manufacturing name, production code and NSF seal in accordance with AWWA C-900, ASTM D-224 and ASTM F-1483.

F. Certification

The Contractor shall upon request furnish manufacturer's certification stating that the pipe supplied meets or exceeds all applicable requirements of AWWA C-900 and ASTM.

2.05 Polyvinyl Chloride Pipe C-905 Rated (14" and larger)

A. Pipe

PVC water main rated C-905 shall conform to standards for polyvinyl chloride plastic pipe AWWA C-905. The material used shall conform to ASTM Specification D-1784 Standard Specification of rigid polyvinyl chloride and chlorinated polyvinyl chloride compounds. Class 12454-B (DOC 1170) and the National Sanitation Foundation Standard No. 61.

The pipe shall be pressure rated in accordance with AWWA C-905.

Class 165	DR-25
Class 235	DR-18

All plastic pipe shall bear identification markings in accordance with AWWA C-905, which shall include the National Sanitation Foundation (NSF) seal of approval. In addition, the plain end of each pipe length shall have two (2) rings 1" apart painted around the pipe at the proper location to allow field checking of the correct setting depth of the pipe in the bell or fitting.

B. Joints

Joints shall be bell end or coupling push-on type.

The push-on joint and joint components shall meet the requirements for ASTM Specification D-3139, Joint for the Plastic Pressure Pipe, using Flexible Elastomeric Seals (ASTM F-477). The joint shall be designed so as to provide for the thermal expansion and contraction experienced with a total temperature change of seventy-five (75) degrees F in each joint of pipe. Details of the joint design and assembly shall be in accordance with joint manufacturer's standard practice.

The lubricant shall have no deteriorating effects on the gasket or the pipe. The lubricant containers shall be labeled with manufacturer's name.

Gaskets shall meet all applicable requirements of ANSI Standard A-21-11.

C. Fittings

Fittings shall be furnished in accordance with AWWA C-110 (ANSI A-21.10) and AWWA C-153 (ANSI A-21.53).

D. Locator Tape and Wire

All PVC pipe shall be installed with a metallic locator tape. Tape shall be color coded and installed above the pipe in accordance with the tape manufacturer's instructions.

Locate wire shall be #12 standard copper wire with thermoplastic insulation and capable of carrying 600 Volts. The wire shall be temporarily held in place during initial backfilling of the pipe using duct tape. The wire shall be brought to the ground surface at 1000 foot intervals through a cast iron valve box. A minimum of 2 feet extra wire shall be left in the valve box for future connection to utility locate equipment. Each box shall be marked with a pipe line locate marker manufactured by Carsonite, Buckeye Partners, L.P., or equal. Labels selected by the Owner shall be affixed to the marker. Marker will be required at all riser locations unless instructed differently by the Engineer. Cast iron valve boxes shall be in accordance with WM-16, Paragraph 2.02, Valve Boxes.

E. Markings

Each section of pipe shall be marked with size and O.D. Base, PVC, DR ratio, AWWA pressure class, manufacturing name, production code and NSF seal in accordance with AWWA C-905, ASTM D-224 and ASTM F-1483.

F. Certification

The Contractor shall upon request furnish manufacturer's certification stating that the pipe supplied meets or exceeds all applicable requirements of AWWA C-905 and ASTM.

2.06 Molecularly Oriented Polyvinyl Chloride Pipe (PVCO) (4" - 12")

A. Pipe

PVCO water main shall conform to standards for Molecularly Oriented Polyvinyl Chloride Plastic Pipe, AWWA C-909. The material used shall conform to ASTM D-1784 Standard Specification of rigid polyvinyl chloride - chlorinated polyvinyl chloride compounds, Class 12494-B.

The pipe shall be pressure rated in accordance with AWWA C-909.

Class 100	350 psi test
Class 150	500 psi test
Class 200	650 psi test

All plastic pipe shall bear identification markings in accordance with AWWA C-909, which shall include the National Sanitation Foundation (NSF) seal of

approval. In addition, the plain end of each pipe length shall have two (2) 1" apart painted, around the pipe at the proper location to allow field checking of the correct setting depth of the pipe in the bell or fitting.

B. Joints

Joints shall be bell end or coupling push-on type.

The push-on joint and joint components shall meet the requirements for ASTM Specification D-3139, Joint for the Plastic Pressure Pipe, using Flexible Elastomeric Seals. The joint shall be designed so as to provide for the thermal expansion and contraction experienced with a total temperature change of seventy-five (75) degrees F in each joint of pipe. Details of the joint design and assembly shall be in accordance with joint manufacturer's standard practice.

The lubricant shall have no deteriorating effects on the gasket or the pipe. The lubricant containers shall be labeled with manufacturer's name.

Gaskets shall meet all applicable requirements of ANSI Standard A-21-11.

C. Fittings

Fittings shall be furnished in accordance with AWWA C-110 (ANSI A-21.10) and AWWA C-153 (ANSI A-21.53). PVC0 shall only be tapped through a service saddle. Direct tapping the wall of the pipe is not permitted.

D. Locator Tape and Wire

All PVC0 pipe shall be installed with a metallic locator tape. Tape shall be color coded and installed above the pipe in accordance with the tape manufacturer's instructions.

Locate wire shall be #12 standard copper wire with thermoplastic insulation and capable of carrying 600 Volts. The wire shall be temporarily held in place during initial backfilling of the pipe using duct tape. The wire shall be brought to the ground surface at 1000 foot intervals through a cast iron valve box. A minimum of 2 feet extra wire shall be left in the valve box for future connection to utility locate equipment. Each box shall be marked with a pipe line locate marker manufactured by Carsonite, Buckeye Partners, L.P., or equal. Labels selected by the Owner shall be affixed to the marker. Marker will be required at all riser locations unless instructed differently by the Engineer. Cast iron valve boxes shall be in accordance with WM-16, Paragraph 2.02, Valve Boxes.

E. Markings

Each section of pipe shall be marked with size and O.D. Base, PVC, AWWA pressure class, manufacturing name, production code and NSF seal in accordance with AWWA C-909.

2.07 Service Saddles

- A. Shall be double strap type of stainless or brass construction with confined “O” ring seal and AWWA thread outlet. Service saddles shall be of a design which will accurately fit pipe (O.D.) to provide a positive seal between main and saddle at the rated working pressure of the main.
- B. The service saddle shall be marked to indicate size of main (O.D.) and outlet size on body and strap. Service saddle shall be a double strap Ford Style 202B, Mueller BR 2S Series for service lines, or approved equal.

2.08 Corporation Stops

- A. Shall be brass, designed and manufactured in accordance with AWWA Standard Specification C-800 and shall be individually inspected and tested for the leaks at the factory prior to shipment. Corporation stops shall be of a design which will permit use with drilling machines of current design.
- B. Corporation stops shall be ball type furnished with AWWA inlet thread and compression joint outlet as manufactured by Ford Meter Box Co., Mueller Co., or approved equal.

2.09 Curb Stops and Curb Boxes

- A. The curb stops shall be a brass ball valve with pack joints suitable for use with the plastic service line specified and manufactured by the Ford Meter Box Company, Inc., Muller Co., or equal. The curb boxes shall be an extension type curb box with an arch pattern base suitable for use with the specified curb stop. All boxes shall be heavily coated with an asphaltic-base coating. The lid shall have “Water” imprinted on it and brass pentagon head plug. The lid and base shall be cast iron.

2.10 Insert Stiffeners

- A. Insert stiffeners are required for all PE pipe connections to corporation stop and meter setter pack joint inlet/outlet compression couplings or fittings. Stiffeners shall be solid, stainless steel, sized to match the I.D. of the service pipe, as manufactured by Ford, Mueller, or approved equal.

2.11 Polyethylene (PE) Service Pipe (CTS)

- A. Polyethylene pipe (SDR-PR) service line for water distribution, hereinafter referred to as PE pipe, shall conform to all applicable requirements in the latest revision of ASTM D-1248, ASTM D-2737, ASTM D-3350, and AWWA C-901 standards for Copper Tube Size (SDR-9).
- B. Polyethylene extrusion compound from which the polyethylene pipe is extruded shall comply with applicable requirements for PE-3408 ultra-high molecular weight polyethylene plastic material. Material shall be as described in ASTM D-1248 latest revision.

- C. The PE pipe shall be rated for use with water at 73.4°F at a hydrostatic design stress of six hundred thirty (630) psi and a working pressure of one hundred sixty (160) psi in accordance with ASTM D-1599.
- D. The minimum burst pressure at 73.4°F determined in accordance with ASTM D-1599, latest revision, shall be six hundred thirty (630) psi. The time of testing of such specimen shall be between sixty (60) and seventy (70) seconds.
- E. PE service pipe shall have the following nominal dimensions and weights:

Nominal Size (Inches)	Nominal O.D. (Inches)	Approx. I.D. (Inches)	Minimum Wall (Inches)	Approx. Pounds/ 100- Feet
3/4	0.875	0.681	0.097	9.8
1	1.125	0.875	0.125	16.3
2	2.125	1.653	0.236	60.9

- F. PE pipe shall be permanently marked indicating nominal size, PE 3408, standard dimension ratio, pressure rating at 73°F, manufacturer's name (or trademark), date, code, appropriate ASTM designation, and the NSF-pw seal indicating approval for potable water.
- G. PE pipe shall be homogenous throughout and free of visible cracks, holes, foreign inclusions or other defects. It shall be uniform in color, capacity, density and other physical properties.
- H. PE pipe shall be as manufactured by Phillips Drisco Pipe, Inc., Richardson, TX, Crestline Plastic Pipe Co., Inc., or approved equal.
- I. The Contractor shall furnish a certification from the manufacturer of the pipe that the manufacturer is fully competent and capable of extruding PE pipe of uniform texture and strength to fully comply with the properties and ASTM specifications listed and further that the pipe for this project will be manufactured.
- J. The service line shall include a #12 locating wire installed with it for future location.

2.12 Polyethylene (PE) Service Pipe (IPS)

- A. Polyethylene pipe (SDR-PR) service line for water distribution hereinafter referred to as P.E. pipe shall conform to all applicable requirements in the latest revision of ASTM D-1248, ASTM D-2737, ASTM D-3350 and AWWA C-901 standards for Iron Pipe Size (SDR-7).
- B. Polyethylene extrusion compound from which the polyethylene pipe is extruded shall comply with applicable requirements for PE-3408 ultra-high molecular weight polyethylene plastic material. Material shall be as described in ASTM D-1248 latest revision.

- C. The PE pipe shall be rated for use with water at 73.4°F at a hydrostatic design stress of six hundred thirty (630) psi and a working pressure of one hundred sixty (160) psi in accordance with ASTM-D1599.
- D. The minimum burst pressure at 73.4°F determined in accordance with ASTM D-1599 latest revision, shall be six hundred thirty (630) psi. The time of testing of such specimen shall be between sixty (60) and seventy (70) seconds.
- E. PE service pipe shall have the following nominal dimensions and weights:

Nominal Size (inches)	Approx. O.D. (Inches)	Nominal I.D. (Inches)	Minimum Wall (inches)	Approx. Pounds/100 Ft.
3/4	1.060	0.824	0.118	15
1	1.349	1.049	0.15	25
2	2.657	20.67	0.295	96

- F. PE pipe shall be permanently marked indicating nominal size, PE 3408, standard Dimension Ratio, pressure rating at 73°F, manufacturer's name (or trademark), date, code, appropriate ASTM designation, and the NSF-pw seal indicating approval for potable water.
- G. PE pipe shall be homogenous throughout and free of visible cracks, holes, foreign inclusions or other defects. It shall be uniform in color, capacity, density and other physical properties.
- H. PE pipe shall be as manufactured by Phillips Drisco Pipe, Inc., Richardson, TX; Crestline Plastic Pipe Co., Inc., or approved equal.
- I. The Contractor shall furnish a certification from the manufacturer of the pipe that the manufacturer is fully competent and capable of extruding PE pipe of uniform texture and strength to fully comply with the properties and ASTM specifications listed and further that the pipe for this project will be manufactured.
- J. The service line shall include a #12 locating wire installed with it for future location.

2.13 Copper Service Pipe

- A. All copper pipe (“K”) service line for water distribution hereinafter referred to as pipe, shall conform to all applicable requirements in the latest revision of ASTM and AWWA Standards for Copper Tube Size (SDR-9).

PART 3 INSTALLATION OF POTABLE WATER MAIN

Potable water mains shall be installed in accordance with AWWA/ASTM D-2774 Standards and manufacturer’s recommendations, and Uni-Bell PVC Pipe Association, Standard Uni-B-3. If any conflict between these standards, manufacturer’s recommendations, the manufacturer’s recommendations shall take precedence.

3.01 Alignment and Grade

The water mains shall be laid and maintained to lines and grades established by the plans and specifications, with fittings, valves, tapped or bossed outlets, and hydrants at the required locations unless otherwise approved by the Engineer. Valve-operating stems shall be oriented in a manner to allow proper operation. Hydrants shall be installed plumb.

A. Clearance

When crossing existing pipelines or other structures, alignment and grade shall be adjusted as necessary, with the approval of the Engineer, to provide clearance as required by federal, state, and local regulations or as deemed necessary by the Owner to prevent future damage or contamination of either structure. Horizontal separation from sewers shall be 10' measured horizontally from outside edge of water main to the outside edge of any existing and proposed sanitary sewers or storm sewers. When installation closer than 10' is required or when crossing sewers, the water main shall be installed at least 18" above the top of the sewer.

Installation not meeting the above requirements shall be as shown on plans and in accordance to state regulations.

3.02 Trenching

A. Width

Refer to WM-2, Paragraph 2.12, for trench width requirements.

B. Bell Holes

Holes for the bells shall be provided at each joint, but shall be no longer than necessary to allow joint assembly and to ensure that the pipe barrel will lie flat on the trench bottom. Push-on type joints require only minimum depressions for bell holes.

Other than noted previously, 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 withdrawal of pipe slings or other lifting tackle without damaging coating or polyethylene encasement.

C. Rock Conditions

When excavation of rock is encountered, all rock shall be removed to provide a clearance below and on each side of all pipe, valves, and fittings of at least 6" for pipe sizes 24" or smaller and 9" for pipe sizes 30" and larger. When excavation is completed, a layer of appropriate backfill material shall be placed on the bottom of the trench to the previously mentioned depths, leveled, and tamped.

This installation procedure shall be followed when gravel formations containing loose boulders greater than approximately 8" (200 mm) in diameter are encountered.

In all cases, the specified clearances shall be maintained between the bottom of all pipe and appurtenances and any part, projection, or point or rock, boulder, or stone of sufficient size and placement that, in the opinion of the Engineer, could cause a fulcrum point or pointload.

3.03 Pipe Laying

Proper implements, tools and facilities shall be provided and used for the safe and convenient performance of the work. All pipe, fittings, valves, and hydrants shall be lowered carefully into the trench by means of a derrick, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to water main materials and protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench. Where practical, the trench should be dewatered prior to installation of the pipe.

A. Examination of Material

All pipe, fittings, hydrants, and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for inspection by the Engineer, who may prescribe corrective repairs or reject the materials.

B. Pipe Ends

All lumps, blisters, and excess coating shall be removed from the socket and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be wiped clean and dry and be free from dirt, sand, grit, or any foreign materials before the pipe is laid.

C. Pipe Cleanliness

Foreign material shall be prevented from entering the pipe while it is being placed in the trench. No debris, tools, clothing, or other materials shall be placed in the pipe at any time.

D. Pipe Placement

As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material.

E. Pipe Plugs

At times when pipe-Laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Engineer. The plug shall be fitted with a means for venting. When practical, the plug shall remain in

place until the trench is pumped completely dry. Care must be taken to prevent pipe flotation, should the trench fill with water.

Prior to removal of the plug for extending the line or for any other reason, air and/or water pressure in the line shall be released.

F. Ductile Iron Encasement

Polyethylene encasement for ductile iron pipe shall be installed in accordance with ANSI/AWWA C105/A21.5.

3.04 Joint Assembly

Joints shall be assembled in accordance with the manufacturer's instructions.

A. Assembly

After placing a length of pipe in the trench, the manufacturer's lubricant shall be properly applied. Spigot end shall then be centered in the bell and the pipe pushed home and brought to correct line and grade. Pipe and fittings which do not allow a sufficient and uniform space for joints shall be removed and replaced with pipe of proper dimensions to insure such uniform space. Precautions shall be taken to prevent dirt from entering the joint space.

B. Joint Deflection

When it is necessary to deflect pipe from a straight line in either the horizontal or vertical plane, the amount of joint deflection shall not exceed 80% of the allowance recommended by the manufacturer.

C. Pipe Cutting

Cutting pipe for insertion of valves, fittings, or closure pieces shall be done in conformance with all safety recommendations of the manufacturer of the cutting equipment. Cutting shall be done in a safe, workmanlike manner without creating damage to the pipe lining. An oxyacetylene torch shall not be used.

Cut ends and rough edges shall be ground smooth, and for push-on joint connections the cut end shall be beveled by methods recommended by the manufacturer and approved by the Engineer.

3.05 Bedding for Water Main

Bedding material shall be native soil, Class I, II or Class III as required for the various laying conditions.

Where rock excavation is required, a minimum of 6" of Class I, II or Class III bedding is required for mains up to 24" diameter and 9" for 30" and larger.

Where non-granular backfill is to be consolidated to the top of pipe earth, or loam free of rocks or other debris, shall be placed by hand or carefully by equipment to prevent

horizontal movement of the pipe. This material shall be hand tamped or spaded to firmly support the pipe haunches.

Backfilling shall be in accordance with Section WM 3.

Where granular backfill is required, granular fill shall be placed by hand or carefully by equipment. This material shall be hand tamped or spaded to firmly support the pipe haunches.

3.06 Thrust Restraint

A. Hydrants

The bowl of each hydrant shall be well braced against a sufficient area of unexcavated earth at the end of the trench with stone slabs or concrete thrust blocks, or it shall be tied to the pipe with suitable stainless steel tie rods, clamps, or restrained joints as shown on the plans.

B. Fittings

All plugs, caps, tees, reducers, and bens, unless otherwise specified, shall be provided with thrust blocks or suitably restrained joints as shown on the plans.

C. Design

The design pressure is the maximum pressure to which the pipeline will be subjected, with consideration given to the vulnerability of the pipe soil system when the pressure is expected to be applied. In most cases, this will be the test pressure of the pipe, applied shortly after installation, when the pipe soil system is normally most vulnerable.

For buried pipelines, thrust restraint is achieved by transferring the thrust force to the soil structure outside the pipe. The objective of the design is to distribute the thrust forces to the soil structure in such a manner that joint separation will not occur in unrestrained joints.

D. Concrete Thrust Blocks

Vertical and horizontal thrust blocks shall be made of concrete having a compressive strength of not less than 3000 psi after 28 days. The blocks shall be placed between solid ground, and the fitting to be anchored. The mass of the block and/or the area of bearing on the pipe and on the ground in each instance shall be that shown on the plans. The blocking shall, unless otherwise shown or directed, be so located as to contain the resultant thrust force in such a way that the pipe and fitting joints will be accessible for repair. Concrete for thrust blocks shall be properly mixed by truck or portable mixer. At no time shall pipe be restrained with bags of premixed concrete unless properly mixed with a portable mixer.

E. Restrained Joints

Restraining mechanisms for push-on or mechanical joints may be used instead of or in concert with concrete blocking, if so indicated in the plans and specifications. Tie rods, clamps, or other components of dissimilar metal shall be protected against corrosion by hand application of a suitable coating or by encasement of the entire assembly with 8 mil loose polyethylene film in accordance with ANSI/AWWA C105/A21.5.

Glands shall be manufactured of ductile iron conforming to ASTM A536-80, Grade 60-42-10. Set screws shall be hardened ductile iron. These devices shall have pressure rating with a safety factor of 221. Glands shall be listed with UL and factory manual.

3.07 Disinfection of System

After completion of each extension system, all hydrants and blow-offs shall be flushed to remove dirt and foreign material. The extension shall then be treated to provide water of safe bacteriologized quality and shall meet the approval of the Engineer and the Indiana Department of Environmental Management (IDEM). The Contractor shall furnish the Engineer with two (2) copies of the water analysis report approved by the Indiana Department of Environmental Management (IDEM) prior to installing service meters. The system shall be treated in accordance with AWWA C651 latest revision, however, either of the following modified methods shall be used.

A. Chlorinating the Main

1. Water from the existing distribution system or other approved source of supply shall be made to flow at a constant, measured rate into the newly laid water main. In the absence of a meter, the rate may be approximated by methods such as placing a Pitot gauge in the discharge, measuring the time to fill a container of known volume.
2. At a point not more than 10 ft. 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 50 mg/l free chlorine. To assure 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 or Wastewater* or AWWA manual M12, or using appropriate chlorine test kits.
3. The following gives the amount of chlorine required for each 100 feet of various diameters. Solutions of one percent (1%) chlorine may be prepared with sodium hypochlorite or calcium hypochlorite. The latter solution requires 1 lb. of calcium hypochlorite in 8 gallons of water.

CHLORINE REQUIRED TO PRODUCE 50mg/l CONCENTRATION
in 100 Ft. of PIPE By DIAMETER

Pipe Diameter in.	100-Percent Chlorine lb.	One Percent (1%) Chlorine Solution gal.
4	0.026	0.32
6	0.06	0.72
8	0.108	1.30
10	0.17	2.04
12	0.24	2.88
16	0.434	5.2

4. During the application of chlorine, valves shall be positioned so that the strong chlorine solution in the main being treated will not flow into water mains in active service. 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 hours, 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 period, the treated water in all portions of the main shall have a residual of not less than 10 mg/l free chlorine.

B. Clearing the Main of Heavy Chlorinated Water

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 concentration in the water leaving the main is greater than 0.5 mg/l but less than 2.0 mg/l.

C. Disposing of Heavily Chlorinated Water

Chlorinated water shall be properly discharged to a sanitary sewer. If there is no sanitary sewer available, then a reducing agent shall be applied to the water to be wasted to neutralize thoroughly the chlorine residual remaining in the water. The following table shows the amount of neutralizing chemicals required. Where necessary, federal, state and local regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water.

POUNDS OF CHEMICALS REQUIRED TO NEUTRALIZE VARIOUS RESIDUAL
CHLORINE CONCENTRATIONS IN 100,000 GALS. OF WATER *

Residual Chlorine Concentration mg/l	Sulfur Dioxide (SO ₂)	Sodium Bisulfate (NaHSO ₃)	Sodium Sulfite (Na ₂ SO ₃)	Sodium Thiosulfate (Na ₂ S ₂ O ₃ ·5H ₂ O)
1	0.8	1.2	1.4	1.2
2	1.7	2.5	2.9	2.4
10	8.3	12.5	14.6	12.0
50	41.7	62.6	73.0	60.0

* Except for residual chlorine concentration, all amounts are in pounds

Field dechlorination shall be in accordance with AWWA C655.

D. Bacteriological Tests

After final flushing and again after 24 hours, a sample shall be collected from the end of the line, 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. At least one set of samples shall be collected from the new main and one from each branch. In case of extremely long mains, it is desirable that samples be collected along the length of the line as well as its end. Samples shall be delivered to a State approved lab for testing.

Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate as required by *Standard Methods for the Examination of Water and Wastewater*.

E. Redisinfection

If the initial disinfection fails to produce satisfactory bacteriological samples, the main may be reflashed and shall be resampled. If check samples show the presence of coliform organisms, then the main shall be rechlorinated until satisfactory results are obtained.

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 recommended to sample water entering the new main.

F. Disinfection Procedures When Cutting Into or Repairing Existing Mains

The following procedures apply primarily when mains are wholly or partially dewatered. After the appropriate procedures have been completed, the 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 mains remain full of pressurized water present little danger of contamination and require no disinfection.

1. Trench Treatment

When an old 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.

2. Swabbing With Hypochlorite Solution

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

3. 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.

4. Slug Chlorination

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

5. 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, samples shall be taken on each side of the main break. If positive bacteriological samples are recorded, the situation shall be evaluated by a qualified Engineer who can determine corrective action, and daily sampling shall be continued until two (2) consecutive negative samples are recorded.

G. Special Procedure for Tapping Sleeves

Before a tapping sleeve is installed, the exterior of the main to be tapped shall be thoroughly cleaned and the interior surface of the sleeve shall be lightly dusted with calcium hypochlorite powder.

Tapping sleeves are used to avoid shutting down the main to be tapped. After the tap is made, it is impossible to disinfect the annulus without shutting down the main and removing the sleeve. The space between the tapping sleeve and the tapped pipe is normally $\frac{1}{2}$ inch, more or less, so that as little as 100 mg of calcium hypochlorite powder per square foot will provide a chlorine concentration of over 50 mg/l.

3.08 Service Installation

Service lines shall be installed where shown on plans and/or as directed by Engineer. No tap shall be installed until the main passes the pressure leakage test and has been successfully disinfected.

The main shall be tapped and a corporation stop installed between 10 and 12 o'clock on the pipe circumference. Polyethylene encasement shall be properly cut and repaired. Service lines of dissimilar metals shall be polyethylene wrapped for a minimum clear distance of 3 ft.

Service lines shall be installed with the same depth of cover as specified for mains, and shall be laid with no unnecessary bends. Meter settings shall be as shown on the drawings.

3.09 Testing

All pipe shall be pressure tested in accordance with Section WM 15, Hydrostatic Testing of these WM Specifications.

(SECTION WM 15)

HYDROSTATIC TESTING

PART 1 GENERAL

1.01 Scope

- A. After the pipe has been laid and partially backfilled as specified under "Backfill, Fills and Embankments", all newly laid pipe or any valved sections of it shall, unless otherwise expressly specified, be subjected to a hydrostatic pressure tests. The duration of each pressure test shall be for a period of not less than two hours and not more than six hours. The basic provisions of AWWA C-600 (DI pipe), C-605-94 (PVC pipe), ASTM F2164-02 (PE pipe) or ASTM F2163-02 (PE pipe) shall be followed for all pressure testing. The hydrostatic testing shall be completed after receipt of successful bacteriological test results.
- B. The test pressure shall not exceed pipe and/or thrust resistant design pressures. The test pressure shall not vary by more than plus or minus 5 psi for the duration of the test.
- C. All newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the point of testing or 50 psig whichever is greater.

PART 2 EXECUTION

2.01 Pressurization

- A. 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 Engineer. The pump pipe connection and all necessary apparatus, including gauges and meters shall be furnished by the Contractor. Before applying the specified test pressure, air shall be expelled completely from the test section. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at all points so that the air can be expelled as the section 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 in place at the direction of the Engineer.
- B. 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 approved by the Engineer and the test shall be repeated until it is satisfactory to the Engineer.
- C. Pressure test shall be maintained for a minimum of 2 hours.

- D. HDPE testing shall be conducted in phases as required by ASTM F2164. When the test section is completely filled and purged of air, the pressure shall be gradually increased to the required test pressure. Make-up water shall be added as necessary to maintain maximum test pressure for four (4) hours.

2.02 Leakage Test

- A. After the completion of the pressure test a leakage test shall be conducted to determine the quantity of water lost by leakage under the specified test pressure. 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 of the specified test pressure after the pipe has been filled with water and the air has been expelled.
- B. Leakage shall not be measured by a drop in pressure in a test section over a period of time.
- C. No ductile iron 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 tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test, in pounds per square inch (gauge)

- D. No PVC pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{ND\sqrt{P}}{7,400}$$

Where:

- L = allowable leakage, in gallons per hour
N = number of joints in length tested
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test, in pounds per square inch (gauge)

- E. No leakage will be accepted for HDPE pipe system during the one (1) hour test phase following the four (4) hour pressurization. The one (1) hour test shall be conducted after reducing initial pressure by 10 psi.

2.03 Acceptance

- A. Acceptance shall be determined on the basis of allowable leakage. If any test of laid pipe discloses leakage greater than that specified, the Contractor shall at his own expense, locate and make approved repairs as necessary until the leakage is within the specified allowance.
- B. All visible leaks are to be repaired regardless of the amount of leakage. All flanged pipe shall be "bottle-tight".
- C. If the section under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

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(SECTION WM 16)

VALVES, GATES AND HYDRANTS

PART 1 GENERAL

1.01 Description

- A. The Contractor shall furnish and install all valves, gates and hydrants as specified and as shown on the plans. This shall include all valve boxes, stems, valve operating stand, motor actuators, etc. as necessary for a fully functional installation.

1.02 Quality Assurance

- A. Codes and Standards
 - 1. All codes and standards shall be as set forth in the latest ASTM and AWWA Standards.

1.03 Submittals

- A. Shop Drawings
 - 1. Prior to ordering valves, gates or hydrants submit shop drawings to the Engineer for approval. All submittals shall include certification of conformance with the applicable ASTM or AWWA Standards. No valve, gate or hydrant shall be installed prior to shop drawing approval.

PART 2 PRODUCTS

2.01 Gate Valves

- A. Double Disc
 - 1. Gate valves shall conform to the latest specifications for valves of the American Water Works Association, AWWA Designation C500, so far as they apply, except as otherwise specified. Gate valves shall be of a design and construction for a working pressure of not less than 200 pounds per square inch (psi) for 2" through 12" and 150 psi for 14" and greater, and shall be tested for a water pressure of not less than one hundred fifty percent (150%) of the working pressure.
 - 2. Gate valves four (4) inches in diameter or larger shall be of the double disc type with bronze seats, ductile iron body and removable cast iron bonnets. All such valves shall be entirely bronze-mounted and bronze-faced. Unless otherwise specified all valves four (4) inches and larger shall be of the non-rising stem type.
 - 3. Valves in open chambers or buildings shall be equipped with handwheels unless otherwise shown, specified or required. Where shown or specified,

valves shall be provided with extension stems, operating nuts and tee handle wrenches.

4. Buried valves shall have mechanical joint ends.

B. Resilient Seated

1. Valves shall be designed for a water working pressure of not less than 200 pounds per square inch. Valves shall conform to the latest revision of American Water Works Association Standard C-509 covering resilient seat gate valves (Standard Wall/Cast Iron or Cast Iron). All valves must have a full round, smooth unobstructed oversized flow way which shall be at least as large as the connecting pipe inside diameter.
2. Valves shall have mechanical joint ends as required for buried piping. Gate valves shall have a clear waterway free of pockets, cavities and depressions, and shall accept full size tapping cutters.
3. The wedge shall be of cast iron (solid) completely encapsulated with EPDM. The EPDM shall be permanently bonded to the cast iron wedge to meet ASTM tests for rubber metal bond ASTM D429.
4. Valves shall be non-rising stem. Stems shall be cast bronze with integral collars in full compliance with AWWA. The stem stuffing box shall be O-ring seal type with one (1) ring located above the thrust collar. The ring shall be replaceable with valve fully open and subject to full rated working pressure.
5. All valves furnished shall open counter clockwise with 2-inch AWWA nuts. Keynuts are to be painted black.
6. The body and bonnet shall be coated with fusion bonded epoxy both interior and exterior. Each valve shall have maker's name, pressure rating and year in which manufactured cast on the body. Prior to shipment from factory, each valve shall be tested by hydrostatic pressure equal to requirement of both AWWA and 500 PSI ULFM requirements.

2.02 Valves Boxes

- A. Valve boxes shall be of cast iron, complete with pavement rings, as applicable, and covers. Cast iron boxes shall be of extension type with screw or slide-type adjustment and with flared base. The minimum thickness of metal shall be 3/16". The word "WATER" or "SEWER" shall be cast in cover, as applicable. Boxes shall be installed over each buried valve unless otherwise shown on the drawings. The boxes shall be of such length as will be adapted, without full extension, to the depth of cover required over the pipe at the valve location. A keynut extension shall be installed if the valve nut is greater than 4 feet in depth.
- B. Valve boxes shall be carefully installed and supported in a manner that will not allow surface loads to be transmitted to the valve or pipe. Care shall be taken to

see that the bottom of the box is clear and free of debris, rocks, etc., which will interfere with the operation of the valve stem.

- C. In paved areas, all valve boxes shall be provided with an internal debris cap as manufactured by SW Services, Pollardwater, or equal.

2.03 Plug Valves

A. Ballcentric and/or Eccentric Valves

1. Ballcentric and/or Eccentric Valves shall be the non-lubricated resilient seating type. The valve manufacturer shall have completed proof of design test for two (2) way valves as specified under AWWA C517 and shall furnish or have on file with the engineers, certified copies of these tests. The design of two (2) way valves shall be such that they shall be capable of providing drip tight shut-off with pressure applied from either direction with proper torque applied to maintain the rotating element (plug) in the seated position. The laying length of flanged two (2) way valves twelve (12") inches and smaller shall be as listed in MSS Specification SP-70, for valves fourteen inches (14") and larger shall be manufactured standard. The laying length of three (3) way and four (4) way valves shall be as listed in ANSI Specifications B16.1, Class 125, Table 6, for tees, crosses, and rotating element (plug) shall be single or double style as required for the service.
2. The valve body, bonnet and rotating element (plug) shall be fabricated of cast iron ASTM A126 Class B unless noted otherwise. Valve body and bonnet thickness and flanged end connection shall conform to ANSI B16.1 Class 125 or 250 or be Victaulic grooved as required for the service. The body port area of all valves shall be not less than eighty one percent (81%) of the area of the nominal pipe size, and valves twenty inches (20") in diameter and smaller shall be capable of passing a hard sphere whose diameter is equal to eighty one percent (81%) of the nominal valve size. Valve body seats shall be corrosion resistant nickel welded or mechanically retained in the body. The body and bonnet shall be provided with permanently lubricated, radial journal bearing of porous series 316 stainless steel. Thrust bearing shall be provided to support the closure element fabricated of Series 300 stainless steel and a Teflon backing ring at the operating shaft journal. The rotating element shall be of Buna N unless noted otherwise for the service. The stem seal shall be replaceable without removal of the valve bonnet and shall be the self-adjusting wear compensating multiple U cup, Chevron type of Buna N or double O-Ring. Thrust bearings of Teflon and stainless steel shall be provided.
3. "O" rings shall be contained in a replaceable cartridge.
4. The body port area of rectangular and/or oval ported eccentric seating valves shall be equal to or greater than the nominal connecting pipe area and be capable of passing a hard solid sphere with an outside diameter equal to seventy-five (75%) percent of the nominal pipe diameter without interference from the closure element.

5. Each lever operated valve shall be furnished with a standard length lever or wrench which is removable except that the lever for valves three (3) inch size and smaller may be of non-removable type. Each chain operated valve shall be furnished with double end chain wrench and galvanized iron chain of sufficient length to fit the installation conditions for valves 7 ft. or more above finished floor. Buried valves shall have operating stem to ground level.
6. All plug valves 8-inches and larger shall have an enclosed rotary gear actuator. All plug valves smaller than 8-inches shall have an integral lever or a square nut for wrench or chain lever operation. The actuators shall comply with the latest revision of the applicable AWWA Specification and the following specifications:
 - a. Enclosed Rotary Gear Actuator and Gearing
 - 1) The actuator shall be a worm and gear, single reduction design with provision for input, spur or bevel gear assemblies to meet the given rim pull or input torque requirement. The input shaft of the manual shall be hardened alloy steel. The worm shall also be hardened alloy steel, and the mating worm gear shall be alloy bronze, accurately cut by hobbing machines, and the combination of these shall be self-locking. All gearing shall be grease lubricated at the factory. Ball or roller bearings shall be used to provide smooth rotation of the worm shaft.
 - 2) The gear actuator shall be sized to provide bi-directional shut-off at the maximum operating pressure with a maximum pull of eighty pounds (80 lbs) on the rim of the hand wheel or chain wheel, or a maximum input torque of one hundred fifty foot-pounds (150 lbs) at the operating nut.
 - 3) All actuators shall be provided with a pointer assembly for valve position indication, except when used for buried service.
 - 4) All actuators shall be readily field adaptable to motor operation without disassembly of the manual actuator.
 - b. Enclosures
 - 1) The actuators shall meet weatherproof, submersible, or buried service conditions as required. In no case shall actuators designed for submersible service be rated for less than 50 feet of head for 72 hours. Buried service and submersible actuators shall be built with corrosion resistant input shaft and hardware.

- c. Mechanical Stops
 - 1) An integral adjustable mechanical stop device shall be provided to prevent over-travel. The stops shall allow valve travel of 90 degrees, with a minimum adjustability of ± 5 degrees at each end of travel. All stops shall be of steel material.

2.04 Check Valves

- A. Cushioned Swing Check Valves
 - 1. Cushioned swing check valves shall be a single disc valve with an adjustable weight and lever. A cushion cylinder assembly shall be externally attached to the side of the valve body.
 - 2. Materials of valve components unless otherwise designated, shall be:
 - a. Body, cover, disc, levers, and disc-arm: Cast Iron (ASTM A126 Class B) or cast steel (ASTM A216 Grade WCB)
 - b. Body seat ring: Bronze (ASTM B62) or stainless steel (ASTM 157 C-9)
 - c. Disc seat ring: Buna-N (80 durometer) if metal-to-metal seating is used, disc seat ring shall be compatible for use with body seat ring
 - d. Gasket: Buna-N or composition
 - e. Pivot shaft: Stainless Steel Type 303\
 - f. Stuffing box packing: Composition
 - 3. Valve body shall withstand the system line pressure designated and the flanges shall conform in dimensions and drilling to ANSI B16.1.
 - 4. The cushion cylinder shall be an hydraulic oil medium type with an accumulator and interconnecting hydraulic tubing. The cushioning action shall be adjustable by an integrally mounted adjustment device on the cushion cylinder or by an inline device in the closed loop hydraulic circuit. Air cushioned swing check valves with needle valve are also acceptable.
- B. Rubber Flapper (sewage and sludge)
 - 1. Rubber flapper swing check valves shall have a heavily constructed cast iron body and cover meeting ASTM A-48, Class 30. The body shall be long pattern design (not wafer), with integrally cast-on end flanges. The flapper shall be Buna-N having an "O" ring seating edge and be internally reinforced with steel.

2. Flapper to be captured between the body and the body cover in a manner to permit the flapper to flex from closed to full open position during flow through the valve. Flapper shall be easily removed without need to remove valve from the line. Check valves to have full pipe size flow area. Seating surface to be on a 45 degree angle requiring the flapper to travel only 35 degrees from closed to full open position for minimum head loss and non-slam closure.
3. Buna-N flapper shall have an elastic spring, molded internally, to assist the flapper to close against a slight head to prevent slamming.
4. The valve shall be designed for 175 PSI working pressure for water or sewage. When the check valve is for buried service, stainless steel bolts shall be furnished.
5. Each check valve shall have an external backflow device.
6. Rubber flapper check valves shall be used on all raw wastewater and sludge applications unless otherwise noted on the drawings.

C. Wafer Style Check (Water)

1. The valve shall be a direct acting wafer style (flangeless) swing check valve. The valve shall be spring assisted to close and closure shall be positive and drip tight. The valve shall have only one moving part. The seat material shall be resilient viton rubber located on the valve body away from the flow and replaceable. The clapper and spring shall be stainless steel. Minimum pressure rating shall be 250 psi. Valve body shall be cast iron ASTM A-48.

D. Wafer Style Check (Air)

1. The valve shall be suitable for mounting between 125 lb. class flanges. Valve shall have a cast iron body and shall be springless and seatless. Sealing members shall be silicone suitable for service to 500°F.

E. Swing Check

1. Swing check valves shall be a single disc valve with an adjustable weight and lever for horizontal applications in compliance with applicable parts of AWWA C508.
2. Swing check valves on vertical applications shall be gravity operated.
3. Lever and weight shall be adjustable for variable closure force.
4. Rubber seats shall be provided.

2.05 Lubricated Plug Valve (Gas Lines)

- A. Lubricated plug valves shall be the cylindrical, parallel seat, Milliken design. The valve body (including end connections), rotating element (plug), and bottom cover (bonnet), shall be designed and rated in accordance with the applicable M.S.S. and/or A.P.I. and/or A.N.S.I. Standard(s) as required for the class, service, and materials of construction.
- B. Valves shall be used only on digester gas and/or natural gas pipe lines and shall have G.G.A. and/or U.L. listing and/or be F.M. approved for the service.
- C. The body, plug, and bottom cover of ANSI B16.1 and B16.1 Class 125 and 250 valves, unless noted or otherwise required for the service, shall be fabricated of cast iron (CI) ASTM A-126 Class B and/or ductile iron (DI) ASTM A-395. The body, plug and bottom cover of ANSI B16.5 Class 150 thru 900 valves, unless noted or otherwise required for the service, shall be fabricated of cast steel (CS) ASTM A-216 Grade WBC, forged carbon steel ASTM A-105 Grade 2 and/or Alloy Steel API 6A Type 2 as required for the service. The stem seal shall be reinforced tetrafluorethylene fluorocarbon (TFE) or other material suitable for the service.
- D. The valve lubrication system shall be designed to accept both stick and gun lubrication, and be provided with a leak proof, spring loaded ball check, to retain lubricant and prevent product leakage. A minimum of ten (10) sticks of lubricant (suitable for the service) shall be provided with each valve.

2.06 Butterfly Valves

- A. Standard Valve
 - 1. All butterfly valves shall be of the tight-closing rubber seat type, and shall comply with AWWA Specification C 504, Latest Revision.
 - 2. Bodies of all valves furnished shall have flanges drilled for ASA B 16.1, one hundred twenty-five (125) pound standard or mechanical joint per ANSI A21.11. The bodies shall be of cast iron ASTM A 126, Class B.
 - 3. All shafting shall be of 18-8 stainless steel, Type 304 and have a minimum size as specified in Table 3 of AWWA Specifications, C 504.
 - 4. Provide thrust bearing to hold the valve disc securely in the center of the valve seat regardless of valve position.
 - 5. The valve discs shall be of cast iron ASTM A 48, Class 40 or ductile iron ASTM A-536, and shall seat in the rubber lining.
 - 6. Interior wetted ferrous surfaces shall be coated with epoxy paint in conformance with AWWA C550.
- B. Butterfly Valve Operators
 - 1. Operators shall comply with AWWA C 504.

2. Electric Operator. Electric motor driven valves shall have an a operator capable of transmitting to the valve shaft the torque specified for this class of valve. The electric operator shall be equipped with a 120 volt, 60 cycle, single phase, explosion-proof motor capable of producing the necessary torque at the required time cycle of valve operation. Operation time from full-open to the full-closed position shall be thirty (30) seconds, unless noted otherwise. A pair of limit switches and a pair of torque switches shall be provided. All gear directly associated with the electric motor drive or the valve operator shall be totally enclosed and operate in a lubricating bath. Provision shall be made for manual operation in case of power failure.
 - a. Limit switches shall be provided where required. Switches shall operate on 115 volts and be housed in a NEMA Type IV enclosure.
3. Pneumatic Operator. Pneumatic cylinders shall be of such size as to transmit, as a minimum, the torques as calculated in Appendix A of AWWA C 504 for the required size and Class of valve. Cylinder shall be designed for an operating air supply of 60 psi in response to a 3-15 psi air signal, unless noted otherwise.
 - a. Cylinder bodies shall be of hard drawn brass with cadmium plated end caps. Cylinder pistons shall be of chrome plated steel with stainless steel rods.
 - b. Provisions shall be made to control the speed of travel of the piston to minimize shock at the end of piston travel.
4. Hydraulic Cylinders. Cylinder bodies shall be of a low-zinc content bronze. Cylinder pistons and head and cap ends shall be corrosion resistant. Cylinder piston rods shall be of stainless steel.

C. Wafer Valve

1. The wafer valve shall meet AWWA C504 standards with a working pressure of 150 psi.
2. Body shall be cast iron ASTM A-126, Class B.
3. Disc shall be cast iron ASTM A-48, Class 40 with stainless steel edge.
4. Stem shall be stainless steel, Type 304.
5. Bearings shall be bronze, oil impregnated.
6. Seat shall be Buna-N with encapsulated steel support ring.

2.07 Mud Valves

- A. Mud valves shall be provided where shown on the plans. Valves shall be flanged frame, non-rising stem with cast iron body, bronze seat and ring, sizes as shown. Provide extension stems, couplings and guides, operating nut and/or handwheel.

2.08 Plastic Valves

- A. Ball Valve

Ball valves shall be PVC or CPVC as required by service. Ball valves shall be Union Type with end connections as required by drawings. Seals shall be Viton or EPDM as required by service with Teflon seats. Valves shall be full port design for low pressure loss and have a fine pitched threaded seal retainer for seat adjustment. Valve seats shall be reversible and self-lubricating. Valve shall be rated to 225 psi.

- B. Ball Check Valve

Ball valves shall be PVC or CPVC as required by service. Ball valves shall be Union Type with end connections as required by drawings. Seals shall be Viton or EPDM as required by service with Teflon seats. Valves shall be full port design for low pressure loss and have a fine pitched threaded seal retainer for seat adjustment. Valve seats shall be reversible and self-lubricating. Valve shall be rated to 225 psi. Seat O-ring shall be square cut for positive sealing.

- C. Wafer Butterfly Valve

Butterfly valves 1-1/2" through 8" shall be wafer type single piece body design rated at 150 psi bubble tight shut off. Valve body shall be molded of PVC (Polyvinyl Chloride) with disc molded of Polypropylene or PVC as required. The shaft shall be 416 stainless steel and blow out proof. Liner and O-ring seals shall be EPDM Viton or Nitrile as required by service. The liner shall have a V-notch retention design and an integrally molded flange face seal. Valves 1-1/2" through 8" shall have a plastic molded lever assembly.

2.09 Floor Stands

- A. Floor Stands for valves, sluice gates and regulating or control valves, shall be wheel operated or gear type stands, as shown on the plans. They shall be of approved design suitable for operating the valve or sluice gate to which they are attached.
- B. The direction of operation of the handwheel type floor stand shall be counterclockwise for opening. The stand shall be approximately thirty-six (36) inches high and shall be of the stationary stem type with indicator unless otherwise specified. The operating stem shall be made of bronze. The stands shall be made of the best quality cast iron with smooth exterior surfaces. The stands shall be cleaned and painted before leaving the shop.

- C. All exterior rising stem type floor stands or stands exposed to the weather shall be provided with a clean plastic pipe weather proof housing secured in place over the rising stem which will protect it from dust, dirt and ice and still make it possible to see the position of the top of the gate stem.
- D. Floor stands shall be solidly and accurately set to center over the valve or sluice gate. They shall be securely bolted down to the floor with anchor bolts.

2.10 Pressure Relief Valves

- A. Scope:
 - 1. Tank Pressure Relief Valves shall be installed as shown on the drawings to prevent sub-grade concrete tanks from becoming buoyant and floating from hydrostatic pressure, or to prevent damage to the tank side walls. A pocket of clean crushed stone approximately 3/4" to 2" in diameter should be placed at the external port of the Wall Pipe or Floor Valve. The cover shall open when the external pressure exceeds internal pressure by approximately 5" of head, so that pressure will be equalized on the inside and outside of the tank. All valves shall be cast stainless steel, type 316. Wall pipes for wall type valves shall be ductile iron, unless otherwise required as stainless steel.
- B. Wall Type Pressure Relief Valves:
 - 1. Wall Type Pressure Relief Valves shall have a removable strainer retained in the valve. Pressure Relief Valves without strainers or with strainers in the Wall Pipe are not acceptable. Wall Pipe shall have bolt holes tapped for studs, to allow for flush mounting of the valve to the tank wall. Flange on both Wall Pipe and Wall Valve shall comply with ANSI Class 125 for outside diameter, bolt circle and number of bolts. Flange thickness for 4" valves shall be a minimum of 7/16"; 6" valves shall be a minimum of 1/2". Hinge pin connecting the body and lid shall be made of stainless steel. Hinge pins of bronze are not acceptable.
- C. Floor Type Pressure Relief Valves:
 - 1. Floor Type Pressure Relief Valves shall have an integrally cast collar. The lid shall have locking lugs to prevent separation from the valve body. Floor type valves shall have a removable strainer. The length of floor type valves shall be extended with the use of C900 PVC Pipe, having the same OD as ductile iron pipe. The C900 Pipe shall be securely retained by a "Reiber Style, Angled Gasket" inside the casting. O-Rings are not acceptable for retaining C900 PVC Pipe.
- D. Seals:
 - 1. Seals on both body and lid shall be Neoprene, 40 durometer and be field-replaceable. The surfaces on the body and lid where the seals are installed must be machined to insure an overall flush and parallel seating surface. Seals shall be the QuadroSeal "wrap-around" design that surrounds body

and lid on four sides to prevent separation. In addition, seals shall be bonded to body and lid with an adhesive sealant. Designs which rely solely on adhesive are not acceptable.

2. The seals shall be secured to the valve body and lid at their outer perimeters to assure adequate sealing contact. Designs that retain the seal to the lid by means of a screw in the center of the lid are not acceptable.

E. Manufacturer:

1. Tank Pressure Relief Valves shall be QuadroSeal as provided by Trumbull Industries, Youngstown, Ohio.
2. Alternate Products: The use of other than the manufacturer specified above is allowable providing such materials have been accepted in writing by the Engineer as an approved equivalent. Written approval of alternate manufacturers is required prior to award of the project to the Contractor.

F. Execution:

1. Pressure relief valves shall be installed in accordance with the manufacturer's recommendations.
2. A pocket of clean crushed stone approximately $\frac{3}{4}$ " to 2" in diameter shall be placed at the external port of the wall pipe or floor valve. See typical pressure relief valve details for additional information.
3. Upon completion of all work and prior to filling the tanks with water for testing, the pressure relief valves shall be checked to see that they are operating freely and will close securely.

2.11 Heavy Duty Sluice Gate with Resilient Seats

A. Scope

This section covers all heavy duty sluice gates required on the project. Each gate shall be furnished and installed complete with wall thimble or anchor bolts, operating stem, gate lift operator and other appurtenances as specified or needed to make a complete and operable installation.

1. Performance

The resilient sluice gates must meet the performance requirements of AWWA C-501 (latest revision). The resilient seated sluice gate must be able to withstand 25 feet seating, and 25 feet unseating head.

2. General

Gates, stems, lifts and other appurtenances shall be the size, material and construction as shown on the drawings and specified herein. Gates shall meet the requirements of AWWA C-501 (latest revision), with the exception

of the seats, as modified per these specifications. All component parts shall be of the type of material shown, and interchangeable where size and material are the same without grinding, chipping or special fitting in the field. All mating and sliding metal parts shall be fully machined. All sluice gate parts, including lift, shall be designed for the heads shown with a minimum safety factor of five. All materials used in the construction of the gates and appurtenances shall be the best suited for the application.

3. Frame and Guide Rails

The frame and guide rails shall be cast one-piece construction or may have guides troweled and bolted to the frame. Frames shall be standard or extended flange type with round or rectangular opening as indicated on the plans and in the sluice gate schedule. Frames shall be of flush bottom design with a resilient seal attached to the frame so that it is flush with the invert. The frame shall be provided with cast-on pads which shall be machined, drilled, and tapped for the mounting of the wedge devices. The back of the frame flange shall be machined to a plane and drilled to match the wall thimble, pipe flange, or anchor bolt pattern. Guide rails shall be of such length as to retain at least one-half of the vertical height of the slide when it is in the fully opened position. A groove running the full length of the guide rail shall be accurately machined to receive the slide tongue with a nominal clearance of 1/16 inch.

4. Cover or Slide

The cover shall be of one piece cast construction with vertical and horizontal ribs, a reinforced pocket to receive the thrust nut, and pads to receive the wedges. All wedge pads shall be machined, drilled and tapped to receive the wedge devices. The cover shall have fully machined tongues running the full length of each side to properly engage the guide rail grooves. A thrust nut shall be provided to attach the slide to the stem. The nut shall be threaded and in the case of rising stems, provided with keys or two set screws locked into indents in the stem to prevent rotation of the stem. For non-rising stems, the stem shall turn freely in the thrust nut to open and close the slides as the stem is rotated.

5. Seating Faces

Seats shall be of a resilient material which is both abrasion and corrosion resistant. The seat material on both the frame and the cover (slide) shall be permanently attached.

6. Wedges

All wedges and wedge blocks shall be solid corrosion resistant material and shall be of sufficient number to provide a practical degree of watertightness. All wedge bearing surfaces and contact faces shall be machined to maximize contact and wedging action. Wedges shall be fully adjustable, but once set shall not rotate or move from the desired position. All fasteners and adjustment screws shall be corrosion resistant.

7. Testing, Shop

The gate shall be adjusted so that the seats are slightly compressed and there is no clearance at any point between frame and cover seating surfaces.

8. Wall Thimbles

Wall thimbles shall be heavy, one piece castings. The front flange shall be machined to a plane and shall be drilled and holes tapped to mate the drilling pattern of the gate frame. Holes shall be plugged as to prevent concrete from intruding into threaded area. The vertical centerline shall be clearly shown by permanent marks at the top and bottom of the machined face. The work "top" shall be marked permanently near the top centerline of the thimble opening. The surfaces to be cast into the concrete shall be free of paint, oil and grease. Corrosion resistant studs and nuts shall be provided for attaching the gate. Mastic shall be used to form a seal between the front face of the thimble and the back of the gate frame. Stainless steel anchor bolts shall be used.

2.12 Slide Gates

A. Description

Slide gates shall be either self-contained with yoke and bench stand actuator, or standard design with separate stem guides and wall bracket or floor stand mounted gate lift.

1. Slide gates shall be designed for the seating and unseating head as required by application and as shown on the drawings.
2. Slide gates shall be either standard or downward opening weir design as required by the drawings.

B. Construction

1. Frames and slides shall be aluminum ASTM B204 and ASTM B211 Alloy 6061-T6.
2. Rails and yokes shall be aluminum ASTM B209 and B211 Alloy 6061-T6 or B211 Alloy 6063-T5.
3. Fasteners and anchor bolts shall be stainless steel ASTM A193 18-8 or A276 Type 304 or 316.
4. Stems shall be stainless steel ASTM Type 304 or 316.
5. Flush bottom seals and "J" bulb seals shall be neoprene (CR), ASTM D-2000 BC610-615 or other suitable composition for extended use in water and sewage.

6. Frame and Guides

- a. The gate frame shall be a rigid, welded unit, composed of guide rails, cross bars, invert of top seal support housing (on gate with resilient seals) and head rails (self-contained only) with a clear opening the same size as the waterway, unless otherwise specified.
- b. The frame, guides, yoke and cross bars shall be capable of withstanding the thrust forces created during seating and unseating of the gate against the hydraulic head without exceeding one fifth (1/5) the tensile strength or one third (1/3) the yield of the materials and the deflection shall not exceed the lesser of 1/360 of the span or 0.25 inches.
- c. Frame shall be flatback, spigotback or embedded type as required or as shown on the drawings.
- d. All surfaces in contact with concrete shall be provided with an asphaltum varnish or bituminous coating not less than seven (7) mils thick.
- e. The guide frame shall incorporate a dual slot.
- f. The primary slot of the guide frame and all cross bars shall be provided with high density (linear) polyethylene (HDPET) bearing bars to support and guide the slide gate plate (disc) unless noted otherwise.
- g. The secondary slot will allow the slide gate plate reinforcing structural members to be extended to the edge of the primary guide slot.
- h. The guides shall be of sufficient length to insure the support of not less than two thirds (2/3) of the height of the slide gate plate (disc) when the gate is in the full open position.
- i. The guides, or self contained slide gates, shall have sufficient cross section to withstand all the hydraulic and dynamic load imposed by the yoke.
- j. The yoke shall be fabricated of structural aluminum members welded or bolted to the top of the guides and the design shall allow the removal of the slide gate plate (disc) and stem without removal of the yoke.

C. Slide Gate Plate (Disc or Weir)

- 1. The slide gate plate (disc or weir) shall be reinforced and the deflection under the rated head of the gate shall not exceed the lesser of 1/360th of the span or a maximum of 0.25 inches.

D. Stem Connection

1. The stem connection shall be either the clevis type with structural members welded to the slide gate plate (disc or weir) with a series 300 stainless steel pin or bolt to act as a connector, or a bronze thrust nut supported in a weld nut pocket.

E. Stem

1. The stem shall be sized to withstand the thrust or torque developed by the lift or gear actuator with an input torque of one hundred (100) foot pounds.
2. The unsupported length (L) to radius of gyration (r) L/r of the stem shall not exceed 200.

F. "J" Bulb Seals (JBS)

1. "J" bulb seals (JBS) shall be mounted either on the frame or gate slide plate (disc), but the seal shall not protrude into or reduce the specified opening.
2. Anchor and Assembly Bolts or Studs
 - a. All assembly bolts, nuts, washers and including anchor bolts shall be stainless steel ASTM A193, 18-8 or ASTM A276 Type 304 or 316.

G. Actuators and Accessories

1. General

- a. Actuators and accessories (gate lifts, gear actuator, hand cranks, etc.) shall be furnished as required.

2. Direct Manual Actuators

- a. Manual actuators, lift nut or gear type shall be sized for a maximum input torque of fifty (50) foot pounds.
- b. Handwheel type lifts shall be without gear reduction.
- c. Gear type lift actuators may be either single or double reduction type depending on the lift or torque requirements.
- d. Lift nuts shall be ASTM B584 Alloy 865.
- e. Lift nuts on rising stem valves shall be flanged and be supported on non-metallic thrust washers, roller or ball bearing, sized to take the thrust and lift loads during operation.

- f. All gears shall be fabricated of bronze, steel or ductile iron with machine cut teeth. The gear housing shall be weather proof construction, fabricated of cast iron ASTM A126 Class B, or equal. The housing shall be provided with lubrication fittings to permit lubrication of all gear and bearings.
- g. Rising stem actuator shall be provided with a stem cover of clear plastic with an indicator strip.

3. Motor Driven Actuator

- a. Operators shall be floor stand or frame mounted. Gear reduction shall be fully enclosed with mechanical seals around the operating nut and around the pinion shafts.
- b. All pinion shafts shall operate on roller bearings.
- c. Units shall be interconnected by means of steel tubing or shafting with flexible couplings at each connection.
- d. Motor drives shall be mounted between the interconnected operators or at either end of the shaft. The unit shall include electric 260/460v motor drive reduction gearing. Drive shall include limit and torque switches, emergency handwheel with declutching device, and reversing controller.
- e. Drive shall be designed for local operation. The local control station shall be housed in a NEMA 4 enclosure and include hand-off auto switch, pushbutton station with indicating lights.
- f. For other service conditions see Section 2.13.4.

2.13 Actuators and Accessories

- A. Actuator and accessories (i.e. cylinders, diaphragms, motors, gears, limit switches, extensions, pilots, etc.) shall be furnished and mounted as herein specified and as required by the drawings.
- B. Manually Lever Actuated — Direct manually actuated valves eight inches (8") and smaller shall be supplied with an integral lever or a square nut for wrench or chain lever operation.
- C. Manually Gear Actuated — Direct manually actuated valves ten inches (10") and larger, and all four inch (4") and larger valves installed as the first isolation (shut off) valve on the discharge of pump, shall be provided with an enclosed rotary gear actuator. Gear actuator shall be sized to provide bi-directional shut off at the maximum operating pressure with a maximum pull of eighty pounds (80#) on the rim of the hand wheel or chain wheel, or a maximum input torque of one hundred fifty foot pounds (150'#) at the operating nut.

D. Electric Motor Actuators

1. Electric motor actuators shall be furnished and constructed in accordance with ANSI/AWWA C540 except as hereinafter modified.
2. The actuator shall include a position indicator.
3. The controls for manual positioning shall include, but not be limited to, the reversing starters (with overload protection), control power transformer, local remote selector switch, open-stop-close push buttons and position indication lights, as specified under AWWA C504 (Section 3.14.1, parts 1 thru 4).
4. The controls for modulating service shall be as listed in AWWA C504, Section 3.14.2, parts 1 thru 4, and be compatible with the controller and control loop response requirements. A position potentiometer, independent of feedback potentiometer (in the case of modulating service), shall be supplied for each control valve. It shall be mechanically driven by gearing from the valve stem and in step at all times whether the unit is being electrically or manually operated.
5. All actuators shall be shop-wired as specified in AWWA C504, Section 3,14.4, Wiring.

2.14 Stop Gates

A. FRP Gates

1. All stop gates should be molded of fiberglass reinforced polyester to the exact size as indicated on the drawings, assuring resin rich sealed edges. Both sides of the plate shall be faced with a ten (10 mil) C-veil and finished smoothed with a layer of ultraviolet inhibited resin.
 - a. Deflectors shall be limited to no more than 1/360 of the plate width at maximum aerating head. Stop plates shall be laminated with a sandwich center core having a high density polyurethane, closed cell foam for high rigidity, high strength and water resistant integrity.
 - b. Stop plates shall be manufactured in accordance with the applicable portion of NBS15-69 and ASTM C-582 and inspected in accordance with ASTM D-2563.
 - c. Frames shall be constructed of the same material and shall have a embedded flush bottom seal of neoprene rubber.
 - d. Each gate should be furnished with a heavy duty handle of cast aluminum alloy 356-T6 with a clear opening of 4" x 2" where required by the drawings.

B. Aluminum Stop Gates

1. Guides shall be of extruded aluminum. The invert of the frame shall be an angle welded to the bottom of the frame. A neoprene seal shall be attached to the angle and held in place with a bolted retainer bar. The guides shall be designed for maximum rigidity and shall have a weight of not less than four pounds per foot for face mounted gates and two and one-half pounds per square foot for channel mounted and embedded frame gates.
2. The disc or sliding member shall be of aluminum plate reinforced with "U" shaped aluminum extrusions welded to the plate not more than 16" apart.
3. The disc shall not deflect more than 1/360 of the span of the gate under the design head.
4. Single pipe reinforced handles shall be provided for gates up to 3 feet in width. Dual handle shall be provided for gates over three feet in width. Special pipe extensions handle available on request.
5. All parts of the gate shall have a minimum thickness of 1/4 inch. Guide frames assembled from aluminum plate or structural shapes or which require field welding are not acceptable. All necessary fasteners and anchor bolts shall be furnished by the slide gate manufacturer.
6. Materials:

<u>Components</u>	<u>Material</u>	
Frames - Disc - Invert:	Aluminum 6061-T-6	ASTM B-209 ASTM B-211
Fasteners & Anchor Bolts:	Stainless Steel Type 304	ASTM A-276
Invert Seal:	Neoprene	ASTM D-2000

Finish: Mill finish on aluminum. Provide bitumastic paint on all surfaces adjacent to concrete.

2.15 Hydrants

A. Yard Hydrants

Install where shown on the plans a 1-1/4" freezeless yard hydrant with a brass nozzle (3/4 IPS). Each hydrant on non-potable water systems shall have a 3" x 6" metal or FRP sign securely attached to it with the phrase "NON POTABLE WATER" permanently and clearly printed in black letters on a white background.

Hydrants shall be Woodford Model Y-1, Water Source LLC, or equal.

B. Fire Hydrants

1. The fire hydrants shall be 5 ¼ inch (main valve opening) with 6 inch auxiliary valve and connection pipe with breakoff flange and coupling assembly. The fire hydrants shall have two (2) 2 ½" hose nozzles and one (1) 4 ½" pumper nozzle threaded to meet the requirements of the local Fire Department. Nozzle caps shall be equipped with chains. All fire hydrants shall be arranged for operation with operating nut of size and shape which is the same as that of the existing fire hydrants, or as specified by the local Fire Department. Pumper nozzle shall have a nominal setting of between eighteen (18) and twenty-four (24) inches above the curb or centerline of road, and if necessary, the Contractor shall furnish extensions. Hydrant color shall be per the Owner's request.
2. Hydrants shall have 6 inch mechanical joint inlets and auxiliary gate valves shall be mechanical joint.
3. Hydrant barrels shall be constructed in such a manner that it is not necessary to cut off the water or to excavate to make repairs. The barrel of the hydrant shall be constructed in sections which are to be jointed in such a manner that the upper section of the barrel extending above the ground may be separated from the lower, section by impact without injury to the stem or the barrel.
4. The main valve construction at the bottom of the hydrant shall be such as to permit the water to drain from the hydrant barrel when the main valve is closed. The main valve stem seats and packing glands to be of bronze or approved rust resisting metal and to be constructed in such a manner as to be easily replaced without excavating. The main valve facing shall be made of rubber.
5. Hydrants shall be located in such a manner as to provide complete accessibility, and in such a manner that the possibility of damage from vehicles or injury to pedestrians will be minimized. When set in the space between the curb or sidewalk or between the sidewalk and property line, no portion of the hydrant or nozzle cap shall be within six (6) inches of the sidewalk. All hydrants shall stand plumb and shall have their nozzles parallel or at right angles to the curb.
6. Hydrants shall be thoroughly cleaned of dirt and other foreign matter before setting, and the bowl of each hydrant shall be well braced against unexcavated earth at the end of the trench with stone slabs or concrete backing, or it shall be tied to the pipe with suitable rods or clamps. All hydrants are to be properly supported and braced and surrounded with approximately 1/2 cubic yard of washed gravel.

C. Flushing Hydrants

1. Flushing hydrants shall be 2-1/8" size with 3" connection. All working parts of the flushing hydrants shall be brass. Flushing hydrants shall be provided with one (1) 2-1/2" hose nozzle threaded to meet the requirements of the

local Fire Department. Nozzle caps shall be equipped with chains. The flushing hydrant shall be self-draining with non-freeze barrel provided with cast iron top stock. Flushing hydrants shall be as manufactured by Kupferle, Mueller, Kennedy, M & H, or equal.

2. Flushing hydrants shall be 3" mechanical joint inlets and shall be provided with auxiliary 3" M.J. gate valves with box.
3. Hydrant color shall be per the Owner's request.

D. Installation

1. A drainage pocket two feet in diameter and two feet in height shall be excavated above the base of each hydrant. The pocket shall be filled and compacted with coarse gravel or broken stone mixed with coarse sand, under and around the base of the hydrant to a level above the waste opening. No hydrant drainage pocket shall be connected to a sewer.
2. A reaction or thrust blocking shall be provided at the base of each hydrant and shall not obstruct the drainage outlet of the hydrant. The size and shape of concrete thrust blocking and the number and size of restraining rods shall be approved by the Engineer.

2.16 Valve/Gate Tags

All non-buried valve(s) and all gates shall be marked with a brass tag. Each tag shall be minimum of 1" diameter and be stamped with the appropriate identification number provided by the Owner.

(SECTION WM 17)

MISCELLANEOUS PIPE AND FITTINGS

PART 1 GENERAL

1.01 Description

- A. The Contractor shall furnish and install, as required, small pressure and drainage pipe together with all fittings, thrust blocking, service lines or other specials as shown on the plans or specified and, necessary to complete the work, including necessary pipe for purpose of tests. Pipe systems shall be constructed of the pipe materials as specified herein.
- B. All pipe to be furnished under this Contract shall conform to specifications of this section. Actual materials furnished shall be permitted only as indicated in the Detailed Specifications.
- C. Related work described elsewhere:
 - 1. Excavation WM-2
 - 2. Backfill WM-3

1.02 Quality Assurance

- A. Codes and Standards
 - 1. Each length of pipe shall be marked per the requirements of the respective ASTM Standard and/or AWWA.
 - 2. All codes and standards shall be set forth in the latest ASTM and AWWA Standards.
 - 3. Upon request by the Engineer, the Contractor at his own expense, shall furnish copies of all material tests required by the applicable Standards.

1.03 Submittals

- A. Shop Drawings
 - 1. Prior to ordering pipe material, submit shop drawings to the Engineer for approval. All submittals shall include certification of conformance with the applicable ASTM and AWWA Pipe Standards. No field work shall be started prior to shop drawing approval.

PART 2 PRODUCTS

2.01 Pressure Rated PVC (SDR Series 2 ½” and Less Buried Application)

A. Material

PVC pipe shall be rigid polyvinyl chloride pipe in accordance with ASTM D1784 for Type I, Grade I and ASTM D2241.

For diameters of 2 ½” to 1” the pipe shall be made to standard thermoplastic pipe dimension ratio (SDR), Class 26 for continuous pressure rating of 160 psi.

For diameters of ¾” or less, SDR 13.5 shall be used.

B. Fittings

Pipe and fittings shall be jointed with a solvent cement per ASTM D2672 consisting of a viscous, brushable solution of polyvinyl chloride in suitable active solvents. The cement shall be purchased from the pipe manufacturer and used according to the manufacturer’s instructions and shall produce a joint of sufficient strength to permit normal installation handling within five (5) minutes after jointing, when exercising reasonable care.

2.02 PVC (schedule rated) (exposed or buried application)

A. Material

PVC schedule rated piping and fittings shall be either Schedule 40 or 80 as required by the drawings.

Schedule 80 piping shall be in accordance with ASTM D2467, Class 12454 or 11443. Schedule 40 piping shall be in accordance with ASTM2466, Class 12454 or 11443.

Piping carrying potable water shall be certified to NSF Standard No. 14.

B. Fittings

Fittings shall be standard socket type or threaded. Where piping connects to equipment a flange, threaded or union connection shall be used. All threaded connections and fittings shall be in accordance with ANSI B.1.20.1.

2.03 Copper Tubing

A. Material

All copper pipe shall conform to the latest revision of the ASTM “Standard Specification for Seamless Copper Water Tube, Designation B 88”. Tube shall be Type K, soft temper for underground service. Type L hard copper tube shall be used for interior applications involving general plumbing and heating. Type K hard temper shall be used in chlorine rooms.

B. Fittings

Fittings for copper piping shall be extra heavy red brass, carefully manufactured of the proper type and size to make up the necessary connections. All fittings which are used with Type K copper tube shall be of the flared type and all fittings used with Type L copper tube shall be of the solder type, unless otherwise shown or specified.

2.04 Polyethylene Tubing (CTS)

A. Polyethylene Pipe (SDR-PR) service line for water distribution, hereinafter referred to as PE pipe, shall conform to all applicable requirements in the latest revision of ASTM D-1248, ASTM D-2737, ASTM D-3350, and AWWA C-901 standards for copper tube size (SDR-9).

B. Polyethylene extrusion compound from which the polyethylene pipe is extruded shall comply with applicable requirements for PE-4710 ultra-high molecular weight polyethylene plastic material. Material shall be as described in ASTM D-1248 latest revision.

C. The PE pipe shall be rated for use with water at 73.4°F at a hydrostatic design stress of six hundred thirty (630) psi and a working pressure of one hundred sixty (160) psi in accordance with ASTM D-1599.

D. The minimum burst pressure 73.4°F determined in accordance with ASTM D-1599, latest revision, shall be six hundred thirty (630) psi. The time of testing of such specimen shall be between sixty (60) and seventy (70) seconds.

E. PE service pipe shall have the following nominal dimensions and weights:

Nominal Size (inches)	Nominal O.D. (inches)	Approx. I.D. (inches)	Minimum Wall (inches)	Approx. Pounds/100 Ft.
3/4	0.875	0.681	0.097	9.8
1	1.125	0.875	0.125	16.3
2	2.125	1.653	0.236	60.9

F. PE pipe shall be permanently marked indicating nominal size, PE 3408, standard dimension ratio, pressure rating at 73°F, manufacturer's name (or trademark), date, code, appropriate ASTM designation, and the NSF-pw seal indicating approval for potable water.

G. PE pipe shall be homogenous throughout and free of visible cracks, holes, foreign inclusions or other defects. It shall be uniform in color, capacity, density and other physical properties.

H. PE pipe shall be as manufactured by Phillips Drisco Pipe, Inc., Richardson, TX, Crestline Plastic Pipe Co., Inc., or approved equal.

I. The Contractor shall furnish a certification from the manufacturer of the pipe that the manufacturer is fully competent and capable of extruding PE pipe of uniform

texture and strength to fully comply with the properties and ASTM specifications listed and further that the pipe for this project will be manufactured.

- J. The service line shall include a #12 locating wire installed with it for future location.

2.05 Polyethylene (PE) Service Pipe (IPS)

- A. Polyethylene Pipe (SDR-PR) service line for water distribution hereinafter referred to as P.E. pipe shall conform to all applicable requirements in the latest revision of ASTM D-1248, ASTM D-2737, ASTM D-3350 and AWWA C-901 standards for iron pipe size (SDR-7).
- B. Polyethylene extrusion compound from which the polyethylene pipe is extruded shall comply with applicable requirements for PE-3408 ultra-high molecular weight polyethylene plastic material. Material shall be as described in ASTM D-1248 latest revision.
- C. The PE pipe shall be rated for use with water at 73.4°F at a hydrostatic design stress of six hundred thirty (630) psi and a working pressure of one hundred sixty (160) psi in accordance with ASTM D-1599.
- D. The minimum burst pressure at 73.4°F determined in accordance with ASTM D-1599 latest revision, shall be six hundred thirty (630) psi. The time of testing of such specimen shall be between sixty (60) and seventy (70) seconds.
- E. PE service pipe shall have the following nominal dimensions and weights:

Nominal Size (inches)	Approx. O.D. (inches)	Nominal I.D. (inches)	Minimum Wall (inches)	Approx. Pounds/100 Ft.
3/4	1.060	0.824	0.118	15
1	1.349	1.049	0.150	25
2	2.657	20.67	0.295	96

- F. PE pipe shall be permanently marked indicating nominal size, PE 3408, standard dimension ratio, pressure rating at 73°F, manufacturer's name (or trademark), date, code, appropriate ASTM designation, and the NSF-pw seal indicating approval for potable water.
- G. PE pipe shall be homogenous throughout and free of visible cracks, holes, foreign inclusions or other defects. It shall be uniform in color, capacity, density and other physical properties.
- H. PE pipe shall be as manufactured by Phillips Drisco Pipe, Inc., Richardson, TX, Crestline Plastic Pipe Co., Inc., or approved equal.
- I. The Contractor shall furnish a certification from the manufacturer of the pipe that the manufacturer is fully competent and capable of extruding PE pipe of uniform texture and strength to fully comply with the properties and ASTM specifications listed and further that the pipe for this project will be manufactured.

- J. The service line shall include a #12 locating wire installed with it for future location.

2.06 Cast Iron Soil Pipe

A. Material

All cast iron soil pipe shall be in accordance with the latest revisions of ASTM Standards Designation A74, and with American Standards Association Specification A40.1 as most recently revised. The pipe shall be of the extra heavy weight and shall be furnished in five (5) foot lengths. All fitting dimensions shall conform to the above standards. All joints shall be of the bell and spigot type. The pipe shall be coated inside and out with coal tar pitch varnish or epoxy.

B. Fittings

Shall be cast iron with push-on joints per ASTM C564 or CISPI 310.

2.07 PVC Waste and Vent Pipe

A. Material

Waste and vent piping shall be Schedule 40 PVC conforming to Commercial Standards CS-272-65 DW and ASTM D2665, "Polyvinyl Chloride Plastic Drain, Waste and Vent Pipe and Fittings".

B. Fittings

Fittings shall be Schedule 40 PVC solvent weld socket type or gasketed push-on type.

2.08 Steel Air Main

A. Stainless Steel

1. All stainless steel pipe shall be 304L material, Schedule 10 minimum in accordance with ASTM A312 for 3" and larger. All welding shall be by the shielded arc, inert gas, MIG or TIG method. Filler wire shall be added to all welds to provide for a cross section and weld metal equal to or greater than the parent metal. Butt welds shall have full penetration to the interior surface and gas shielding shall be provided to the interior and exterior of the joint. Interior weld beads shall be smooth, evenly distributed with an interior projection not exceeding 1/16" beyond the I.D. of the air header or fittings. Fittings shall be 304L conforming to ASTM A403.
2. The outside weld area shall be wire brushed. Brushes shall be of stainless steel and used only on stainless steel. All discoloration and deposits left by welding shall be removed by pickling.

3. After shop fabrication, all stainless steel assemblies and parts shall be passivated by immersion in a pickling solution of 6% nitric acid and 3% hydrofluoric acid at 140°F for a minimum of 15 minutes. Parts shall be free of iron particles or other foreign material. A complete neutralizing operation shall be required by immersion in a tri-sodium phosphate rinse.
 4. Quick coupling flanges shall be nickel plated cast ductile iron with stainless steel hinge pin.
 5. All 304 L material shall conform to the chemical requirements of ASTM 240-72a and AISI304 L except that the maximum carbon content shall be limited to .030%.
 6. Pipe dimensions shall be as shown on the drawings with dimensional tolerances conforming to ASTM 554-72 and ASTM A530-72.
 7. All anchor bolts shall be 303 stainless steel.
 8. All gaskets shall be 45 to 55 durometer (Shore A) neoprene suitable for temperatures to 250°F.
 9. Victaulic grooved fittings shall be 304L conforming to ASTM A403. Coupling shall be style 89 Rigid Coupling with Grade T nitrile gasket for air service up to 230°F.
- B. Carbon Steel
1. All carbon steel pipe shall be Type S, seamless, grades A and B.
 2. All pipe shall be furnished and installed in accordance with ASTM A53 and ANSI B36.10.

2.09 Galvanized Steel Piping

- A. Galvanized steel pipe shall be in accordance with ASTM A120.
- B. Usages shall be limited to potable and non-potable water lines, interior to buildings and basements and valve pits.
- C. Exterior of pipe shall receive one coat of primer in accordance with Workmanship and Materials, Section 32, "Painting".

PART 3 EXECUTION

3.01 Plastic Piping Installation

- A. All buried PVC and polyethylene piping shall be bedded and backfilled in accordance with details of the design drawings and shall include a metallic tracer wire.

- B. Exposed PVC piping shall be provided with expansion joints on long, straight runs to compensate for changes due to thermal expansion and contraction.
- C. Exposed PVC piping shall have supports (ceiling or wall) spaced to prevent any deflection under operating conditions.
 - 1" diameter or less at 4'-0" maximum spacing
 - 1 ¼" diameter or larger at 6'-0" maximum spacing
- D. The interior PVC piping system shall be made a sufficient number of unions to permit breaking of lines at key points for maintenance. Unions shall be located at such points as shown on the drawings or as directed by the Engineer in the field.
- E. Acid resistant PVC drain lines shall be used in lab areas.
- F. Exposed PVC piping shall be painted and labeled in accordance with Workmanship and Materials, Section 25, "Painting" and schedule provided on the drawings.

3.02 Copper Piping

- A. Exposed piping shall have supports (ceiling or wall) spaced to prevent any deflection under operating conditions.
 - 1" diameter or less at 5' maximum spacing
 - 1 ¼" diameter and larger at 8' maximum spacing
- B. Exposed hot and cold water lines shall be insulated with foam type jacket protected with a wrapping or cover system.
- C. Pipes shall be provided with labels for indication of usage.

3.03 Carbon Steel

- A. After welding and field cleaning, the exterior surfaces shall be coated per Workmanship and Materials, Section WM-25.
- B. For air mains, coating shall be suitable for operating temperatures of 120° - 160°F.

3.04 Testing

- A. All pipe systems shall receive a hydrostatic test. Testing shall be in accordance with Section WM-15 of the Workmanship and Materials.

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(SECTION WM 18)

STRUCTURAL STEEL

PART 1 GENERAL

1.01 Description

- A. Extent of structural steel work is shown on the contract drawings, including schedules, notes and details to show size and location of members, typical connections, and type of steel required.

- B. Structural steel is that work defined in American Institute of Steel Construction (AISC) “Code of Standard Practice” and as otherwise shown on drawings.

- C. Source Quality Control: Materials and fabrication procedures are subject to inspection and tests in mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.
 - 1. Promptly remove and replace materials or fabricated components which do not comply.

- D. Design of Members and Connections: Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site whenever possible without causing delay in the work.
 - 1. Promptly notify Structural Engineer whenever design of members and connections for any portion of structure are not clearly indicated.

- E. Related work specified elsewhere:
 - 1. Miscellaneous and Metal and Aluminum Section WM-19
 - 2. Painting Section WM-25

Loose Lintels are furnished under Section WM-19, Miscellaneous Metals.

- F. Work furnished but not installed: Anchor bolts and other embedded connection components.

1.02 Quality Assurance

- A. The latest editions of the following standard specifications shall govern the fabrication and erection of the structural steel, except as modified by the contract drawings or this specification:
 - 1. American Institute of Steel Construction (AISC) “Code of Standard Practice for Steel Buildings and Bridges”:

- a. Paragraph 4.2.1 of the above code is hereby modified by deletion of the following sentence: "This approval constitutes the owner's acceptance of all responsibility for the design adequacy of any connections designed by the fabricator as a part of his preparation of these shop drawings."
 2. American Institute of Steel Construction (AISC) "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings", including "Commentary" and supplements thereto as issued.
 3. American Institute of Steel Construction (AISC) "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
 4. American Welding Society (AWS) D1.1 "Structural Welding Code - Steel".
 5. ASTM A6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use".
 6. Steel Structures Painting Council specifications SSPC.
- B. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".
1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.
 - a. If recertification of welders is required, re-testing will be Contractor's responsibility.
- C. Environmental Standards: Steel primer paint shall comply with provisions of the following:
1. Environmental Protection Agency (EPA) requirements for less than 350 grams per liter of Volatile Organic Compounds (VOC).
- D. Fabricator and erector shall have continuous business operation for at least 5 years and by evidence of past projects indicate capability of conducting work of a similar nature; have sufficient well maintained equipment to perform the work; maintain an adequate stockpile of materials; qualified labor to fabricate or erect without delay the materials required for this project.

1.03 Submittals

- A. Product Data: Submit producer's or manufacturer's specifications and installation instructions for following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).
1. Structural steel (each type), including certified copies of mill reports covering chemical and physical properties.

2. High-strength bolts (each type), including nuts and washers.
- B. Shop Drawings: Submit shop drawings prepared under supervision of a registered Professional Engineer, including complete details and schedules for fabrication and assembly of structural steel members, procedures and diagrams. Fabrication of structural steel members shall not begin until the shop drawings have been reviewed.
1. Include details of cuts, connections, camber, holes and other pertinent data. Indicate welds by standard AWS A2.1 and A2.4 symbols, and show size, length, and type of each weld.
 - a. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as work of other sections.
- C. Test Reports:
1. Submit all test reports regarding welding, bolting, and headed studs per Section 3.03.

1.04 Product Handling

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground using pallets, platforms or other supports. Protect steel members and packaged materials from erosion and deterioration.
1. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Anchor bolts and other anchorage devices which are embedded in cast-in-place concrete shall be delivered to the project site in time to be installed before the start of concrete operations.

PART 2 PRODUCTS

2.01 Materials

- A. Metal Surfaces, General: For fabrication of work which will be exposed to view, use only materials which are smooth and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names and roughness. Remove such blemishes by grinding, or by welding and grinding prior to cleaning, treating and application of surface finishes.
- B. Steel Shapes, Bars and Plates: ASTM A36 unless noted otherwise on the Contract Drawings. High strength steel is noted on the Contract Drawings as "Gr50" denotes ASTM A 572 material (Fy = 50 ksi).
- C. Structural steel tubing: ASTM A500, Grade B, Fy = 46 ksi.

- D. Structural steel pipe: ASTM A53, Type E or S, Grade B, $F_y = 35$ ksi or ASTM A501, $F_y = 36$ ksi.
 - E. Connection bolts: ASTM A325N (bearing bolts).
 - F. Anchor bolts: ASTM A36.
 - G. Drilled-in anchors (expansion bolts): KWIK-Bolt II stud anchor by Hilti Fastening Systems, Red Head, or approved equal.
 - H. Welding rods: AWS E70XX for ASTM A35 and ASTM A572 steel.
 - I. Headed studs (used as anchor studs or as shear connectors): ASTM A108, Grade 105 or 1020.
 - 1. KSM Fastening Systems, Omark Industries, Nelson Stud Welding, TRW Nelson Division, Blue Arc Welding Studs, Erico Products, or approved equal.
 - J. Deformed bar anchors: ASTM A496.
 - 1. KSM Fastening Systems, Omark Industries, Nelson Stud Welding, TRW Nelson Division, or approved equal.
- The use of manually welded anchors, rods, bars, straps, or reinforcing bars is not acceptable as a substitute for headed studs or deformed bar anchors.
- K. Malleable Iron Wedge Inserts: Hohman-Barnard, Peerless Hardward, or approved equal.
 - L. Grout: non-metallic, non-shrink, high-strength grout (minimum 5000 psi compressive strength at 28 days).
 - 1. Five Star, Kemset, Masterflow 713, Quikrete, or approved equal.
 - M. Shop paint: Per Section WM-18, 2.03.

2.02 Fabrication

- A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings. Provide camber in structural members where indicated.
 - 1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
 - 2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of

members exposed in final structure free of markings, burns, and other defects.

- B. Connections: Weld or bolt shop connections, as indicated.
 - 1. Bolt field connections, except where welded connections or other connections are indicated.
 - a. Provide high-strength threaded fasteners for all bolted connections.
- C. High-Strength Bolted Construction: Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A325 or A490 Bolts" (RCRBSJ).
- D. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.
- E. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld shear connectors, spaced as shown, to beams and girders in composite construction. Use automatic end welding of headed stud shear connectors in accordance with manufacturer's printed instructions.
- F. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on final shop drawings.
 - 1. Provide threaded nuts welded to framing, and other specialty items as indicated to receive other work.
 - 2. Cut, drill or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.
- G. Connections:
 - 1. Unless otherwise noted, beam connections shall be simple connections.
 - 2. The steel supplier shall design the connections for at least the reactions indicated on the framing plans, but never less than 50% of the total allowable uniform load on the span.
 - 3. Connection angles shall be 5/16" in thickness (Minimum).
 - 4. Minimum connection strength shall not be less than that of two 3/4" diameter A325 bolts.
 - 5. Beam connections shall consist of double web angles unless detailed otherwise on the drawings.

- H. Welds shall be tested as outlined in Section 3.03. The correction of faulty welds shall be in accordance with AWS "Structural Welding Code D1.1".
- I. Steel members of different grades but of the same size and length shall be marked and detailed to prevent misplacement during erection. Varying connection gages between grades of steel is an acceptable means of prevention.

2.03 Shop Painting

- A. Shop paint all structural steel except the following:
 - 1. Contact surfaces in connections using high strength friction bolts,
 - 2. Surfaces to be field welded,
 - 3. Structural steel that will receive sprayed-on fireproofing,
 - 4. Steel encased in concrete,
 - 5. Embedded steel items (surfaces in contact with concrete),
 - 6. The top surface of the top flange for all composite beams,
 - 7. Crane rails.
- B. Shop Primer:
 - 1. Material: As specified in WM-25
 - 2. Volume solids: 55.0 ± minimum
 - 3. Shop primer shall be compatible with the specified finish paint.
- C. Surface Preparation:
 - 1. SSPC - SP6 Commercial Blast Cleaning
- D. Application:
 - 1. Structural steel shall receive one coat of shop paint except surfaces inaccessible after assembly shall receive a second coat.
 - 2. Dry film thickness: 2.0 mils minimum.
 - 3. Follow coating manufacturer's printed directions.

PART 3 EXECUTION

3.01 Erection

- A. Erect in accordance with the AISC "Specifications for Design, Fabrication and Erection of Structural Steel for Buildings".
- B. Field connections shall be made using A325 high strength bolts, bearing type, except where welded connections are called for on the Contract Drawings.
- C. Bolt Tightening:
 - 1. High Strength Bolts shall be "friction" type fasteners when used in the following connections:
 - a. Connections subjected to loosening.
 - b. Connections subject to fatigue due to vibrations.
 - c. Connections subject to stress reversals.
 - d. Wind bracing connections.
 - e. Fasteners in oversized, short or long slotted holes.

"Friction" type fasteners shall be tensioned in accordance with Table 3 of the "Specification for Structural Joints using ASTM A325 or A490 Bolts". The contact surfaces in a "friction" type connection shall be left unpainted as noted in section 2.03, A, 1.
 - 2. High Strength bolts shall be designed as "bearing" type fasteners and tensioned in accordance with Table 3 of the "Specification for Structural Joints using ASTM A325 or A490 Bolts" when used in the following connections.
 - a. Connections subject to tension loads.
 - b. Column splices in structures over 100 feet in height.
 - c. Beam to Column connections in structures over 125 feet in height.
 - 3. High strength bolts that are not covered by sections 3.01, C, 1 & 2 shall be "bearing" type fasteners. These fasteners need only be tighten to a "snug-tight" condition. "Snug-tight" shall be as defined in the "Specification for Structural Joints using ASTM A325 or A490 Bolts".
 - 4. High strength bolts described by sections 3.01, C, 1 & 2 may be tightened by any method found acceptable by the "Specification for Structural Joints using ASTM A325 or A490 Bolts" unless otherwise noted on the drawings.
- D. Set all structural steel accurately to lines and grades. Connect temporarily with sufficient high strength bolts to insure complete safety of the structure until permanent connections are made. Erection tolerances shall be in accordance with the AISC Code of Standard Practice.

- E. Provide temporary guy lines, bracing, and shoring as required, to maintain stability and alignment until the entire system (including metal deck erection) is erected, permanently connected, braced and set.
- F. Any and all misfits shall be reported to the Engineer for resolution. Burning of new or unfair holes or cutting with a torch will not be permitted without the approval of the Engineer. Reamers, twist drills and saws shall be employed where burning is prohibited.
- G. Any member that has assumed a bend or buckle in its final position due to forced fit shall have one or both ends and any intermediate connections unbolted and re-drilled or reamed to relieve such bowing to the satisfaction of the Engineer.
- H. No piece that has been bent, broken, twisted or otherwise damaged shall be incorporated into the work. Such pieces shall be repaired or corrected on the ground to the satisfaction of the Engineer or replaced with a new piece. Failure to observe this will be cause for rejection of the piece in place.
- I. Prior to the erection of any steel, the Contractor shall verify the location, elevation and plumbness of all anchor bolts and concrete surfaces. The Contractor shall report immediately to the Engineer in writing any condition which he finds unacceptable or that would prevent erection of the structural steel within AISC tolerance for plumbness and elevation. The Contractor shall be responsible for all corrections, and all corrections shall be made in a manner acceptable to the Engineer.
- J. The erector shall acquaint himself with all conditions at the site which can affect his methods and sequence of operations. Abide by Owner's regulations concerning traffic, parking and construction material delivery.
- K. FIELD TOUCH-UP BY STEEL ERECTOR: Field bolts, field welds and abrasions to the shop coat shall be repaired and painted by the structural steel erector using the same paint and care as for shop coat. All such surfaces shall be washed with a suitable degreasing solvent. This contractor shall also remove any and all accumulations of mud, clay, rust, scale, grease, etc. that have been acquired, for any reason, during shipment, storage and erection and the shop coat restored to its original condition.
- L. Sub base (leveling) plates under column base plates will not be permitted.
- M. Install headed studs using manufacturer approved equipment in accordance with the manufacturer's instructions.
- N. Furnish all anchor bolts for anchorage of structural steel at an advance date for incorporation into the concrete foundation by others. Provide heavy hex nuts and washers for each bolt. Anchor bolts shall not be installed until shop drawings have been reviewed.
- O. Observe all federal, state and local laws and area trade rules in the erection and handling of structural steel.

3.02 Cleaning Up

- A. Upon completion of erection, promptly remove all tools, equipment and rubbish caused by or resulting from the erection work.

3.03 Testing

- A. All testing shall be by a testing agency approved by the Engineer, performed by registered/qualified technicians. The Contractor will employ the testing agency.
- B. Test shop and field welds as indicated below:
 - 1. All complete penetration welds shall be tested for 100% of the total weld length using ultrasonic testing apparatus.
 - 2. All partial penetration welds shall be tested for 50% of the total weld length using the magnetic particle method.
 - 3. 20% of all fillet welds shall be tested using the magnetic particle method.
 - 4. All welds shall be visually inspected.
- C. Inspect and test bolted connections; (see Section WM-18, 3.01C). A minimum of 10 percent of the bolts (and no less than 2 bolts in each connection) that are tightened per paragraph 3.01C, 2 shall be tested.
- D. Inspect and test headed anchor studs and shear connector studs in accordance with the provisions for quality control of shear connectors, "Structural Welding Code", AWS D1.1.
- E. Test reports shall be prepared by the testing agency giving the following:
 - 1. The type and location of test conducted.
 - 2. The test results.
 - 3. Interpretation of the test results stating whether they comply with the Specification requirements.
 - 4. Procedure taken if the test results are not acceptable.
 - 5. Test results of re-tests after corrective measures have been completed. The cost of all re-testing of faulty welds shall be borne by the Contractor.

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(SECTION WM 19)

MISCELLANEOUS METAL AND ALUMINUM

PART 1 GENERAL

1.01 Description

- A. The Contractor shall furnish and install all miscellaneous metals, including pipe supports, anchors, lintels, steel angles, platforms, hatches, grating, hand railing, etc. all indicated on the drawings and as specified for the complete construction of the work.
- B. Items such as stiffeners, supports, fasteners, or any other metal items required and not separately specified or shown shall be supplied and installed by the Contractor.

1.02 Quality Assurance

- A. Codes and Standards
 - 1. All codes and standards shall be as set forth in the latest ASTM.

1.03 Submittals

- A. Shop Drawings
 - 1. The Contractor shall submit drawings for all steel items indicating all dimensions, weights, coatings, etc. For grating, field measurements shall be verified and used for layouts in all submittals.

PART 2 PRODUCTS

2.01 Steel Lintels

- A. Steel members shall be in full compliance with applicable sections of ASTM Standards.
- B. Lintels shall have a minimum bearing of 8" on each side of opening.
- C. Size of each angle shall be as shown on the drawings, but not any smaller than 2" x 3" x 1/4".
- D. Steel members shall be either hot dipped galvanized or primed per the coating section of the *Workmanship and Materials Section*.

2.02 Miscellaneous Structural Steel

- A. Structural steel members shall be in full compliance with applicable sections of ASTM Standards. Structural steel for building construction shall be specified in the detailed specifications.

- B. All steel members used in the construction of various platforms and stairs shall be sized as shown on the drawings, but not less than 6" channels.
- C. All platforms and stairs shall be designed for a minimum of 200 lbs per square foot.
- D. Steel members shall be hot dipped galvanized.

2.03 Miscellaneous Steel Grating Supports

- A. Steel members used along channels and walks to support grating shall be provided by the Contractor.
- B. Steel angles with a minimum of 1/4" thickness shall be used along the edge of openings. Angles shall have sufficient depth to keep surface of grating level with the top of concrete.
- C. Angles may be either surface mounted or embedded. The minimum bearing dimensions shall be 2".
- D. Where grating panels abutt, the Contractor shall install steel support members along the joint to prevent deflection of panels. An angle or channel section shall be used.
- E. Where removable grating panels are to be provided, the edge of these openings shall be supported with triple angles, wide flange beam or as indicated by the drawings.
- F. All steel members shall be hot dipped galvanized.

2.04 Pipe Supports

- A. All pipe supports shall be steel tubing members of adequate diameter and thickness for the applicable design load.
- B. Supports shall be hot dipped galvanized.
- C. Pipe supports shall be furnished with a base plate and anchors.

2.05 Aluminum Grating

- A. All grating shall be furnished in lengths to fit the spans. Panel widths shall not exceed four (4) feet. Where openings are required for the passage of pipes, gate stems, equipment, or other purpose they shall be provided and the grating reinforced where necessary to preserve its strength. All openings shall be banded to the full depth of the grating.

- B. Unless otherwise specified, aluminum grating shall be made using rectangular shaped or I-shaped bearing bars with minimum dimensions and weight according to clear span as follows:

Rectangular Bar Type		I-Bar Type		Max. Span
Bearing Bar Size	Wt. Lbs. Per Sq. Ft.	Bearing Bar Size	Wt. Lbs. Per Sq. Ft.	
1 1/4" x 3/16"	2.9	1" x 1/4"	2.1	3'-6"
1 1/2" x 3/16"	3.5	1 1/4" x 1/4"	2.5	4'-0"
1 3/4" x 3/16"	4.3	1 1/2" x 1/4"	2.8	5'-0"
2" x 3/16"	4.9	1 3/4" x 1/4"	3.3	5'-6"
2 1/4" x 3/16"	5.5	2" x 1/4"	3.7	6'-0"

- C. Aluminum bearing bars shall be spaced not more than one and three sixteenths (1 3/16) inch on centers and pressure locked with transverse bars spaced not more than four (4) inches on centers. Bearing bars shall be made of aluminum alloy 6061-T6 or 6063-T6 in conformance with ASTM Specification B221-62. Cross or transverse bars shall be aluminum alloy 6063-T42 or 6063-T5. Rectangular bearing bar panels shall have a serrated top surface to provide positive traction. The symmetrically shaped panels made up of I-shaped bearing bars shall be reversible for both positive and negative bending moment, and the top and bottom surface of the bars shall be grooved to provide positive traction. The Contractor shall furnish and install isolators where aluminum grating is to contact dissimilar metals. Isolation method shall be continuous and of a permanent type.

2.06 Aluminum Handrail

- A. Aluminum handrail and posts shall be one and one half (1 1/2) inch I.P.S. Schedule 40 aluminum pipe. The posts and the rails shall be made of 6063(T6), 6005 (T5), or 6105 (T5) alloy. Post spacing shall not exceed six (6) feet apart, unless otherwise shown on the plans or approved by the Engineer. All exposed castings such as wall and floor flanges, flush type fittings etc. shall be 214F alloy to assure compatibility with the posts and rails for uniformity of finish. Mounting screws shall be hardened aluminum or stainless steel as per manufacturer's recommendations.
- B. The railing shall be constructed with welded connections or mechanically assembled, with panels of suitable lengths and shapes to facilitate shipping, handling and speedy erection. The finish of the railing shall be anodized with clear anodic coating in accordance with the Aluminum Association. Coating shall be shop applied and protected during shipment by plastic.
- C. Suitable dielectric insulators shall be provided where connections are made to ferrous metals. Hardened aluminum or stainless steel chains shall be provided for all shown chained openings.
- D. Where a three (3) rail system is required or shown, the system shall consist of a top rail 3'-6" high, an intermediate rail 2'-0" high, and bottom rail 6" high.

- E. Where a two (2) rail system is required or shown, the system shall consist of a top rail 3'-6" high and bottom rail 1'-9" high.
- F. Where a four (4) rail system is required or shown, the system shall consist of a top rail 3'-6" high, and intermediate rails spaced at 10 1/4".
- G. Four (4") inch extruded channel toe boards shall be supplied and secured with screws along walkways.
- H. Provisions shall be made for thermal expansion and contraction; expansion joints shall be provided at a maximum of 24 foot on center. A single, unspliced length of top rail to be attached to a minimum of three (3) posts where possible.
- I. Water drainage shall be provided by 3/16" weep holes at the bottom where posts are grouted in concrete.
- J. Complete railing system shall meet or exceed the load and design requirements of OSHA, UBC and other local and state agencies.

2.07 Aluminum Access Hatches

- A. The aluminum hatch leaves shall be 1/4 inch aluminum diamond pattern plate which is capable of withstanding a live load of 300 pounds per square foot. Channel frame shall be used on valve and meter vaults and potable water tanks with 1/4 inch aluminum with an anchor flange around the perimeter.
- B. Doors shall be equipped with heavy forged brass hinges, stainless steel pins, spring operators or easy operation, and an automatic hold-open arm with release handle. A snap lock with removable handle shall be provided. Hardware shall be stainless steel. A Neopren rubber gasket shall be provided in the frame.
- C. In the front right corner of each channel frame, a 1-1/2 inch drainage coupling shall be located where required in the drawings. The 1-1/2 inch drainage couplings shall be drained by a 1-1/2 inch schedule 80 PVC pipe to the outer edge of the adjacent slab or gravel sump.
- D. Aluminum surfaces shall be mill finish. Surfaces in contact with concrete shall have bituminous coating.
- E. The hatch shall be installed in accordance with the manufacturer's written instructions. Hatch frame and leaves shall be installed flush with adjacent surface.
- F. Where required by the drawings, a nylon safety net or protection grating shall be furnished for fall prevention.

2.08 Metal Ladders

- A. Metal ladders shall be 2" round continuous aluminum pipe rails with 3/4" round slip resistant rungs at 1'-0" on center. Safety climb device shall be provided. Anchorage shall be 3/4" round taper-bolt anchors. Welds shall be continuous and

ground smooth. All rungs and ladder components shall meet all latest OSHA requirements for slip resistance and dimensions.

2.09 Wall Louvers

- A. When not supplied in other sections, louvers shall be as follows:
 - 1. The entire assembly shall be factory fabricated. Frames shall be flush, minimum 50% NFA. Louvers shall be manufactured by Construction Specialties, Industrial Louvers, Inc. or equal. Louvers shall be constructed of anodized aluminum.

PART 3 EXECUTION

3.01 Steel Members

- A. The Contractor shall install all steel supports in accordance with all details provided on the drawings.
- B. All welds shall be smooth and free of sharp edges.
- C. All field welds on galvanized coatings shall receive a field applied coating to seal weld areas.
- D. Anchors and bolts shall be stainless steel.
- E. Metal stairways shall have slopes between 30 and 40 degrees from the horizontal to facilitate carrying samples, tools, etc. Each tread and riser shall be of uniform dimension in each flight. Minimum tread run shall not be less than 9 inches (230 mm). The sum of the tread run and riser shall not be less than 17 inches (430 mm) nor more than 18 inches (460 mm). A flight of stairs shall consist of not more than a 12-foot (3.7 m) continuous rise without a platform.

3.02 Aluminum Grating

- A. Contractor shall field verify all dimensions for proper fit of panels.
- B. All removable panels shall be properly supported along all sides.
- C. Any field cutting shall be in accordance with the manufacturer's requirements.
- D. Where aluminum stair treads are used, the face of each tread shall have a slip resistant surface edge. Nosing shall be aluminum and coated surface with encapsulated aluminum oxide grit. The replaceable nosing surface shall be secured with standard connectors.

3.03 Aluminum Handrail

- A. The Contractor shall protect all railings from damage prior to installation.

- B. Manufacturer supplied protection plastic wrapping shall be kept on railing until erection is complete.
- C. Contractor shall comply with all of the manufacturer's installation requirements for fastening and thermal expansion/contraction control.
- D. Contractor shall place an isolator between handrail base plate and any other ferrous metal surface.
- E. Contractor shall place a bituminous coating on post or base plate where in contact with concrete.

3.04 Aluminum Access Hatches

- A. Where access hatches are to be used in precast concrete structures, the frame shall be placed in the top section by the precast supplier.
- B. Prior to precasting the hatch(es), the Contractor shall submit shop drawing(s) for review by the Engineer.
- C. Where a channel frame is required, the Contractor shall install Schedule 80 PVC pipe and fittings to direct drainage to the exterior of structure.
- D. Where surface grade does not allow a free gravity drain, the Contractor shall direct the channel drain line to a pea gravel sump, below grade (exterior to the structure).

(SECTION WM 21)

EXPANSION AND CONSTRUCTION JOINTS AND WATERSTOPS

PART 1 GENERAL

1.01 Waterstops

- A. Coil Waterstop - shall be manufactured from bentonite waterproofing compound. Waterstop shall be 1" X 3/4" flexible strips. The coil waterstop shall be installed in strict compliance with manufacturer's recommendations, including hydrating all in place material with potable water prior to exposure to wastewater. On vertical surfaces the waterstop shall be installed with adhesive primer. For horizontal surfaces waterstop shall be installed with either adhesive primer or nailing. Coil waterstops shall be Waterstop-Rx as manufactured by CETCO, Hydro-Flex Waterstop as manufactured by Henry Company, or equal.

- B. Plastic waterstops - shall be manufactured from virgin polyvinyl chloride plastic compound and shall not contain any scrap or reclaimed material. It shall be of the ribbed style not less than three-eighths by nine (3/8 X 9) inches, unless otherwise noted on the plans. Other dimension and style or type shall be as shown on the plans or as specified, except that center bulb type shall be provided where the joint is subject to traverse or shearing movement.

- C. See Section WM 5.2, "Cast-in-Place Concrete", for submittal requirements and for related materials.

1.02 Backing Rod

- A. Backing rod shall be an extruded closed-cell polyethylene foam rod such as Minicel backer rod, manufactured by Industrial Systems Dept., Plastic Products Group of Hercules, Inc., Middletown, DE; Ethafoam SB, as manufactured by Dow Chemical Company, Midland, MI; or equal. The rod shall be one eight (1/8) inch larger in diameter than the joint width except that a one (1) inch diameter rod shall be used for a three fourths (3/4) inch wide joint. Where possible, full length sections shall be provided for the joint; splices shall be minimized.

1.03 Preformed Joint Filler

- A. For tank walls and slabs, joint filler shall be ASTM D 1752, Type III. Filler shall be granulated cork particles specially treated, dehydrated and compressed, designed to expand in the presence of moisture. Cork joint filler shall be self expanding cork by W.R. Meadows, Inc., A.P.S. Cork, or equal.

- B. Asphalt filler shall be used for unsealed expansion or isolation joints in sidewalks, driveways, floor slabs on-grade or elsewhere as indicated on the drawings. Filler shall be ASTM D 994. Asphalt filler shall be Sealtight asphalt expansion joint filler manufactured by W.R. Meadows, Inc., Construction Materials International, or equal.

1.04 Poured Joint Filler

- A. Hot-poured elastic joint filler shall meet ASTM D1190. Filler shall be Sealtight No. 164 manufactured by W. R. Meadows, Inc., Construction Materials International, or equal.

1.05 Sealants for Caulked Joints

- A. Only the materials from a single manufacturer shall be used for the same joint. Use of other than one material for the same joint shall not be allowed unless approved by the sealant manufacturer.
- B. Sealants shall be self-leveling (S/L) for horizontal and sloping joints with a slope less than two percent (2%). Nonsag sealants (N/S) shall be used for steeper sloped joints, vertical joints, and overhead joints.
- C. Primer shall be the type recommended by the sealant manufacturer.
- D. Color of the sealant shall be gray, or shall match the color of unpainted exposed surfaces, except that submerged may be either black or gray.

1.06 Nonsubmerged Joints

- A. Joints one (1) inch or less in width shall utilize the following sealants: Isoflex 814, Sikaflex 427, or equal.
- B. Joints greater than one (1) inch wide shall utilize the following sealants: Isoflex 814 (S/L), Sikadur CJR, or equal for horizontal joints. Isoflex 2000, Sikadur Combiflex, or equal for vertical joints.

1.07 General Sealants

- A. Except where otherwise shown or specified, sealants shall be as follows:
- B. Submerged Sealants:
 - 1. Sikaflex Ia or 427 - Sika Chemical Co., Lyndhurst, NJ; or Isoflex 908 or 814 - H.S. Peterson Co., Pontiac, MI; or PRC 210, 220, or 270 - Products Research and Chemical Corp., Burbank, CA; or Vulkem 116 or 45 - Master Mechanics Co., Cleveland, OH; or equal.
- C. Nonsubmerged Sealants:
 - 1. Flexible sealants shall be provided for all joints not exposed to water which are subject to structural movement.
 - 2. Joints one (1) inch or less in width shall utilize the following sealants: PRC 210 (N/S), PRC 220 (S/L), PRC 270; or equal.
 - 3. Joints subject to pedestrian or vehicular traffic shall utilize PRC 230; Isoflex 814; Vulkem 45 (S/L); Vulkem 245; or equal.

1.08 Coal Tar Tape

- A. Coal tar tape shall be Protecto Wrap 200, manufactured by Protecto Wrap Co., Denver, CO; Tapecoat CT, manufactured by Tapecoat Company, Inc., Evanston, IL; or equal.

1.09 Steel Expansion Joint Dowels

- A. Double-Coat polyethylene coated steel bar dowel, as manufactured by Republic Steel, Cleveland, OH; or equal. Dowel bars in any size and number are readily available by contacting Republic Steel Corp., P.O. Box 6778, Cleveland, OH 44101, All-States Construction Supply Co., Inc., 6009 Sixth Avenue South, Seattle, WA 98108, or approved equal.

1.10 Installation of Waterstops

- A. Join waterstops at all intersections so that a continuous seal is provided. Center the waterstop on the joint. Hold waterstop positively in correct position. In the event of damage to the waterstop, repair the waterstop in an acceptable manner. Vibrate concrete to obtain impervious concrete in the vicinity of all joints.
- B. In horizontal joints, insure that the areas below the waterstop are completely filled with concrete. Make a visual inspection of the entire waterstop area during the concrete placement.

1.11 Plastic Waterstop

- A. Install in accordance with the details shown and the instructions of the manufacturer. At least ten (10) minutes shall be allowed before the new splice shall be pulled or strained in any way. The finished splices shall provide a cross section that is dense and free of porosity with tensile strength of not less than eighty percent (80%) of the unspliced materials.

1.12 Construction Joints

- A. Prior to placing the abutting concrete, the contact surface shall be cleaned and roughened by approved means to remove all laitance and expose the aggregate. The exposed portion of the reinforcing steel shall be cleaned of all concrete. The cleaning method shall be conducted so as not to damage the waterstop, if one (1) is present. Grout for horizontal construction joints shall be of the Metallic NonShrink Aggregate Type.

1.13 Joint Preparation

- A. The joints shall be accurately located and constructed to produce straight joints and shall be vertical or horizontal except where walls intersect sloping floors.
- B. The concrete pour shall not commence until after the joint preparation has been inspected and approved by the Engineer.

1.14 Location

- A. Joints as shown on the plans, or as approved.

1.15 Time Between Pours

- A. At least two (2) hours must elapse after depositing concrete in the columns or walls before depositing in beams, girders, or slabs supported thereon. Beams, girders, brackets, column capitals, and haunches shall be considered as part of the floor or roof system and shall be placed monolithically therewith.

1.16 Expansion Joints

- A. The premolded joint filler shall be of sufficient width to completely fill the joint space. If a waterstop is in the joint, the premolded joint filler shall be accurately cut to butt tightly against the waterstop and the side forms.
- B. At locations where joint sealant is to be applied, the premolded joint filler shall be precut to the required depth.
- C. Cavities for joint sealant shall be formed with either precut premolded joint filler or smooth accurately shaped material that can be removed.
- D. Concrete shall be thoroughly vibrated along the joint form to produce a dense, smooth surface. Surface irregularities along the joint sealant cavity due to improper concrete consolidation or faulty form removal shall be repaired with an approved compound compatible with the joint sealant in a manner that is satisfactory to the sealant manufacturer.

1.17 Bituminous Type Premolded Joint Filler

- A. Drive nails at about one (1) foot on centers through the filler to provide anchors into the concrete when it is placed. Place premolded joint filler in the forms in the proper position before concrete is poured.

1.18 Pourable Joint Filler

- A. Install pourable joint fillers in accordance with the manufacturer's instructions. Thoroughly clean joints by sandblasting the concrete surfaces of each side of the joint from the plastic waterstop to the top of the joint, dry the joint, and remove all dust and foreign material, and prime before pouring the filler. Avoid damaging the waterstop by sandblasting operations. Primer shall be compatible with the filler material.

1.19 Rubber Asphalt Type

- A. Heat rubber asphalt filler material in a double-walled boiler and place in the joint by means of a nozzle. Prevent spillage outside of the joint. Begin pouring joint filler at the bottom of the horizontal joint and proceed upwards in a manner that will preclude the possibility of trapping air in the joint. Use masking tape at each side of joint to assist in cleaning all spillage.

1.20 Sealants

- A. Just prior to installing the joint sealant, the joint cavity shall be cleaned by sandblasting or power wire brushing. Install bond breaker tape per manufacturer's instructions.
- B. After the joints have been prepared as described above, the joint sealant shall be applied. The primer, if required, and joint sealant shall be applied only with the equipment and methods recommended by the joint sealant manufacturer.
- C. Application criteria for the sealant materials such as temperature and moisture requirements, and primer cure time shall be in strict accordance with the recommendations of the sealant manufacturer.
- D. Exposed joints shall have masking tape applied along the edges of the exposed surface. The joints shall be troweled smooth with a tuck pointing tool wiped with a solvent recommended by the manufacturer.
- E. After the sealant has been applied, the masking tape and any sealant spillage shall be removed.

1.21 Preformed Control Joints

- A. The preformed control joint shall be installed straight, flush, or slightly below the top of the slab and with equipment and methods approved by the manufacturer of the joint material.
- B. Steel preformed tongue and groove type shall be adequately braced to withstand pressure of wet concrete.

1.22 Steel Expansion Joint Dowels

- A. Install parallel to wall or slab face and in true horizontal position by securing tightly in forms with rigid ties. Dowels shall be oriented to permit joint movement.

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(SECTION WM 22)

ROADWAYS AND PARKING AREAS

PART 1 GENERAL

1.01 Scope

- A. The Contractor shall furnish all materials, equipment and labor to construct and/or reconstruct new and existing roadway, alley, driveway, parking area and other pavement areas including those removed or damaged as a result of construction. These include access roads, approaches and entrances.
- B. The Contractor shall furnish all materials and labor necessary to install a compacted aggregate base for all traffic areas to receive subsequent hard surface pavements (concrete or hot mix asphalt) and those areas to receive just the compacted aggregate pavement as specified and as ordered by the Engineer.
- C. The Contractor shall be responsible for any damage to drives, roads, sidewalks, culverts, and other structures whether existing and/or new as constructed as part of the Contractor's work. Any repairs made due to damage caused by the Contractor shall be at his expense. This includes pavements for shoulders.
- D. The Contractor shall keep all pavements completely clean from mud, loose aggregate and other debris and objectionable materials by the end of each workday.
- E. Note: If local standards, specifications or other regulations require a higher strength/depth pavement section, this will supersede what is specified in these Workmanship and Materials Specifications, unless specifically noted otherwise in the specifications.

1.02 Product Handling

- A. The Contractor shall store and protect miscellaneous items on the Project site so it does not interfere with other property owners or the general public.

1.03 Submittals Required Prior to the Commencement of Work

- A. The Contractor shall submit copies of current materials certificates signed by the material producer and the Contractor certifying that each pavement material item complies with, or exceeds, the specified requirements.
- B. The Contractor shall submit hot mix asphalt mix designs for this item.
- C. The Contractor shall submit concrete mix designs for this item.
- D. A paving joint plan shall be submitted for concrete pavements.

1.04 Related Specifications

A. Comply with applicable portions of the following WM Specifications:

WM-2	Excavation
WM-3	Backfill, Fills and Embankments

PART 2 PRODUCT

2.01 Pavement Materials

A. Hot Mix Asphalt (HMA) Pavement

The State Department of Transportation Standard Specifications, Section 402, shall apply with the exceptions as noted herein. The current version of the State Department of Transportation Specifications, Recurring Special Provisions, and Supplemental Specifications are applicable.

1. Description: This work shall consist of one or more courses of HMA base, intermediate, surface mixtures or other miscellaneous HMA material, produced from a State Department of Transportation Certified HMA producer, in accordance with State Test Method (ITM) 583.
2. Design Mix Formula and Mixture Type: The design mix formula, prepared in accordance with 402.04, shall be based on the following table and as may be amended from time to time:

Mixture Type	Type B	Type C	Type D
Design ESAL	<3,000,000	3,000,000 to <10,000,000	≥10,000,000
Surface	4.75, 9.5, 12.5* mm	4.75, 9.5, 12.5* mm	4.75, 9.5, 12.5* mm
Surface - PG Binder	64-22	70-22	70-22
Intermediate	9.5, 12.5, 19.0, 25.0 mm	9.5, 12.5, 19.0, 25.0 mm	9.5, 12.5, 19.0, 25.0 mm
Intermediate - PG Binder	64-22	64-22	70-22
Base	25.0 mm	25.0 mm	25.0 mm
Base - PG Binder	64-22	64-22	64-22

*Surface 12.5 mm ≥ 195 lbs/sq.yd. min.

3. Recycled Asphalt Pavement: (RAP): Recycled asphalt pavement, up to 25%, may be used as a substitute for a portion of the new material required to produce HMA mixtures. See State Department of Transportation Standard Specifications 402.08.
 4. Acceptance of Mixtures: Acceptance shall be based on 402.09. The Type D Certification shall include the PG Binder Grade sent to the project.
- B. A tack coat per Section 406 in accordance with the latest State Department of Transportation Standard Specifications shall be applied on a clean surface before

placing the surface course. All HMA or concrete pavements shall be tacked at a rate of no less than as shown in the table below prior to placement of subsequent HMA mixtures.

Surface Type	Application Rate*(gal./sq yd)
New Asphalt	0.05 to 0.08
Existing Asphalt	0.06 to 0.11
Milled Asphalt	0.06 to 0.12
PCCP	0.05 to 0.08
* The asphalt material shall not be diluted.	

If a prime coat is required on new and existing compacted aggregated bases, all compacted aggregate bases shall be primed in accordance with State Department of Transportation Standard Specifications 405 Prime Coat, at a rate of no less than 0.50 to 0.75 gal./sq. yd.

C. Concrete Pavement

- Concrete pavements shall comply with Section 502, "Portland Cement Concrete Pavement, PCCP" in accordance with the latest State Department of Transportation Standard Specifications. Compressive strengths shall be no less than 4,000 psi and as per Section 502.04 Concrete Mix Criteria. Cold weather (below 45 degrees F) placement will not be permitted without an approved plan for cold weather concrete work and at the approval of the Engineer.

D. Compacted Aggregate Base

- Compacted aggregate base meeting the requirements of Section 301, "Aggregate Base" in accordance with the latest State Department of Transportation Standard Specifications shall be provided. Aggregate shall meet the requirements for No. 53 coarse aggregate in Article 904, "Aggregates" of the State Department of Transportation Standard Specifications.
- All aggregates shall be crushed limestone unless otherwise approved by the Engineer. Crushed slag may be used on a case by case basis.

E. Geotextiles and Geogrids

- Woven and non-woven geotextile fabrics and HDPE geogrids per State Department of Transportation Standard Specifications Section 918, "Miscellaneous", may be used as a separation layer between unstable soils and the placement of compacted aggregate base (subbase) materials. Supportive documentation shall be required and submitted to the Engineer for approval prior to their use.

F. Hydrated Lime (Quick Lime)

1. The Contractor may elect to submit an alternate plan for stabilizing the subgrade by use of hydrated lime per State Department of Transportation Standard Specifications Section 215, "Chemical Modification of Soils". In such a case a licensed geotechnical engineer or professional geologist will be required to outline the proposed method and process.

PART 3 **EXECUTION**

3.01 **Installation**

- A. The placement of all pavement materials shall be in accordance with the latest State Department of Transportation Standard Specifications. All road cuts shall be saw-cut in a uniform, straight line prior to removal of the pavement. If, after saw-cutting, the exposed pavement becomes cracked as a result of construction loads, additional saw-cutting and removal or milling will be required. The thickness of all pavements to be placed under this specification shall be no less than existing pavement thickness found. The thickness of pavements and base materials shown herein is intended for those areas where a minimum thickness is not specified.

- B. New construction and driveways and parking areas disturbed by construction shall be constructed and restored to the original or better condition. Unless noted otherwise, it is not the intent to repave entire drives and parking areas in the project area, but rather to repave and repair the trench width and any areas damaged during construction, so long as they are completed in a uniform and neat manner. No irregular, jagged or raveled patch repairs are permitted. The existing pavement shall be saw cut along that portion to be removed. If local standards or specifications require thicker pavement sections, then the local standards and/or specifications shall be followed.

1. Hot Mix Asphalt Pavement

- a. Asphalt drives and parking areas outside of the public right-of-way shall consist of no less than a 1 ½ inches HMA surface, Type B on 3 ½ inches of HMA base, Type B on 6 inches of compacted aggregate, #53 in accordance with the State Department of Transportation Standard Specifications.
- b. Local asphalt pavements, including roads, drives and parking areas within the public right-of-way shall consist of no less than 1 ½ inches HMA surface, Type B on 4 inches of HMA Base, Type B on 8 inches of compacted aggregate, #53 base in accordance with the State Department of Transportation Standard Specifications.
- c. Collector asphalt pavements, including major municipal streets, drives and parking areas within the public rights-of-way, shall consist of no less than 1 ½ inches of HMA surface, Type B on 2 ½ inches of HMA Intermediate, Type B on 4 inches of HMA Base, Type B on 8 inches of compacted aggregate, #53 in accordance

with the State Department of Transportation Standard Specifications.

- d. Arterial asphalt pavements, including major municipal streets, drives and parking areas within the public rights-of-way, shall consist of no less than 1 ½ inches of HMA surface, Type B on 2 ½ inches of HMA Intermediate, Type B on 6 inches of HMA Base, Type B on 8 inches of compacted aggregate, #53 in accordance with the State Department of Transportation Standard Specifications, unless specified otherwise in the Detailed Specifications.
- e. HMA pavements shall be prepared, placed, compacted, and finished in accordance with Section 402, "Hot Mix Asphalt, HMA, Pavement". The Contractor's particular attention is directed to the requirement of cutting or sawing of pavement removal areas to neat, straight lines prior to actual pavement removal. This requirement applies to all sewer trenches, service line trenches and force main trenches.
- f. The existing pavement shall be saw cut along that portion to be removed.

2. Compacted Aggregate Surfaces and Bases

- a. Unless noted otherwise, all road repairs shall consist of no less than 8 inches of compacted aggregate, #53 base. During construction, all pavement crossings shall be filled with compacted surfaces and bases and maintained to minimize the development of objectionable pavement depressions.
- b. The surface course material shall be deposited and spread uniformly upon the prepared subgrade, in a single layer no less than six (6) inches in thickness measured after compacting. The material shall be free of lumps of clay and shall be of uniform mixture and density when placed. Portions of the layer in which the aggregates become segregated in spreading shall be removed and replaced with satisfactory material. Material shall not contain free water or frost, and shall not be placed in snow or on soft or frozen subgrade.
- c. Compacted aggregated base shall be shaped, graded and compacted using vibratory rollers and compactors. The Contractor shall maintain the compacted aggregate base until the temporary or a permanent pavement is placed.
- d. After being uniformly spread, the surfacing material shall be harrowed with a spike tooth harrow and floated with a road drag or grader until the surface is free from waves or irregularities. Harrowing and floating shall be continued until the surface has the required grade, line and cross section as shown on the plans,

except that the harrowing shall not be carried on at such time or to such extent that the fine material will be separated from the coarse material. If the surfacing material is not thoroughly compacted by traffic before final acceptance or placement of hot asphaltic concrete pavement, then it shall be accomplished by means of suitable roller and wetting or drying to obtain maximum density.

- e. Compacted aggregate base is to be placed as a base for the permanent pavement replacement for streets maintained by the Owner. All existing paved streets, roads, alleys, driveways, etc., cut for sewers and pipelines will require an 8-inch compacted aggregate base as part of the pavement replacement.
- f. Additional aggregate required in trenches to maintain safe traffic flow, before placement of pavement shall be at the Contractor's expense. All excess aggregate removed to fit the placement of pavement shall be hauled from the site. When the trenches are prepared for replacement of a permanent pavement and the top portion of the compacted aggregate base is cut away, a full 8" of compacted aggregate base shall be remaining.
- g. Compacted aggregate used for construction traffic shall be removed and the subgrade removed and re-compacted. Additional compacted aggregate shall be added to meet the lines and grades required for the pavement section.

3. Areas Receiving Pavement

- a. Additional aggregate shall be required in all trenches in order to maintain safe traffic flow before placement of final pavements and shall be at the Contractor's expense. All excess aggregate removed to fit the placement of pavement shall be removed from the project area. When the trenches are prepared for replacement of a permanent pavement and the top portion of the compacted aggregate base is cut away, a full 8" of compacted aggregate base shall be remaining.
- b. The surface of the compacted aggregate surface course shall be graded to the required elevations and cross sections as shown and/or as established by the Engineer. All soft spots and/or unstable or unsatisfactory base material shall be removed and replaced with suitable material to provide a satisfactory base beneath all areas to be paved. The newly placed or previously placed base material shall be scarified, brought to optimum moisture condition and thoroughly compacted ahead of the paving operations.

4. Concrete Pavements

- a. Concrete surfaces shall be repaired as indicated on the drawings. Concrete pavements shall comply with Section 502, "Portland

Cement Concrete Pavement, PCCP” in accordance with the latest State Department of Transportation Standard Specifications. A broom or tined finish is required.

- b. The minimum pavement thickness shall be 6 inches. For urban and commercial areas, the minimum thickness shall be 8 inches in low volume truck areas and 9 inches when the amount of truck traffic exceeds 10 %. Also, concrete pavements that need to be removed shall be removed to the nearest existing pavement joint.
- c. A paving joint plan shall be submitted to the Engineer for approval prior to placing the concrete pavement.

5. Curb and Gutter

- a. All permanent restoration of street curb and gutter shall be of the same type and thickness as the existing curb and gutter. The grade of the restored curb and gutter shall conform to the grade of the existing adjacent curb and gutter. Curbs and gutter shall be saw cut at approximately 10-ft. intervals but shall match adjacent joints in sidewalks.

6. Driveways and Sidewalks

- a. All permanent restoration of driveways and sidewalks shall conform to the manner of construction as originally placed and to the lines and grades as given by the Engineer. Replacement of concrete shall be from joint to joint. No patching of concrete shall be permitted. One-half (½) inch expansion joint material shall be installed wherever new concrete is placed against any existing or newly-cured concrete surfaces (vertical concrete surfaces only).
- b. New sidewalks shall be installed in minimum widths of 48 inches or of the same width as existing sidewalks and minimum lengths of 60 inches. The minimum width around obstructions (utility features, utility poles, signs, walls, or other obstructions) shall be four (4) feet.
- c. Unless specified elsewhere, sidewalks constructed adjacent to curbs, gutters or street pavement shall be six (6) feet wide.
- d. Unless specified elsewhere, sidewalks constructed with a utility strip separating the sidewalk from curbs, gutters or street pavement, shall be five (5) feet wide.
- e. All new sidewalks shall be 4 inches thick using Class A concrete on 6 inches of compacted aggregate No. 53, except at driveways where the concrete shall be 6 inches thick. The new walk shall slope less than 2.0% (1.5% preferred) across the width of the walk toward the street unless otherwise noted and broom finished at right angles to the walkway. A ½ inch expansion joint and preformed joint filler material shall be installed at no more than 30-foot

intervals. Tooled contraction joints shall be placed on the new sidewalk at 5-foot intervals.

- f. Where sidewalks are replaced, the replacement sidewalk shall be installed the full width of the walk and from joint to joint. All sidewalk ramps to a public street or alley shall conform to the latest ADA regulations.
- g. All ADA ramps shall be in conformance with the latest State Department of Transportation Standard Specifications unless superseded by ADA (United States Access Board) regulations. All finished slopes exceeding maximum ADA slopes shall be considered unacceptable.

C. Subgrades

- 1. The construction of subgrades shall be outlined in the Contractor's Plan of Operation and is to be submitted to the Owner prior to initiation of the actual work.
- 2. The subgrade of roadways and parking areas shall be shaped either by cutting or filling as the plans may show or as directed by the Engineer. The area between the lines shown on the plans or necessary for construction shall be cleared of all topsoil, vegetation, brush, logs or other perishable material. During construction, the subgrade shall be formed and maintained in such a manner that the surface water will readily flow off the surface. The subgrade shall be brought to the correct grade on cuts and to approximate grade on fills with the proper allowance for settlement and shall then be allowed to settle. The subgrade shall be brought to the true shape and grade before the surfacing is placed.
- 3. All subgrade areas to receive a compacted aggregate base shall first be brought to optimum moisture conditions and shall be compacted to an optimum condition as determined by results of soils testing by a geotechnical testing company provided by the contractor. Subgrades shall be compacted to a minimum of 95 percent of the maximum dry density as determined in accordance with ASTM D 1557 (Modified Proctor) using Method A for soil and Method C for granular materials.
- 4. The Contractor shall be responsible for compaction testing using a licensed geotechnical engineer or professional geologist.
- 5. Should weather conditions cause the subgrade to become wet and/or saturated, muddy, spongy or frozen or unusually dry for extremely dry conditions, the contractor shall again bring the subgrade up to optimum moisture conditions and retest the compacted subgrade. In frozen subgrades, the temporary pavement materials shall be used if the disturbed areas must remain open to traffic or will otherwise create a potential public hazard.

6. Soft and/or yielding or other unsuitable subgrade materials shall be removed if corrective measures are not effective. Proof rolling with the use of a pneumatic tire, two or three-axle tandem rollers or loaded dump truck shall be used to confirm if compacted subgrades exhibit soft and/or yielding properties.
7. Excavated materials to be later used for fill or topsoil shall be stockpiled and used to make the fills and embankments as shown on the plans and in compliance with the Workmanship and Materials Specifications. Backfilling shall be done in a manner to avoid any undue structural loading on structures. Stockpiles shall be located so as to avoid interference with access to project areas and to least interfere with other contractors performing work on behalf of the Owner in the same vicinity and as approved by the Engineer.

3.02 Shoulders and Existing Traffic Areas Not Receiving Hard-Surfaced Pavements

- A. Compacted aggregate No. 53 base is to be placed as a base and surface for shoulders and the permanent replacement for off-street parking, drives, parking lots and other areas not receiving hard-surfaced pavements. All existing off-street parking, drives, parking lots and other areas, etc., cut for sewers and pipelines will require a minimum 8-inch compacted aggregate base and surface replacement. The depth of shoulders shall be as shown on the plans.

3.03 Proof Rolling Before Final Paving

- A. Before placement of any hard surfaced materials such as hot mix asphalt or concrete pavements, the compacted subbase shall be proof-rolled with the use of a pneumatic tire, two or three-axle tandem rollers or loaded dump truck to confirm if compacted subbases exhibit soft and/or yielding properties. If they exhibit soft and/ or yielding properties they shall be removed and the subgrade and aggregate base re-compacted and proof-rolled again until it is acceptable for final paving courses.
- B. Use of Roadway During Construction
 1. The Contractor may prepare the subgrade of the roads at the start of construction and use them throughout the construction period either with or without placing the surfacing material. If the aggregate is placed and the road used during construction period, then the Contractor shall perform all necessary patrol maintenance at frequent intervals and add any additional aggregate required to maintain the road. Before the final acceptance of the work, the roads and parking areas including shoulders shall be brought to the grade and cross section shown on the plans and left in a condition satisfactory to the Engineer.
 2. The prepared subgrade shall be protected by the Contractor to prevent undue rutting from truck or other equipment. If such damage does occur, the subgrade shall be reshaped and compacted prior to placing the aggregate courses.

C. Roadway Ditches

1. All open ditches and channel changes parallel to and adjacent to the road shall be performed as a part of the roadway work. Lines, grades and cross sections of ditches shall be as shown on the plans unless otherwise required by the Engineer to obtain proper drainage.

3.04 Traffic Control

- A. The CONTRACTOR shall carry out the WORK in a manner which will cause a minimum of interruption to traffic, and may close to through travel not more than two (2) consecutive blocks, including the cross street intersected. Where traffic must cross open trenches, the CONTRACTOR shall provide suitable bridges to street intersections and driveways. The CONTRACTOR shall post suitable signs indicating that a street is closed and necessary detour signs for the proper maintenance of traffic. Prior to closing of any streets, the CONTRACTOR shall notify responsible municipal authorities.
- B. The CONTRACTOR shall plan construction activities to minimize impact to traffic. Local traffic access must be maintained at all times. To maintain traffic movement, appropriate traffic control devices shall be used. Such traffic control devices shall comply with the latest edition of the State Manual on Uniform Traffic Control Devices. The CONTRACTOR shall follow the requirements of the State Department of Transportation Standard Specifications Traffic Control Plans when no other plan is submitted for review.
- C. The Local Highway Department shall be notified no less than five (5) calendar days prior to any construction activities occurring within the right-of-way.

3.05 Testing

- A. All materials provided under this Specification shall meet the requirements of the applicable standards of the State Department of Transportation Standard Specifications, latest edition. The Contractor shall provide current certifications of such compliance, and the cost for such testing shall be borne by the Contractor.
- B. Contractor's *Plan of Operation* indicating how work will be completed, what testing will be provided, what equipment will be used and what provisions will be made to protect existing property and utilities.
- C. Soil compaction tests will be required for each 800 linear feet per lift of embankments constructed. The Contractor's licensed geotechnical engineer or professional geologist making these tests shall provide written reports with these tests. The contractor may only reduce the number of tests required based on a written quality control plan and performance-based test results from the geotechnical engineer or professional geologist who will also provide recommendations for the frequency of tests needed.

(SECTION WM 23)

CHAIN LINK FENCE AND GATES

PART 1 GENERAL

1.01 Description

- A. The Contractor shall erect the fencing in such a manner that it will follow the general contours of the ground or so that the top rail will show only gradual or sweeping curves.

- B. The Contractor shall construct the fencing and gates as indicated on the drawings.

1.02 Quality Assurance

- A. Code and Standards

American Society for Testing & Materials (ASTM) Standards:

A90/A90M	Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
A 121	Zinc-Coated (Galvanized) Steel Barbed Wire
A 123	Zinc (Hop-Dip Galvanized) Coatings on Iron and Steel Products
A 392	Zinc-Coated Steel Chain Link Fence Fabric
A 428	Test Method for Weight of Coating on Aluminum-Coated Iron or Steel Articles
F 668	Polyvinyl Chloride (PVC) Coated Steel Chain Link Fence Fabric
F 900	Industrial and Commercial Swing Gates
F 934	Standard Colors for Polymer Coated Chain Link Fence Materials
F 1043	Specifications for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework
F 1083	Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded for Fence Structures
F 1183	Aluminum Alloy Chain Link Fence Fabric
F 1184	Industrial and Commercial Horizontal Slide Gate
F 1345	Zinc - 5% Aluminum Mischmetal Alloy Coated Steel Chain Link Fence Fabric
F 1665	PVC Coated Steel Barbed Wire

1.03 Submittals

- A. Shop Drawings

The Contractor shall submit drawings for all materials.

PART 2 PRODUCTS

2.01 Metallic Coated Steel Chain Link Fabric

A. Base Metal

The base metal of the fabric shall be a good commercial quality of steel wire of standard gages.

B. Zinc Coating

The zinc coating on the fabric may be either Class 1 — the weight of zinc coating shall not be less than 1.20 oz./ft.² (366 gm/m²) of uncoated wire surface; or Class 2 — the weight of zinc coating shall not be less than 2.0 oz./ft.² (610 gm/m²) of uncoated wire surface as determined from the average of results of two or more specimens, and not less than 1.8 oz./ft.² (500 g/m²) of uncoated wire surface for any individual specimen.

C. Zinc — 5% Aluminum Mischmetal Alloy Coating

The metallic coating on the fabric may be either Class 1 — the weight of metallic coating shall not be less than 0.60 oz./ft.² (183 gm/m²) or Class 2 — the weight of metallic coating shall not be less than 1.00 oz./ft.² (305 gm/m²) of uncoated wire surface as determined from the average of results of two or more specimens, and not less than 0.90 oz./ft.² (250 gm/m²) of uncoated wire surface for any individual specimen. The zinc 5% aluminum mischmetal alloy used for the coating shall conform to the grades specified in ASTM designation B-750, Standard Specification for Zinc 5% Aluminum Mischmetal Alloy (UNSZ38510) in Ingot Form Hot-Dip Coatings.

D. Fabric Sizes

The height, diamond count, size of mesh, and wire diameters of chain link fabric shall be 72" height, diamond count 20 ½, gauge 9 or 11, and wire diameter 0.120" or 0.148".

E. Height of Fabric

The height of the fabric shall be the overall dimension from ends of twists or knuckles. The tolerance of the nominal height shall be plus or minus one inch (± 25mm).

F. Mesh Sizes

The permissible variation from the specified size of mesh shall be ±1/8 in. (±3.2mm) for all mesh sizes over 1 in. (25mm) and ±1/16 in. (±1.6mm) for all mesh sizes 1 in. (25mm) and under.

G. Wire Diameter

The diameter of the coated wire shall be determined as the average of two readings measured to the nearest 0.001 inch (0.025 mm) taken at right angles to each other on the straight portion of the parallel sides of the mesh. The tolerance in the diameter of the coated wire shall be plus or minus 0.005 inch ($\pm 0.13\text{mm}$).

H. Selvage

Fabric 72 inches (1830mm) high and over shall be knuckled at one selvage and twisted at the other.

2.02 PVC Coated Steel Chain Fence

A. Base Metal

The base metal shall be steel of such quality and purity that, when drawn to the size of wire required and coated with PVC, the finished fencing shall be of uniform quality and have properties and characteristics as prescribed in the specification.

B. PVC Coated Wire

1. Wire used for the manufacture of fabric shall meet the requirements of this specification and shall be capable of being woven into fabric without the PVC coating cracking or peeling. PVC shall be plasticized and thoroughly compounded so that this is full dispersment of pigments, stabilizer and other components.
2. Class 1 PVC coated wire shall have the PVC coating extruded onto wire that is zinc coated or zinc 5% aluminum alloy coated by the hot-dip method, zinc coated by the electrolytic process or aluminum coated by the hot-dip method.
3. Class 2a PVC coated wire shall have the PVC coating extruded and adhered to wire that is zinc coated or zinc 5% aluminum alloy coated by the hot-dip method, zinc coated by the electrolytic process or aluminum coated by the hot-dip method.
4. Class 2b PVC coated wire shall have the PVC coating fused and adhered to a primer that is thermally cured onto wire that is zinc coated or zinc 5% aluminum alloy coated by the hot-dip method, zinc coated by the electrolytic process, or aluminum coated by the hot-dip method.
5. The type of metallic coating on the steel wire substrate shall be the choice of the manufacturer unless otherwise specified.

C. Mesh and Fabric

1. The wire shall be woven throughout in the form of approximately uniform square mesh, having parallel sides and horizontal and vertical diagonals of approximately uniform dimensions. The top and bottom of the fabric shall be knuckled or twisted as specified.

The size of mesh shall be 2".

The permissible variation from the specified size of mesh shall be $\pm 1/8$ in. (3.2mm) for all mesh sizes over 1 in. (25mm) and $\pm 1/16$ in. (1.6mm) for all mesh sizes 1 in. (25 mm) and under.

2. Typical diamond count for standard height is 20 $\frac{1}{2}$ ".
3. Chain link fabric shall be fabricated from wire diameters as necessary to meet the requirements. The diameter shall be determined as the average of two readings taken at right angles to each other on the straight portion of the parallel sides of the mesh and measured to the nearest 0.001 inches (0.03mm).
4. The permissible variation from the specified diameter of core wire shall be ± 0.005 inch (0.13mm) for a core wire diameter over 0.105 in. (2.67mm) and ± 0.004 in. (0.10mm) for a core wire diameter of 0.105 in. (2.67mm) or less.
5. Diameter shall be either 0.120" or 0.148".
6. Chain link fabric, unless otherwise noted, shall be furnished in the standard heights. The height of fabric shall be the overall dimensions from ends of twists or knuckles. Permissible variation from the specified height shall be ± 1 inch (25mm) for standard selvage on fabric with mesh sizes 1 in. (25mm) and over and $\pm \frac{1}{2}$ in. (13mm) for all fabric with mesh sizes less than 1 inch (25mm).

D. Strength

1. Wire constituting the fabric shall meet the minimum breaking strength as determined according to A 370 (870 lbs. for 0.120" and 1250 lbs. for 0.148").
2. Specimens to establish conformance to this requirement shall comprise individual pickets from a section of the fence fabric. The specimens shall be of sufficient length so as to be firmly gripped in the testing machine after straightening. PVC coating may be removed from the sample by chemical or mechanical means before testing. The actual gage length (distance between jaws) of the specimen shall be limited to the underformed length of wire between the two adjacent bends.

E. Metal Coating

1. For Class 1 or Class 2 fabric, the weight of metallic coating shall conform to the following table:

Specified Diameter of Core Wire		Weight of Metallic Coatings		Minimum Weight of Aluminum Coating	
		Minimum Weight of Zinc or Zinc 5% Aluminum Alloy Coating			
Inches	(mm)	oz./ft ²	(g/m ²)	oz./ft ²	(g/m ²)
0.148	(3.76)	0.30	(92)	0.20	(61)
0.120	(3.05)	0.30	(92)	0.20	(61)

2. The weight of coating shall be determined on an individual piece of wire removed from the fabric. This specimen may be any length of wire over 12 inches (305mm) and shall include both bends and straight sections, but shall not include either twists or knuckles.
3. The weight of zinc, or zinc 5% aluminum alloy coating shall be determined by the method contained in Test Method A90/A90M after stripping the PVC.
4. The weight of aluminum coating shall be determined by the method contained in Test Method A 428, after stripping the PVC coating.

F. PVC Coating

1. The thickness of the PVC coating shall be in accordance with the following table:

Thickness of PVC Coating				
	Class 1, Class 2a		Class 2b	
	Inches	(mm)	Inches	(mm)
Minimum Thickness at Any Point	0.015	(0.38)	0.006	(0.15)
Maximum Thickness at Any Point	0.025	(0.64)	0.010	(0.25)
Note: Thickness of zinc coat can be estimated using 1 ounce of zinc per square foot (305 g/m ²) equivalent to a coating thickness of 0.0017 inch (0.043mm)				

2. The thickness of the PVC coating shall be determined on an individual piece of wire removed from the fabric. This specimen may be any length of wire over 12 inches (305mm) and shall include both bends and straight sections, but shall not include either twists or knuckles.
3. For Class 1 or Class 2a material, mechanically strip the PVC coating from the wire and measure the minimum and maximum thickness of the PVC coating with a suitable micrometer.
4. For Class 2b material, strip the PVC coating by chemical means and determine the diameter of the bare wire. Scrape the coating from one side of the wire and measure the reduced diameter with a micrometer. The thickness of coating at this point is the difference between the measurement thus obtained and the measured diameter of the bare wire.

In a similar manner, determine the thickness of coating at right angles to the first determination.

G. PVC Properties

The PVC coated wire from which the fabric is woven shall have a demonstrated ability to conform to the following requirements.

1. Adhesion Tests

a. Class 2a

Three (3) specimens from each lot shall be tested. Measure a distance of 3/4 inch (19mm) from the end of the specimen. With a regular hand grip wire stripper exert maximum hand pull parallel to the axis of the wire. Attempt to remove the measured portion of the vinyl sleeve from the core wire. The lot shall be acceptable if the vinyl sleeve is not capable of being removed from the core wire on all three samples.

b. Three (3) specimens from each lot shall be tested. Make two (2) cuts parallel to the axis of the wire through the coating, approximately 1/16 inch (1.6mm) apart, at least 1/2 inch (12.7mm) long. With a knife, peel back a section of the coating between 1/8 inch (3.2mm) and 1/4 inch (6.4mm) long, to produce a tab. Attempt to remove the 1/16 inch (1.6mm) strip of coating by pulling the tab. The lot shall be acceptable if the coating breaks rather than separates from the core wire on all three specimens.

2. Accelerated Aging

PVC coated wire from which the fabric is woven shall withstand exposure for 1000 hours without failure at a black panel temperature of 145°F (63°C) when tested in accordance with ASTM D 1499. Type D, E or F apparatus described in ASTM G 23 or Type BH apparatus described in ASTM G 26 shall be used for the test.

The product shall be construed to have failed the test if:

- a. The wire fails to withstand the mandrel bend test.
- b. Shrinkage of the PVC coating is greater than 1/16 inch per ft. (5.2mm/m) of wire.
- c. There is a significant change in color or gloss of the PVC surface as determined by visual inspection.

3. Mandrel Bend
 - a. PVC coated wire when subjected to a single bend at -20°F (-29°C) around a mandrel no larger than ten times the diameter of the wire shall not exhibit breaks or cracks in the PVC coating.
 - b. The mandrel bend test shall be performed on an individual piece of wire removed from the fabric. This specimen may be any length of wire over 12 inches (305mm) and shall include both bends and straight sections, but shall not include either twists or knuckles.

4. Color

- a. Unless otherwise stipulated, the color of the PVC in Class 1, 2a and 2b fabric shall be either green, brown or black in accordance with the standard colors and ASTM F 934.
- b. Compliance with this requirement shall be determined by comparison of specimens of the PVC coated wire to standard flat specimens of fused film of approximately the thickness specified for the PVC coating to be applied to the wire, and measuring at least 1-1/2 x 1-1/2 inch (38mm x 38mm).
- c. Standard flat specimens for the evaluation of color of Class 1 or Class 2a coatings shall be prepared by milling, calendaring, or compression molding PVC pellets, using temperatures approximating those to be used in the extrusion process.
- d. Standard flat specimens for the evaluation of Class 2b coatings shall be prepared by thermally fusing PVC powder onto a suitable base, using temperatures approximating those to be used in the powder coating process.
- e. The color of the standard flat specimens shall be determined in accordance with ASTM D 2244 and D 1729. The color of the specimens shall not vary more than 6 Delta E when exposed to 500,000 Langley's accelerated weathering operated in accordance with Practice G 90 with both day and night spray cycles.

- H. PVC Coated Tension Wire

1. PVC coated tension wire shall be manufactured in accordance with ASTM 1664 which requires either a (1) heavy duty 7 gage, 0.177 in. (4.50mm) metallic coated core wire having a breaking strength of 1950 lbf (8670 N) or a (2) light duty 9 gage 0.148 in. (3.76mm) metallic coated core wire having a breaking strength of 1290 lbf (5740 N). The PVC coating shall be Class 1 extruded, Class 2a extruded and adhered or Class 2b fused and adhered.

I. PVC Coated Barb Wire

- PVC coated barb wire shall be manufactured in accordance with ASTM F 1665 which requires two strands of 14 gage, 0.080 in. (2.03mm) metallic coated core wire with four-point 14 gage, 0.080 in. (2.03mm) zinc coated or aluminum alloy barbs. The PVC coating shall be Class 1 extruded, Class 2a extruded and adhered or Class 2b fused and adhered. The spacing of the barbs shall be Type I, 5 in. (125mm) on center or Type II, high security 3 in. (75mm) on center.

2.03 Steel Fence Rails, Posts, Gates, and Accessories

A. Materials

- Posts, gate frames, braces, rails, stretcher bars, truss rods and tension wire shall be of steel. Gate hinges, post caps, barbed wire supporting arms, stretcher bar bands, and other parts shall be of steel, malleable iron, ductile iron or equal except that post tops, rail ends, ties and clips may be of aluminum.
- Where required to match fence fabric, supplemental color coating shall be provided, 10 mils (0.25mm) of polyvinyl chloride or 2 mils (0.8mm) of polyester should be obtained in conjunction with all coatings as indicated. Unless otherwise indicated, color of the coating shall be in accordance with ASTM F934, Green, Olive Green, Brown, and Black. Moveable and threaded fittings need not be coated but field coated per manufacturer's recommendations.
- Intermediate posts shall be Type I or Type II round pipe or "C" roll formed sections conforming to the dimensions and weights shown in Table 1.

Use and Section	TABLE 1 — Dimensions and Weights					
	Nominal Outside Diameter		Nominal Weight Per Foot (± 10% Tolerance)			
	Inches	(Millimeters)	Type I		Type II	
			Lbs/Ft	(kg/m)	Lbs/Ft	(kg/m)
End, corner and pull posts fabric height 6'0" (1.83m):round square	2.375	(60.0)	3.65	(5.43)	3.12	(4.64)
	2.00	(50.8)	2.60	(3.87)		
	2.875	(73.0)	5.79	(8.62)	4.64	(6.90)
Over 6'0" (1.83 m): round square	2.50	(63.5)	5.10	(7.60)		
Rails and post braces	1.66	(42.0)	2.27	(3.38)	1.83	(2.72)
Intermediate Posts for Fabric Heights	Nominal Weight Per Foot (± 10% Tolerance)					
			Type I		Type II	C Sections
			Lbs/Ft	(kg/m)	Lbs/Ft	(kg/m)
6'0" (1.83 m) and less; round C Section	1.90	(48.3)	2.72	(4.05)	2.28	(3.39)
	1.875" (47.6mm) x 1.625" (41.3mm)					
Over 6'0" (1.83m); round C Section	2.375	(60.0)	3.65	(5.43)	3.12	(4.64)
	2.25" (57.1mm) x 1.70" (43.2mm)		3.65	(5.43)	3.12	(4.64)
			2.64	(3.93)	2.64	(3.93)

4. Type I round post shall be hot dipped galvanized with a minimum average zinc coating of 1.8 oz./ft.² (0.55 kg/m²) meeting ASTM F-1083 for standard weight (Schedule 40) galvanized pipe.
5. Type II round post shall be steel pipe cold-formed and welded per ASTM F1043, Group IC, having a minimum yield strength of 50,000 psi (344mPa). The external zinc coating shall be Type B, zinc with polymer film, 0.90 oz./ft.² (275g/m²) minimum zinc coating with a chromate conversion and a verifiable polymer film. The internal coating shall be Type B, zinc 0.90 oz./ft.² (275g/m²) minimum or type D, zinc pigmented, 81% nominal coating with 0.30 mils (0.008mm) minimum thickness.
6. Roll formed "C" Section steel shapes shall be produced from steel having a minimum yield strength of 45,000 psi (10mPa) and meet the strength and protective coating requirements of ASTM F-1043.
7. Terminal posts, braces and rails shall be round or square Type I or round Type II and shall conform to dimensions and weights as shown in Table 1.

B. Zinc Coating

All Type I and Type II steel framework and other iron parts shall be zinc coated by the hot-dipped method, using zinc Grade E. The weight of zinc coat on Type I rail, post and brace shall have not less than 1.8 oz./ft.² (0.55Kg/m²) coating as listed in 1.1.1. Type II steel rails, posts and braces shall have an average weight of not less than 0.90 oz./ft.²) as listed in 1.1.2 Zinc weight shall be determined in accordance with ASTM A-90.

C. Post Braces

Shall be provided for each gate, corner, pull, and end post for use when top rail is omitted or with fabric 6 feet (1.80m) or more in height, and shall consist of a round tubular brace extending to each adjacent line post at approximately mid height of the fabric, and a truss consisting of a rod not less than 5/16 inch (7.90mm) nominal diameter from the line post back to the gate, corner, pull, or end post, with a turnbuckle or other equivalent provision for adjustment. Truss rods may be eliminated in any line of fence where there is a continuous center rail.

D. Post Tops

Shall consist of ornamental tops or combination tops with barbed wire supporting arms, as required. When so required, or when a top rail is to be provided, the top shall be provided with a hole suitable for the through passage of the top rail. The post tops shall fit over the outside of posts and shall exclude moisture from posts.

E. Barbed Wire Supporting Arms

When required to be furnished, shall be at an angle of approximately 45° arms the top wire shall be approximately twelve inches horizontally from the fence line

and the other wires spaced uniformly between the top of the fence fabric and the outside strand. Barbed wire arm shall be of sufficient strength to withstand a weight of 250 pounds (113.3kg) applied at the outer strand of barbed wire.

F. Top Rails

Shall be in lengths not less than 18 feet (5.5m), and shall be fitted with couplings or swaged for connecting the lengths into a continuous run. The couplings shall be not less than 6 inches (152.4mm) long, with 0.070 inches (1.75mm) minimum wall thickness, and shall allow for expansion and contraction of the rail. Open seam outside sleeves shall be permitted only with a minimum wall thickness of 0.100 inches (2.50mm). Suitable ties or clips shall be provided in sufficient number for attaching the fabric securely to the top rail at intervals not exceeding 24 inches (610mm). Means shall be provided for attaching the top rail to each gate, corner, pull and end post.

G. Tension Bars

Shall not be less than 3/16 inch (4.76mm) by 3/4 inch (19.05mm) and not less than 2 inches (50mm) shorter than the normal height of the fabric with which they are to be used. One tension bar shall be provided for each end and gate post, and two for each corner and pull post.

H. Ties or Clips

Of adequate strength shall be provided in sufficient number for attaching the fabric to all line post at intervals not exceeding 15 inches (380mm); and not exceeding 24 inches (610mm) when attaching fabric to top rail or tension wire.

I. Bands or Clips

Of galvanized steel or aluminum alloy per ASTM F-626 shall be provided in sufficient number for attaching the fabric and stretcher bars to all terminal posts at intervals not exceeding 15 inches (380mm). Tension bands shall be formed from flat or beveled steel and shall have a minimum thickness after galvanizing of 0.078 inch (1.98mm); and minimum width of 3/4 inch (19.05mm) for posts 4" O.D. (101.60mm) or less and 0.108 inch (2.74mm) thickness by 7/8 inch (22.23mm) for posts larger than 4" O.D. (101.60mm). Brace bands shall be formed from flat or beveled steel and shall have a minimum thickness of 0.108 inch (2.74mm) after galvanizing; and minimum width of 3/4 inch (19.05mm) for post 4" O.D. (101.60mm). Standard mill tolerances of ± 0.005 inch (± 0.127 mm) on thickness and 0.010 inch (0.25mm) on width shall apply - attachment bolts shall be 5/16 (7.94mm) width shall apply - attachment bolts shall be 5/16 (7.94mm) x 1-1/4 inch (31.76mm) galvanized carriage bolts with nuts.

J. Tension Wire

Shall be Marcellled (spiralled or crimped) #7 gage, 0.177 inches (4.50mm) \pm 0.005 inches (± 0.127 mm) in diameter, conforming to ASTM A-824.

1. Tension Wire Coating - shall conform to ASTM A-824 Type I, Aluminum-coated, 0.40 oz/ft (122g/m²) or Type II Zinc-coated Class 2, 1.20 oz/ft.²(366g/m²)

K. Barbed Wire

1. Shall consist of two strands of twisted wire with 4 point barbs on 5 inch (127mm) spacing. The following listed barbed wires are acceptable for use with chain link fencing:

Line Wire Gage	Line Wire Coating Weight	Barb Gage	Barb Coating Weight
12 ½	ZN 0.80 oz/ft. ² (245g/m ²)	14	ZN0.65 oz/ft. ² (200g/m ²)
12 ½	AL 0.30 oz/ft. ² (90g/m ²)	14	Aluminum Alloy, or Aluminum Coated AL 0.25 oz/ft. ² (75g/m ²)
12 ½	Aluminum Alloy	14	Aluminum Alloy

2. Zinc-coated barbed wire shall conform to ASTM A-121, Chain link fence grade. Aluminum-coated barbed wire shall conform to ASTM A-585, Type I, 5 inch (127mm) or Type II, 3 inch (76mm) barb spacing.

L. Swing Gates

1. Materials

Swing gates shall conform to ASTM F 900.

Materials - The base materials of the gate frame shall be round or rectangular tubular members, welded at all corners or assembled with corner fittings. Gates assembled with corner fittings shall have adjustable truss rods 5/16 in. (7.9mm) minimum diameter on panels 5 ft. (1.5m) wide or wider. Truss rods shall be the same base metal and finish as the gate frames.

The Interior Bracing - when needed shall be the same metal and shape tubular material and finish as the gate frame, but need not be the same size. Gate leaves shall have vertical interior bracing at maximum intervals of 8 feet (2.4m) and shall have a horizontal interior member if the fabric height is 8 feet (2.4m) or more.

Zinc-Coated Steel Frames - shall be in accordance with ASTM Specifications F 1043 or F 1083, or a combination thereof, and shall match that selected for any adjoining fence framework. Welded joints shall be coated in accordance with Practice A780, employing a zinc-rich paint.

Aluminum Alloy Gate Frames - shall be in accordance with Specification F 1043.

Polymer-Coated Steel or Polymer-Coated Aluminum Frames - shall be in accordance to paragraphs 3 and 4. Welded joints shall be top-coated to match the frame color.

Gate Fabric - shall be the same type as used in fence construction. The fabric shall be attached securely to the gate frame at intervals not exceeding 15 in. (357mm).

Barbed Wire Top - shall have the end members of the gate frame extended in height to accommodate three strands of barbed wire.

2. Dimensions, Mass, and Permissible Variations

- a. Size of the gate opening shall be measured from the inside face to inside face of gate posts.
- b. Dimensions and weights of gate frame members and posts shall be in accordance with Tables 2 and 3.
- c. Gate frame shall be designed for the width and built so that the outer members shall not sag in excess of the lesser of 1% of the gate leaf width of 2 in. (50.8mm).

3. Gate Accessories

- a. Gate Hinges - Hinges shall be structurally capable of supporting the gate leaf and allow the gate to open and close without binding. The hinges shall be so designed to permit the gate to swing a full 180°.
- b. Single Gate Latch - Gate latch shall be capable of retaining the gate in a closed position and shall have provision for a padlock.
- c. Double Gate Latch - Gate latch shall be a drop rod or plunger bar arranged to engage the gate stop. Locking devices shall be constructed so that the center drop rod or plunger bar cannot be raised when the gate is locked. The latching devices shall have provision for a padlock.
- d. Gate Stops - Gate stops shall be provided for all double gates.
- e. Keepers - shall be provided for each gate leaf over 5 ft. (1.5m wide).

Table 2				
Gate Frame Members, Dimensions and Weights				
Gate Fabric Height	Outside Dimensions		Minimum Weight lb/ft	
	in. (mm)		(kg/m)	
6 ft (1.8m) or less:				
Round tubular (steel)	1.66	(42.2)	1.83	(2.72)
Rectangular tubular (steel)	1.50	(38.1)	1.84	(2.74)
Round tubular (aluminum)	1.90	(48.3)	0.91	(1.35)
Rectangular tubular (aluminum)	2.00	(50.8)	0.91	(1.35)
Over 6 ft. (1.8m):				
Round tubular (steel)	1.90	(48.3)	2.28	(3.39)
Rectangular tubular (steel)	2.00	(50.8)	2.52	(3.75)
Round tubular (aluminum)	1.90	(48.3)	0.91	(1.35)
Rectangular tubular (aluminum)	2.00	(50.8)	0.91	(1.35)
Interior Bracing:				
Round pipe (steel)	1.66	(42.2)	1.83	(3.39)
Rectangular pipe (steel)	1.50	(38.1)	1.84	(2.74)
Round tubular (aluminum)	1.90	(48.3)	0.91	(1.35)
Rectangular tubular (aluminum)	2.00	(50.8)	0.91	(1.35)
Note: Gate leaf shall have vertical interior bracing at maximum intervals of 8 ft. and shall have a horizontal interior or member if fabric height is 8 ft. or more. Additional horizontal, vertical or diagonal member or diagonal truss rods may be needed to comply with requirements of 2.c.				

Table 3					
Dimensions and Weight of Gate Posts					
Gate Leaf Width		Outside Diameter		Minimum Weight	
		of Pipe		lb/ft (kg/m)	
		in. (mm)			
For Gate Fabric Height of 6 ft. (1.8m) or less: Up to and including 4 ft. (1.2m)	Steel	2.375	(60.3)	3.11	(4.63)
	Aluminum	2.375	(60.3)	1.22	(1.81)
Over 4 to 10 ft. (1.2 to 3.7m)	Steel	2.875	(73.0)	4.64	(6.91)
	Aluminum	2.875	(73.0)	1.94	(2.89)
Over 10 to 18 ft. (3.7 to 5.5m)	Steel	4.000	(101.6)	8.65	(12.88)
	Aluminum	4.000	(101.6)	2.99	(4.45)
For Gate Fabric Height of 6 ft. (1.8m): Up to and including 6 ft. (1.8m)	Steel	2.875	(73.0)	4.64	(7.04)
	Aluminum	2.875	(73.0)	1.94	(2.89)
Over 6 to 12 ft. (1.8 to 3.7m)	Steel	4.000	(101.6)	8.65	(12.88)
	Aluminum	4.000	(101.6)	2.99	(4.45)
Over 12 to 18 ft. (3.7 to 5.5m)	Steel	6.625	(168.3)	18.02	(26.82)
Over 18 to 24 ft. (5.5 to 7.3m)	Steel	6.625	(219.1)	27.12	(40.36)
Note: All gate posts shall be of sufficient strength so that the total deflection of the gate frame and the gate post at the end of the gate leaf shall not exceed the lesser of 2% of the gate leaf width or 4 in. When necessary to meet this requirement due to the total weight of the gate leaf, the next larger size post listed in the above Table shall be used.					

M. Sliding Gates

Sliding gates shall comply with ASTM F 1184 which provides for overhead slide gates which are horizontal slide gates supported only from above and cantilever slide gates which are horizontal slide gates spanning an opening without a top or bottom support

within that opening. Cantilever slide gates shall be supplied with steel or aluminum frames using eternal or internal rollers. Safety guide posts and roller guards shall be required for cantilever slide gates using external rollers.

PART 3 EXECUTION

3.01 Installation

- A. Installation of fencing and gates shall meet the requirements of ASTM F 567 which are not intended to preclude any practice that has a proven performance equal to or better under varying conditions nor do they support to address all of the safety problems involved. It is the responsibility of the contractor to provide appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.
- B. Site Preparation shall involve the location of fence lines, gates, terminal posts, underground utility locations, USC&G benchmarks, property monuments and underground structures by the contractor who shall also provide for site cleaning and grading with adequate clearance on both sides of the fence line.
- C. Post Location shall be as required spaced equidistant at intervals not exceeding 10 ft. (3.05m). Measure the interval parallel to the grade of the proposed fence and in the line of the fence from center to center of the posts.
- D. Terminal Posts (end corner and gate posts) shall be set at the beginning and end and end of each continuous length of fence and at abrupt changes in vertical and horizontal alignments.
- E. Post Foundations shall be concrete with hole diameters dug or drilled a minimum of four times the largest cross direction of the post and a minimum depth of 24 in. (609.6mm) plus an additional 3 in. (76.2mm) for each 1 ft. (305mm) increase in the fence height over 4 ft. (1.22m).
- F. Set Posts in a vertical position, plumb and align while concrete 2500 psi (17.2 mPa), is backfilled into the excavation and extended 2 in. (50mm) above grade and crowned to shed water or to 2 in. (50mm) below grade if a cover of sod, blacktop, or other material is provided.
- G. Mechanical Devices can be used in place of concrete for the setting of fence posts provided the device strength in the ground is equal or superior to the strength developed by the concrete footing.
- H. Solid Rock or Concrete can be encountered where overburden of soil is not present. In this case set posts in the solid rock or concrete to a depth three times the largest cross section of the posts. The diameter of the hole shall be ½ in. (13mm) greater than the largest cross section of the post.
- I. Sleeves can be used in order to leave voids in new concrete construction. Half-fill the void with nonshrinkable hydraulic cement and force the post to the bottom of the hole and plumb. Thoroughly work additional grout into the hole so as to leave no voids. Crown the grout to shed water.

- J. Drive Posts are to be driven by mechanical means to a minimum depth of 36 in. (914.4mm) or 6 in. (152.4mm) greater than what is required for posts set in concrete for a given fence height except where soil conditions are unstable or rock or concrete is encountered. In the case of the latter, the depth should be in keeping with standard fence construction practices for the local area or utilize the solid rock or concrete requirements previously outlined. When driving posts the tops must be protected to prevent distortion of the exposed end. The use of a drive cap is required.
- K. Gate Posts - shall be set in concrete footings. Swing gate posts shall be set in footings as listed in Table 4. Cantilever slide gate post footings shall have a minimum diameter of 12 in. (304mm) and a minimum depth of 42 in. (1066mm). Overhead slide gate posts shall be set in a 12 in. (304mm) diameter hole with a depth of 38 in. (1.2m) for gate openings up to 24 ft. (7.3m). For openings 24 ft. (7.3m) to 40 ft. (12.19m), a 4 in. (101.6mm) outside diameter double post shall be set in a 24 in. (610mm) by 16 in. (406.4mm) sized hole, with a depth of 48 in. (1.2m).
- L. Terminal Post - bracing is required on all fabric over 6 ft. (1.83m) and on fabric over 12 ft. (3.66m) in height a center rail is required. Securely fasten diagonal braces to the terminal post and the adjacent line post or its footing or a footing of equal size. There should be no more than a 50° angle between the brace and the ground. Securely fasten horizontal braces (if used in place of diagonal braces) with truss rods from the bottom of the terminal post to the adjacent line post where the brace rail terminates. Attach the brace at the halfway point of the terminal post above grade.
- M. Top Rail - must be supported at each post so that a continuous brace from end to end of each stretch of fence is formed. Securely fasten the top rail to the terminal posts and join with sleeves or coupling to allow for expansion and contraction.
- N. Tension Wire - should be stretched from end to end of each stretch of fence. Bottom tension wire should be fastened within the bottom 6 in. (150mm) of the fabric. The tension wire should be taut and free of sag.
- O. Chain-Link Fabric - shall be placed on the outside of the area enclosed or as directed. Place the fabric by securing one end, applying sufficient tension to remove all slack before making attachments elsewhere. Tighten the fabric to provide a smooth uniform appearance free from sag. The fabric may be cut by untwisting a picket and attaching each span independently at all terminal posts. Stretcher bars shall be used with tension bands or other suitable devices at 15 in. (380mm) maximum intervals. The fence fabric shall be installed 2 in. (50mm) above ground level. Measure clearance at the post with a tolerance of ± 3 in. (± 76 mm). The fabric shall be fastened to the line posts at intervals not exceeding 15 in. (380mm). Fasten the fabric to the rail or tension wire at intervals not exceeding 24 in. (610mm). Rolls of wire fabric may be joined by weaving a single picket into the ends of the rolls to form a continuous mesh.

- P. Barbed Wire - where required, shall be pulled taut to remove all sag. Firmly install in the slots of extension arms, and secure it to a terminal post utilizing terminal post band arms or brace bands or other suitable devices.
- Q. Proper Gate Operation - and design requires consideration of opening direction, grade clearance, and possible obstructions.
- R. Work areas - shall be left neat and free of any debris caused by the erection of the fence. All work shall be performed in a safe and orderly fashion in accordance with the Williams-Steiger Occupational Safety and Health Act of 1970.

A padlock shall be provided for each gate or set of gates with duplicate keys. All padlocks provided shall operate with the same key.

The Contractor shall furnish and install all materials to construct mow strips centered under the fence fabric when indicated on the drawings. Strips shall have an exposed runner width of not less than 24-inches of 4" thick crushed stone with a size range of 1/2-inch to 3/4-inch over a minimum of 6 mil. polyvinyl weed barrier. The Contractor shall also apply a weed control agent to the stone strip.

Table 4						
Minimum Requirements for Setting Industrial and Commercial Swing Gate Posts						
Gate Leaf Width	Height	Post Size Specification F 900	Size of Hole		Depth	
			Diameter		Depth	
			Dirt	Solid Rock or Concrete	Dirt	Solid Rock or Concrete
4 ft. or less (1.2m)	6ft. or less (1.8m)	Steel 2.375 (60.3mm) Aluminum 2.375 (60.3mm)	10 in. (254mm)	Post O.D. + ½ in. (+13mm)	30 in. (762mm)	Post O.D. x 3
Over 4 ft. to 10 ft. (1.2m to 3.7m)	6ft. or less (1.8m)	Steel 2.875 (73.0mm) Aluminum 2.875 (73.0mm)	12 in. (304mm)	Post O.D. + ½ in. (+13mm)	36 in. (914.5mm)	Post O.D. x 3
Over 10 ft. to 18 ft. (3.7m to 5.5m)	6ft. or less (1.8m)	Steel 4.0 (101.6mm) Aluminum 4.0 (101.6mm)	14 in. (356.4mm)	Post O.D. + ½ in. (+13mm)	36 in. (914.5mm)	Post O.D. x 3
6 ft. or less (1.8m)	Over 6 ft. (1.8m)	Steel 4.0 (101.6mm) Aluminum 4.0 (101.6mm)	10 in. (254mm)	Post O.D. + ½ in. (+13mm)	36 in. (914.5mm)	Post O.D. x 3
Over 6 ft. to 12 ft. (1.8m to 3.7m)	Over 6 ft. (1.8m)	Steel 4.0 (101.6mm) Aluminum 4.0 (101.6mm)	12 in. (304mm)	Post O.D. + ½ in. (+13mm)	36 in. (914.5mm)	Post O.D. x 3
Over 12 ft. to 18 ft. (3.7m to 5.5m)	Over 6 ft. (1.8m)	Steel 6.625 (168.3mm)	16 in. (406.4mm)	Post O.D. + ½ in. (+13mm)	42 in. (1066mm)	Post O.D. x 3
Over 18 ft. to 24 ft. (5.5m to 7.3m)	Over 6 ft. (1.8m)	Steel 8.625 (219.1mm)	18 in. (457.2mm)	Post O.D. + ½ in. (+13mm)	48 in. (1.2m)	Post O.D. x 3

(SECTION WM 24)

SEEDING AND SODDING

PART 1 GENERAL

1.01 Description

- A. The areas to be seeded shall be those areas which are shown on the plans or as specified in the Detailed Specifications.

1.02 Prepared Seedbed

- A. It must be recognized that preparing a seedbed in residential areas and public places requires that it be free from objectionable materials and be left in a smooth and uniform appearance that is aesthetically pleasing to the Owner.
- B. Prior to start of preparation of seeding the Contractor shall remove all debris, sheds, tools, equipment and other objects larger than 3/4 inches (19 mm) in greatest diameter from the area to be seeded. The areas to be seeded shall be loosened and reworked by means of discing, harrowing, and rolling; or reworked by means of powered rotary tiller; so that the ground will be left in a satisfactory manner ready for seeding. The surface of the area to be seeded shall be left smooth and uniform which conforms to the finished grades and cross sections as shown on the plans and without depressions or irregularities, or as otherwise specified.
- C. After the seed has been sown, and prior to compacting, the lawn area shall be cleared of all construction materials and debris, stones or other objects larger than 3/4 inches (19 mm) in greatest diameter, and all wire, roots, brush, stumps or other objects that may interfere with subsequent mowing operations.

1.03 Time of Seeding

- A. Spring seeding shall be done between March 1 and May 15, and Fall seeding between August 15 and October 15. During these periods, the time of seeding shall be determined by the Engineer whose decisions shall be based on the moisture content of the soil, and weather conditions. The Engineer may, at his option, extend the seeding season. (Mulched seeding may be done between March 1 and October 15 or possibly later in the fall.)

PART 2 PRODUCTS

2.01 Lime, Fertilizer and Seed

- A. Lime: Agricultural hydrated lime shall be uniformly applied at a rate of one (1) ton per acre over the area to be seeded unless otherwise specified. The Contractor may substitute one and one half (1 ½) tons of agricultural ground limestone for one (1) ton of agricultural hydrated lime.

- B. Fertilizer: Fertilizer of the 10-20-10 grade shall be uniformly applied over the area to be seeded at the rate of 0.44 ton for each acre to be seeded unless otherwise specified. The above fertilizer is equivalent to four hundred (400) pounds ammonium sulphate, 20%N; three hundred fifty-five (355) pounds triple super phosphate, forty-five percent (45%) P₂O₅; one hundred thirty-three (133) pounds murate of potash, sixty percent (60%).
- C. Spreading Method: The lime and fertilizer shall be spread uniformly over the area to be seeded, and shall be mixed into the top two (2) inches of soil with a disc harrow, rotary tiller, mixer or hand raking.
- D. Seed: Unless otherwise specified, the following Pure Live seeds shall be mixed and applied at the rate of one hundred twenty (120) pounds per acre (2.8 pounds per 1,000 square feet):
 - Kentucky Bluegrass - Pao Pratensis -----70 lb.
 - Kentucky 31 Fescue - Festuca Elatior,
var. arundiancea -----30 lb.
 - Red Fescue - Festurca rubra -----20 lb.

PART 3 EXECUTION

3.01 Seeding Method

- A. The Contractor shall employ the broadcasting method for seeding. The sowing seed mixtures shall be kept thoroughly mixed during the sowing operations to prevent separation of species and the subsequent lack of uniform distribution of species. The sowing shall be stopped when satisfactory results are not likely to be obtained due to excessive moisture, high winds, or other unfavorable conditions.
- B. Seed shall be broadcast by either hand or by approved sowing equipment at a rate which will provide not less than the minimum quantity of pure live seed as specified. The seed shall be uniformly distributed over the designated areas. If sowing is by hand methods, one half (½) the seed shall be sown when the sower is moving in one (1) direction and the remainder sown with the sower moving in right angles to the first direction. Where seed is sown by means of approved broadcasting equipment, the seed may be sown with a single pass of the equipment. Broadcast sowing shall not be done during windy weather. The seed shall be covered by means of a brush harrow, spike tooth harrow, chain harrow, cultipacker, or other approved device, so that most of the seed will be placed within a satisfactory depth range.
- C. After the seed has been sown, and prior to compacting, the lawn area shall be cleared of all construction materials and debris, stones or other objects larger than 3/4 inches (19 mm) in greatest diameter, and all wire, roots, brush, stumps or other objects that may interfere with subsequent mowing operations.

3.02 Mulched Seeding

A. General

1. When specified in the Detailed Specifications, the required mulch seeding shall consist of seeding as specified hereinbefore under the heading of "Seeding", and then covering the seeded areas with mulch.

B. Mulch

1. The mulching material may consist of straw, chaff, clover, timothy, alfalfa, peppermint or soy bean hay, shredded fodder or clover chaff. All mulch shall be free from primary noxious weeds as set forth under Section 914.05 of the State Department of Transportation Standard Specification.
2. The mulching material at the time of delivery to the site of the work shall not contain more than fifty percent (50%) moisture. The mulching material shall be applied uniformly in a continuous blanket to a depth of approximately two (2) inches. After being held down, the mulch shall be thoroughly wetted, care being taken not to displace the seed or soil underneath.

C. Holding Mulch in Place

1. Unless otherwise specified, the mulch shall be held in place in accordance with State Department of Transportation Standard Specifications. Regardless of the method used, the mulching material shall be satisfactorily maintained in place until final completion and acceptance of the work.

3.03 Sodding

A. General

1. The areas to be sodded shall be those areas which are shown on the plans or as specified in the Detailed Specifications. Sod shall be fibrous, well rooted bluegrass, or other approved sod, with the grass cut to a height of not more than three (3) inches. Edges of sod shall be cleanly cut, either by hand or machine, to a uniform thickness of not less than one and one half (1 1/4) inches, to a uniform width of not less than sixteen (16) inches, and in strips of not less than three (3) feet in length.
2. Sod shall be free from all primary noxious weeds as defined by the State Seed Law.

B. Preparation of Ground before Sodding

1. The area to be sodded shall be smooth and uniform, and shall conform with the cross section required by the Plans or as directed. Grades prepared for sod shall be of sufficient depth below adjacent unsodded areas so that newly laid sod will conform with the surrounding surface.

2. After the grade has been prepared, and the topsoil has been spread, three fourths (3/4) lb. of agricultural hydrated lime and one fifth (1/5) lb. of 10-20-10 fertilizer shall be applied to each square yard, and thoroughly mixed into the top two (2) inches of soil. The area shall then be raked, and all clods, stones and debris removed.

C. Laying Sod

1. Sod strips shall be carefully laid by hand in the direction designated by the Engineer. At the edges of sodded areas the sod shall be carefully fitted into the grade, if excavated.
2. The sod strips shall be butted closely together to avoid any open joints. After laying and the initial watering, the sod shall be firmly tamped or rolled to insure firm contact with the soil underneath and shall conform with the surrounding surface. After compaction, the sod shall present a smooth, even surface, free from lumps and depressions.
3. Sod placed on slopes shall be pegged if directed by the Engineer. Pegs shall be driven down until not more than one (1) inch protrudes above the sod surface. The number of pegs shall be sufficient to hold the sod in place.

D. Watering Sod

1. The sod shall be thoroughly watered immediately after placing, and the watering continued for at least seven (7) days. If, at the end of thirty (30) days the sod is in good growing condition, the Contractor will not be required to repair or replace any sod which may thereafter be injured or damaged because of drought, unless written agreement for out of season sodding provides otherwise. The Contractor shall furnish the water at his expense.

E. Seasonal and Temperature Limitations for Sodding

1. No sod shall be laid during the months of June, July and August, unless written permission is obtained from the Engineer. When such permission is received the Contractor shall, before laying the sod out of season, agree in writing to the following provisions:
 - a. Sod shall be in good, live and growing conditions;
 - b. Sod shall be placed within thirty-six (36) hours after cutting and during that period be protected from damage;
 - c. Sod shall be watered sufficiently, and otherwise maintained so that it will be in a live, growing condition at the time other items of the contract are accepted, provided the period between placing sod and acceptance is greater than thirty (30) days.

Winter sodding will be permitted when the temperature is above thirty-five degrees Fahrenheit (35 F). No frozen sod shall be laid and no sod shall be laid on frozen soil. Sod shall be properly protected from drying out or freezing and shall be laid within forty-eight (48) hours after cutting.

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(SECTION WM 25.1)

COATINGS FOR WASTEWATER TREATMENT PLANT AND RELATED STRUCTURES

PART 1 GENERAL

1.01 Description

- A. This section covers preparation of surfaces, standard for materials, application standards for interior, exterior, immersed and non-immersed surfaces to be painted. The Contractor shall furnish materials, equipment, tools and labor necessary for total completion. This section is intended to include all work and materials necessary for completion of the work, any incidental item of material, labor or detail required for the proper execution and completion of the work and omitted from this section but obviously required by governing codes, local regulations, trade practices or operational functions, shall be provided as a part of the work without extra charge, even though not specifically detailed or mentioned.

- B. The object of these specifications is to describe the materials and workmanship necessary to provide complete protection of the surface to be coated and to provide a neat finished appearance. Coating shall be done at such times as the Contractor and Engineer may agree upon in order that dust-free and neat work be obtained. All surfaces shall be prepared and all coatings shall be applied strictly in accordance with the most recent manufacturer's printed instructions and shall be performed in a manner satisfactory to the Engineer.

- C. The Contractor shall arrange and conduct a job site conference between the coating manufacturer's representative, the Engineer's representative, and the Contractor's personnel or sub-contractor assigned this work prior to any field surface preparation or coating application.

1.02 References

- A. Reference Standards (all latest versions shall apply)
 - 1. SSPC - The Society for Protective Coatings
 - 2. NFPA - National Fire Prevention Association
 - 3. NAPF – National Association of Pipe Fabricators
 - 4. ASTM - American Standard Testing Materials, D16, D4258, D4259, D4261, & D4263
 - 5. NACE International - National Association of Corrosion Engineers International
 - 6. PDCA - Painting and Decorating Contractors of America
 - 7. ICRI - International Concrete Repair Institute
 - 8. PDCA P5-94 « Benchmark Sample Procedures for Paint
 - 9. SSPC-PA-2 Measurement of Dry Paint Thickness with Magnetic Gauge
 - 10. ASTM G210 SWAT – Rapid Evaluation of Coatings and Linings by Severe Wastewater Analysis Test

B. Qualifications

1. All coating and surface preparation shall be completed by the Painting Contractor or prior approved sub-contractor. The painter shall be specialized in industrial or heavy commercial painting. For small projects, the Contractor may be allowed to apply the specified coatings if approved by the Owner and Engineer.

C. Quality of Materials

1. Materials applied to each surface shall be compatible and complete system. Any incompatible primers or barrier coats shall be removed and re-primed. The Contractor shall notify the Engineer in writing of any anticipated problems using the specified coating systems with substrates primed by others.

D. Sample Areas

1. Paint sample areas to establish standard on quality workmanship per *PDCA P5 Benchmark Sample Procedures for Paint*, as directed by the Engineer and to establish a basis for acceptability of the coating work. Job mock-ups and samples approved by the Engineer shall stay in place the remainder of the project to provide a standard of quality to which production work will be compared.

E. Submittals

1. Submit Manufacturer's Technical Data Sheets including paint label analysis and application instructions for each material proposed for use. Equivalent materials of other manufacturers may be substituted on approval by the Engineer. Submittals shall include performance data as certified by a qualified testing laboratory. Substitutions that decrease the film thickness, the number of coats applied, change the generic type of coating, or fail to meet the performance criteria of the specified material will not be approved. Prime, intermediate and finish coats on all surfaces shall be furnished by the same manufacturer.
2. For High H₂S Exposed Coatings, submittals shall include performance data as certified by www.RAEEngineering.ca or www.CorrosionLab.com for SWAT (EIS) ASTM G210 testing for Engineer's evaluation. SWAT test results from other agencies are also acceptable.

F. Color Samples

1. Submit 4 samples of manufacturer's standard color range.

1.03 Product Delivery, Storage & Handling

- A. All materials delivered to the job site shall be in original sealed and labeled containers of the paint manufacturer. Each container shall provide labels with the following information: manufacturer's name, contents by volume for major pigment

and vehicle constituents, expiration date after which material should not be used; thinning instructions and application instructions. Containers which are broken, opened, water marked or contain caked, lumpy or otherwise damaged materials are unacceptable and shall be removed from the work site immediately.

- B. The Contractor shall exercise every precaution in the storage of paints, solvents, cleaning fluids, rags and similar materials as to eliminate the risk of spontaneous combustion or other hazardous conditions. Portable fire extinguishing equipment shall be provided in a convenient location for emergency access. All painting materials stored on the job site shall be stored in a location consistent to the manufacturer's storage requirements. The Contractor shall take all safety precautions in accordance with NFPA Bulletin No. 101.

1.04 Environmental Requirements

- A. Weather
 - 1. Air and Surface Temperatures: Prepare surfaces and apply and cure coatings within air and surface temperature range in accordance with manufacturer's instructions.
 - 2. Surface Temperature: Minimum of 5 degrees F (3 degrees C) above dew point.
 - 3. Relative Humidity: Prepare surfaces and apply and cure coatings within relative humidity range in accordance with manufacturer's instructions.
 - 4. Precipitation: Do not prepare surfaces or apply coatings in rain, snow, fog, or mist.
 - 5. Wind: Do not spray coatings if wind velocity is above manufacturer's limit.
- B. Ventilation:
 - 1. Provide ventilation during coating application and curing stage in confined or enclosed areas in accordance with AWWA D 102.
- C. Dust and Contaminants:
 - 1. Schedule coating work to avoid excessive dust and airborne contaminants.
 - 2. Protect work areas from excessive dust and airborne contaminants during coating application and curing.

1.05 Protection

- A. Provide all required forms of protection necessary to safeguard work of other trades. If necessary, mask and/or cover adjacent surfaces, fixtures, equipment, etc., by suitable means. Method of protection is a contractor's option.

PART 2 PRODUCTS

2.01 Manufacturer

- A. All materials specified herein are manufactured by the Tnemec Company, Inc., Kansas City, MO., the Sherwin Williams Co. (SW), Carboline, **or approved equal.**

These products are specified to establish minimum standards of quality and are approved for use on this project. All products for High H₂S Coatings shall furnish testing data as required in Paragraph 1.02.E.2. The listing or description of these products shall not be constructed so as to eliminate from competition other materials of equal performance which are similar in design, function and performance. Materials by other Manufacturer's shall be approved for use on a submittal basis as described in this section. Within the submittal process, a three-year limited warranty agreement that includes both labor and material for premature coating failure shall be presented for review and approval.

WM 25.1: WASTEWATER

SYSTEM	TNEMEC DFT (mils)	SHERWIN-WILLIAMS DFT (mils)	Carboline DFT (mils)
A. Steel – Structural, Tanks, Pipe, Equipment, and Miscellaneous			
1. Submerged			
a. System Type:		MCU or Epoxy	
b. Surface Preparation:		SSPC-SP10 Near-White Metal Blast Clean	
c. Shop Prime:	Series 1; 2.5-3.5	Corothane I Galvapak; 2.5-3.5	Carbomastic 615; 5.0-8.0
d. Field Touch Up:	Series 1; 2.5-3.5	Corothane I Galvapak; 2.5-3.5	Carbomastic 615; 5.0-8.0
e. Intermediate Coat:	Series 446; 7.0-10.0	SherGlass FF; 7.0-10.0	Carboguard 890 GF; 8.0-10.0
f. Finish Coat:	Series 446; 7.0-10.0	SherGlass FF; 7.0-10.0	Carboguard 890 GF; 8.0-10.0
g. Total DFT:	16.0-24.0	16.0-24.0	21.0-28.0
2. High H ₂ S Gas Exposed			
a. System Type:		Epoxy	
b. Surface Preparation:		SSPC-SP 10 Near-White Metal Blast Clean with a minimum angular profile of 3.0 mils	
c. Prime Coat:	Series 435; 15-20	none required	Not required
d. Finish Coat:	Series 435; 15-20	Dura-Plate 6000 30-40mil DFT; 15-20	Hydroplate 6500; 30.0-40.0
e. Total DFT:	30.0-40.0	30.0-40.0	30.0-40.0
3. Interior Exposed			
a. System Type:		Epoxy	
b. Surface Preparation:		SSPC-SP6 Commercial Blast Clean	
c. Shop Prime:	Series 1; 2.5-3.5	Corothane I Galvapak; 2.5-3.5	Carbomastic 615; 5.0-8.0
d. Field Touch Up:	Series 1; 2.5-3.5	Corothane I Galvapak; 2.5-3.5	Carbomastic 615; 5.0-8.0
e. Intermediate Coat:	Series 66HS; 4.0-6.0	Dura-Plate 235; 4.0-6.0	Carboguard 890; 4.0-6.0
f. Finish Coat:	Series 66HS-Color; 4.0-6.0	Dura-Plate 235; 4.0-6.0	Carboguard 890; 4.0-6.0
g. Total DFT:	11.0-15.0	11.0-15.0	11.0-15.0
4. Exterior Exposed			
a. System Type:		Epoxy/Polyurethane	
b. Surface Preparation:		SSPC-SP6 Commercial Blast Clean	
c. Shop Prime:	Series 1; 2.5-3.5	Corothane I Galvapak; 2.5-3.5	Carbomastic 615; 5.0-8.0

SYSTEM	TNEMEC DFT (mils)	SHERWIN-WILLIAMS DFT (mils)	Carboline DFT (mils)
d. Field Touch Up:	Series 1; 2.5-3.5	Corothane I Galvapac; 2.5-3.5	Carbomastic 615; 5.0-8.0
e. Intermediate Coat:	Series 66HS; 2.0-3.0	Macropoxy 646; 2.0-3.0	Carboguard 890; 4.0-6.0
f. Finish Coat:	Series 73U; 2.0-3.0	Acrolon Ultra; 2.0-3.0	Carbothane 134HG; 2.0-3.0
g. Total DFT:	7.0-9.0	7.0-9.0	10.0-15.0
B. Concrete – Precast, Cast-in-Place, and Dense Concrete Masonry Units			
1. Submerged			
a. System Type:		Epoxy Cementitious Mortar / Modified Polyamine-Cured Epoxy	
b. Surface Preparation:		SSPC-SP 13 to achieve a surface profile of ICRI CSP 3-5. Termination points (saw cuts) should be installed per manufacturer's guidelines.	
c. Surface Repair Mortar (Fill large voids and bugholes in concrete):	Series 217; Per application guide	CemTec RapidSet Vertical Cement; Per application guide	Carbocrete 4010; up to 4"
d. Surfacer (At 1/16" to 1/2" parge coat uniformly applied to fill holes, pits, voids and cracks):	Series 218 at 72 sq. ft. per Large Kit at 1/16"; Per application guide	Dura-Plate 2300; Per application guide	Carboguard 510SG; up to 1/2"
e. Prime Coat:	Series 435; 15.0-20.0	not required	Not required
f. Finish Coat:	Series 435; 15.0-20.0	Dura-Plate 6000; 20.0-30.0	Hydroplate 6500; 20.0-30.0
g. Total DFT:	Nominal 1/8-inch system	Nominal 1/8-inch system	Nominal 1/8-inch system
2. High H2S Gas Exposed			
a. System Type:		100% Solids Fiber Reinforced Epoxy	
b. Surface Preparation:		SSPC-SP 13 to achieve a surface profile of ICRI CSP 3-5. Termination points (saw cuts) should be installed per manufacturer's guidelines.	
c. Surface Repair Mortar (Fill large voids and bugholes in concrete):	Series 217; Per application guide	CemTec RapidSet Vertical Cement; Per application guide	Carbocrete 4010; up to 4"
d. Surfacer (At 1/16" to 1/2" parge coat uniformly applied to fill holes, pits, voids and cracks):	Series 218 at 72 sq. ft. per Large Kit at 1/16"; Per application guide	Dura-Plate 2300; Per application guide	Carboguard 510SG; up to 1/2"
e. Fiber Reinforced Coat:	Series 436; 60.0-80.0	not required	Plasite 5371; up to 1/8"
f. Finish Coat:	Series 435; 80-100 mil DFT	Dura-Plate 6000; 80-100 mil DFT	Plasite 5371; up to 1/8"
g. Total DFT:	Nominal 1/8-inch system	Nominal 1/8-inch system	
3. Interior Exposed			
a. System Type:		Epoxy	
b. Surface Preparation:		SSPC-SP 13 to achieve a surface profile of ICRI CSP 2 or 3	
c. Primer:	66HS; 4.0-6.0 Spray or backroll	Dura-Plate 235; 4.0-6.0 Spray or backroll	Carboguard 890; 4.0-6.0

SYSTEM	TNEMEC DFT (mils)	SHERWIN-WILLIAMS DFT (mils)	Carboline DFT (mils)
d. Finish Coat:	66HS; 4.0-6.0	Dura-Plate 235; 4.0-6.0	Carboguard 890; 4.0-6.0
e. Total DFT:	8.0-12.0	8.0-12.0	8.0-12.0
4. Exterior Exposed			
a. System Type:		Elastomeric Acrylic	
b. Surface Preparation:		SSPC-SP 13 to achieve a surface profile of ICRI CSP 2 or 3	
c. Primer:	Series 156; 110 to 130 sq. ft. per gallon	Loxon XP; 110 to 130 sq. ft. per gallon	Flexide Elastomer; 6.0-8.0
d. Finish Coat:	Series 156; 110 to 130 sq. ft. per gallon	Loxon XP; 110 to 130 sq. ft. per gallon	Flexide Elastomer; 6.0-8.0
e. Total DFT:	12.0-16.0	12.0-16.0	12.0-16.0
5. Below Grade (basement & pit walls which must be dry on the inside)			
a. System Type:		Elastomeric Polyurethane	
b. Surface Preparation:		SSPC-SP 13 to achieve a surface profile of ICRI CSP 3 to 5	
c. Primer:	66HS-1255; 3.0-5.0	Macropoxy 5000; 3.0-5.0	Carboguard 690; 5.0-6.0
d. Finish Coat:	Series 262; 50.0-60.0	Sher-Flex; 50.0-60.0	Reactamine 760; 50.0-60.0
e. Total DFT:	53.0-65.0	53.0-65.0	55.0-66.0
6. Below Grade (Soil Side)			
a. System Type:		Coal Tar Epoxy	
b. Surface Preparation:		SSPC-SP 13/NACE 6 to achieve a surface profile of ICRI CSP 2 or 3. Clean and dry.	
c. Primer:	66HS-1255; 3.0-5.0	Macropoxy 5000; 3.0-5.0	Carboguard 890; 4.0-6.0
d. Finish Coat:	Series 46H-413 Tnemec- Tar; 14.0-20.0	Hi-Mil Sher-Tar Epoxy; 14.0-20.0	Bitumastic 300M; 16.0-24.0
e. Total DFT:	17.0-25.0	17.0-25.0	20.0-30.0
f. Finish Color:	Black	Black	
C. Porous Concrete Masonry Units (CMU)			
1. Interior Exposed			
a. System Type:		Waterborne Epoxy	
b. Surface Preparation:		SSPC-SP 13. Clean and dry.	
c. Primer/Block Filler:	Series 130-6602; 100 sq. ft. per gallon	Cement-Plex 875; 100 sq. ft. per gallon	Sanitile 500; up to 20.0
d. Intermediate Coat:	Series 113; 4.0-6.0	ProIndustrial WB Catalyzed Epoxy B73 Series; 4.0-6.0	Sanitile 555 VOC; 3.0-4.0
e. Finish Coat:	Series 113; 4.0-6.0	ProIndustrial WB Catalyzed Epoxy B73 Series; 4.0-6.0	Sanitile 555 VOC; 3.0-4.0
f. Total DFT:	8.0-12.0 mils over block filler	8.0-12.0 mils over block filler	6.0-8.0 over block filler
2. Exterior Exposed Coating			
a. System Type:		Elastomeric Acrylic	
b. Surface Preparation:		SSPC-SP 13. Clean and dry.	
c. Primer:	Series 156; 110 to 130 sq. ft. per gallon	Loxon XP; 110 to 130 sq. ft. per gallon	Flexide Elastomer; 6.0-8.0

SYSTEM	TNEMEC DFT (mils)	SHERWIN-WILLIAMS DFT (mils)	Carboline DFT (mils)
d. Finish Coat:	Series 156; 110 to 130 sq. ft. per gallon	Loxon XP; 110 to 130 sq. ft. per gallon	Flexide Elastomer; 6.0-8.0
e. Total DFT:	12.0-16.0	12.0-16.0	12.0-16.0
3. Exterior Exposed Sealer			
a. Surface Preparation:		SSPC-SP 13. Clean and dry.	
b. Minimum 7% modified siloxane in water solution	Prime-A-Pell H2O	Loxon Siloxane Water Repellant	n/a
D. Wood			
1. Interior Exposed			
a. System Type:		HDP Acrylic Polymer or Waterborne Epoxy	
b. Surface Preparation:		Clean and dry	
c. Primer:	Series 151; 1.0-2.0	Multi-Purpose Int/Ext Primer B79 Series; 1.0-2.0	Sanitile 120; 1.0-2.0
d. Intermediate Coat:	Series 1029; 2.0-3.0	SherCryl HPA; 2.0-3.0	Carbocrylic 3359MC; 2.0-3.0
e. Finish Coat:	Series 1029; 2.0-3.0	SherCryl HPA; 2.0-3.0	Carbocrylic 3359MC; 2.0-3.0
f. Total DFT:	5.0-8.0	5.0-8.0	5.0-8.0
2. Exterior Exposed			
a. System Type:		Acrylic	
b. Surface Preparation:		Clean and dry	
c. Primer:	Series 151; 1.0-2.0	Multi-Purpose Int/Ext Primer B79 Series; 1.0-2.0	Sanitile 120; 1.0-2.0
d. Intermediate Coat:	Series 1029; 2.0-3.0	SuperPaint Exterior Latex Gloss A84-100 Series; 2.0-3.0	Carbocrylic 3359MC; 2.0-3.0
e. Finish Coat:	Series 1029; 2.0-3.0	SuperPaint Exterior Latex Gloss A84-100 Series; 2.0-3.0	Carbocrylic 3359MC; 2.0-3.0
f. Total DFT:	5.0-8.0	5.0-8.0	5.0-8.0
E. Gypsum Wallboard			
1. Interior Exposed (Process Areas)			
a. System Type:		Latex/Epoxy	
b. Surface Preparation:		Clean and dry	
c. Primer:	Series 151; 0.7-1.5	ProMar 200 0 VOC Primer; 0.7-1.5	Sanitile 120; 1.0-2.0
d. Intermediate Coat:	Series 113; 3.0-5.0	ProIndustrial WB Catalyzed Epoxy B73 Series; 3.0-5.0	Sanitile 555 VOC; 3.0-4.0
e. Finish Coat:	Series 113; 3.0-5.0	ProIndustrial WB Catalyzed Epoxy B73 Series; 3.0-5.0	Sanitile 555 VOC; 3.0-4.0
f. Total DFT:	6.7-12.0	6.7-12.0	7.0-10.0
2. Interior Exposed (Office & Occupied Areas)			
a. System Type:		Latex/Vinyl-Acrylic	
b. Surface Preparation:		Clean and dry	

SYSTEM	TNEMEC DFT (mils)	SHERWIN-WILLIAMS DFT (mils)	Carboline DFT (mils)
c. Primer:	Series 151; 0.7-1.5	ProMar 200 0 VOC Primer; 0.7-1.5	Sanitile 120; 1.0-2.0
d. Intermediate Coat:	Series 113; 2.0-3.0	ProIndustrial WB Catalyzed Epoxy B73 Series; 2.0-3.0	Sanitile 255 VOC; 2.0-3.0
e. Finish Coat:	Series 113; 2.0-3.0	ProIndustrial WB Catalyzed Epoxy B73 Series; 2.0-3.0	Sanitile 255 VOC; 2.0-3.0
f. Total DFT:	5.0-8.0	5.0-8.0	5.0-8.0
F. Ductile Iron Pipe (NOTE – DO NOT paint over Bituminous Shop Coat)			
1. Submerged			
a. System Type:		Epoxy	
b. Surface Preparation:		NAPF 500-03-04 Abrasive Blast Cleaning	
c. Shop Prime:	Series N140-1211; 4.0-6.0	Dura-Plate 235; 4.0-6.0	Carboguard 635 VOC; 4.0- 6.0
d. Field (Shop primer should be Brush off blast cleaned in accordance to SSPC-SP 7/NACE N0.4 and touched up with the following):	Series N140-1211; 4.0-6.0	Dura-Plate 235; 4.0-6.0	Carboguard 635 VOC; 4.0- 6.0
e. Intermediate Coat:	Series 66HS; 4.0-6.0	SherGlass FF; 4.0-6.0	Carboguard 890 GF; 8.0- 10.0
f. Finish Coat:	Series 66HS; 4.0-6.0	SherGlass FF; 4.0-6.0	Carboguard 890 GF; 8.0- 10.0
g. Total DFT:	12.0-18.0	12.0-18.0	20.0-30.0
2. High H2S Gas Exposed			
a. System Type:		100% Solids Epoxy	
b. Surface Preparation:		NAPF 500-03-04 Abrasive Blast Cleaning	
c. Shop Prime:	Series N140-1211; 4.0-6.0	Dura-Plate 235; 4.0-6.0	Carboguard 635 VOC; 4.0- 6.0
d. Field (Shop primer should be Brush off blast cleaned in accordance to SSPC-SP 7/NACE N0.4 and touched up with the following):	Series N140-1211; 4.0-6.0	Dura-Plate 235; 4.0-6.0	Carboguard 635 VOC; 4.0- 6.0
e. Intermediate Coat:	Series 435; 15.0-20.0	15.0-20.0not required	Not required
f. Finish Coat:	Series 435; 15.0-20.0	DuraPlate 6000 at 30-40; 15.0-20.0	Hydroplate 6500; 20.0-30.0
g. Total DFT:	34.0-46.0	34.0-46.0	36.0-42.0
3. Interior Exposed			
a. System Type:		Epoxy	
b. Surface Preparation:		NAPF 500-03-04 Abrasive Blast Cleaning	
c. Shop Prime:	Series N140-1211; 4.0-6.0	Dura-Plate 235; 4.0-6.0	Carboguard 635 VOC; 4.0- 6.0

SYSTEM	TNEMEC DFT (mils)	SHERWIN-WILLIAMS DFT (mils)	Carboline DFT (mils)
d. Field (Shop primer should be Brush off blast cleaned in accordance to SSPC-SP 7/NACE N0.4 and touched up with the following):	Series N140-1211; 4.0-6.0	Dura-Plate 235; 4.0-6.0	Carboguard 635 VOC; 4.0-6.0
e. Intermediate Coat:	Series 66HS; 3.0-5.0	Dura-Plate 235; 3.0-5.0	Carboguard 635 VOC; 4.0-6.0
f. Finish Coat:	Series 66HS; 3.0-5.0	Dura-Plate 235; 3.0-5.0	Carboguard 635 VOC; 4.0-6.0
g. Total DFT:	10.0-16.0	10.0-16.0	12.0-18.0
4. Exterior Exposed			
a. System Type:		Epoxy/Polyurethane	
b. Surface Preparation:		NAPF 500-03-04 Abrasive Blast Cleaning	
c. Shop Prime:	Series N140-1211; 4.0-6.0	Dura-Plate 235; 4.0-6.0	Carboguard 635 VOC; 4.0-6.0
d. Field (Shop primer should be Brush off blast cleaned in accordance to SSPC-SP 7/NACE N0.4 and touched up with the following):	Series N140-1211; 4.0-6.0	Dura-Plate 235; 4.0-6.0	Carboguard 635 VOC; 4.0-6.0
e. Intermediate Coat:	Series 66HS; 3.0-5.0	Dura-Plate 235; 3.0-5.0	Carboguard 635 VOC; 4.0-6.0
f. Finish Coat:	Series 73U; 3.0-5.0	Acrolon 218HS or Hi-Solids Polyurethane; 3.0-5.0	Carbothane 134HG; 2.0-3.0
g. Total DFT:	10.0-16.0	10.0-16.0	10.0-15.0
G. Galvanized Metal			
1. Interior Exposed (SPECIAL CONDITIONS ONLY WERE IDENTIFIED)			
a. System Type:		Epoxy	
b. Surface Preparation:		SSPC-SP 16 – Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel	
c. Primer:	Series 66HS-1255; 2.0-3.0	Macropoxy 646; 2.0-3.0	Carboguard 890; 2.0-3.0
d. Finish Coat:	Series 66HS-1255; 2.0-3.0	Macropoxy 646; 2.0-3.0	Carboguard 890; 2.0-3.0
e. Total DFT:	4.0-6.0	4.0-6.0	4.0-6.0
2. Exterior Exposed (SPECIAL CONDITIONS ONLY WERE IDENTIFIED)			
a. System Type:		Epoxy/Polyurethane	
b. Surface Preparation:		SSPC-SP 16 – Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel	
c. Primer:	Series 66HS; 2.0-3.0	Macropoxy 646; 2.0-3.0	Carboguard 890; 2.0-3.0
d. Finish Coat:	Series 73U; 2.0-3.0	Acrolon 218HS or Hi-Solids Polyurethane; 2.0-3.0	Carbothane 134HG; 2.0-3.0
e. Total DFT:	4.0-6.0	4.0-6.0	4.0-6.0

SYSTEM	TNEMEC DFT (mils)	SHERWIN-WILLIAMS DFT (mils)	Carboline DFT (mils)
H. PVC Pipe Coating			
1. Interior Exposed			
a. System Type:		HDP Acrylic Polymer or Epoxy	
b. Surface Preparation:		Scarify	
c. Primer:	Series 1029; 2.0-3.0	SherCryl HPA; 2.0-3.0	Carbocrylic 3359MC; 2.0-3.0
d. Finish Coat:	Series 1029; 2.0-3.0	SherCryl HPA; 2.0-3.0	Carbocrylic 3359MC; 2.0-3.0
e. Total DFT:	4.0-6.0	4.0-6.0	4.0-6.0
2. Exterior Exposed			
a. System Type:		Acrylic	
b. Surface Preparation:		Scarify	
c. Primer:	Series 1029; 2.0-3.0	SherCryl HPA; 2.0-3.0	Carbocrylic 3359MC; 2.0-3.0
d. Finish Coat:	Series 1029; 2.0-3.0	SherCryl HPA; 2.0-3.0	Carbocrylic 3359MC; 2.0-3.0
e. Total DFT:	4.0-6.0	4.0-6.0	4.0-6.0
I. Concrete Floors			
1. Mild Exposure: (F-1)			
a. System Type:		Silicate Blend	
b. Surface Preparation:		Clean and Dry. No curing compounds.	
c. Primer:	Series 629 CT Densifier; 300-350 sq. ft./gal	Sher-Crete Lithium Silicate Concrete Hardener; 300-350 sq. ft./gal	N/A
d. Finish Coat:	Series 629 CT Densifier; 350-400 sq. ft./gal	Sher-Crete Lithium Silicate Concrete Hardener; 350-400 sq. ft./gal	N/A
e. Total DFT:	N/A	N/A	N/A
f. Finish Color: N/A	N/A	N/A	N/A
2. Heavy Traffic and Chemical Exposure: (F-2)			
a. System Type:		Aggregate-filled epoxy/epoxy	
b. Surface Preparation:		SSPC-SP 13/NACE 6 to achieve a surface profile of ICRI CSP 5 or 6	
c. Primer for concrete:	Series 201; 6.0-8.0	Resuprime 3579 Standard Primer/Binder; 6.0-8.0	Primer 67; 3.0-4.0
d. First Coats:	Series 237; Double broadcast at nominal 1/8 inch	Resufloor 3561 Epoxy Resin Glaze; Double broadcast at nominal 1/8 inch	SteriFloor GP; 10.0-12.0; <i>Broadcast at the rate of 0.4lbs per sq ft</i>
e. Grout Coat:	Series 237; 100 sq. ft. per gallon	Resufloor 3561 Epoxy Resin Glaze; 100 sq. ft. per gallon	SteriFloor GP; 10.0-12.0
f. Finish Coat:	Series 247; Series 247 @ 2.0-3.0 General Polymers @ 6.0-8.0	Resutile 4638; Series 247 @ 2.0-3.0 General Polymers @ 6.0-8.0	Sealer 30; 4.0-5.0
g. Total DFT:	Greater than 1/8 inch	Greater than 1/8 inch	
h. Finish Texture: As required by the engineer.			
3. Decorative: (F-3)			
a. System Type:		Ceramic-filled epoxy. Ceramic Carpet.	

SYSTEM	TNEMEC DFT (mils)	SHERWIN-WILLIAMS DFT (mils)	Carboline DFT (mils)
b. Surface Preparation:		SSPC-SP 13/NACE 6 to achieve a surface profile of ICRI CSP 5 or 6	
c. Primer for concrete:	Series 201; 6.0-8.0	Resuprime 3579 Standard Primer/Binder; 6.0-8.0	Primer 67; 3.0-4.0
d. First Coats:	Series 222; Double broadcast with decorative quarts. DFT 1/8 inch.	Resufloor 3561 Epoxy Resin Glaze Clear; Double broadcast with decorative quarts. DFT 1/8 inch.	SteriQuartz; 1/16" lift; <i>Broadcast at the rate of 0.4lbs per sq ft</i>
e. Grout Coat:	Series 256; 8.0-10.0	Resufloor 3561 Epoxy Resin Glaze Clear; 8.0-10.0	SteriQuartz; 15.0-20.0
f. Finish Coat:	Series 247; 2.0-3.0	Resutile 4638 HS Polyurethane Floor Enamel; 2.0-3.0	Sealer 30; 4.0-5.0
g. Total DFT:	Greater than 1/8 inch	Greater than 1/8 inch	
h. Finish Texture:		As required by the Engineer	
4. High-Build Epoxy/Urethane Floor Coating. Mosaic Decorative Flake: (F-4)			
a. Surface Preparation:		SSPC-SP 13/NACE 6 to achieve a surface profile of ICRI CSP 4 or 5	
b. Primer for concrete:	Series 201; 6.0-8.0	Resuprime 3579 Standard Primer/Binder; 6.0-8.0	Primer 67; 3.0-4.0
c. Base Coat:	Series 224; Broadcast flake to refusal or as directed by Engineer @ 80 sq.ft. per gallon	Resufloor 3746 Epoxy; Broadcast flake to refusal or as directed by Engineer @ 80 sq.ft. per gallon	SteriFlake GP; 10.0-12.0; <i>Broadcast at the rate of 0.4lbs per sq ft</i>
d. Grout Coat:	Series 256; 8.0-10.0	Resufloor 3561 Epoxy; 8.0-10.0	SteriFlake GP; 15.0-20.0
e. Finish Coat:	Series 247; 2.0-3.0	Resutile 4638 HS Polyurethane Floor Enamel; 2.0-3.0	Sealer 30; 4.0-5.0
f. Total DFT:	24.0-31.0	24.0-31.0	
g. Finish Color & Pattern:		As selected by Architect from manufacturer's standard colors	

PART 3 EXECUTION

3.01 Examination

- A. Examine areas and conditions under which coating systems are to be applied. Notify Engineer of areas or conditions not acceptable. Do not begin surface preparation or application until unacceptable areas or conditions have been corrected.

3.02 Protection of Surfaces Not Scheduled to be Coated

- A. Protect surrounding areas and surfaces not scheduled to be coated from damage during surface preparation and application of coatings.
- B. Immediately remove coatings that fall on surrounding areas and surfaces not scheduled to be coated.

3.03 Surface Preparation of Steel

- A. Prepare steel surfaces in accordance with manufacturer's instructions.
- B. Fabrication Defects:
 - 1. Correct steel and fabrication defects revealed by surface preparation.
 - 2. Remove weld spatter and slag.
 - 3. Round sharp edges and corners of welds to a smooth contour.
 - 4. Smooth weld undercuts and recesses.
 - 5. Grind down porous welds to pinhole-free metal.
 - 6. Remove weld flux from surface.
- C. Ensure surfaces are dry.
- D. Immersion or Below Grade Surfaces: Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 10/NACE 2. Create a blast profile of 1.5 to 2.5 mils.
- E. Exterior Exposed or Interior Exposed Surfaces: Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 6/NACE 3. Create a blast profile of 1.5 to 2.5 mils.
- F. Abrasive Blast-Cleaned Surfaces: Coat abrasive blast-cleaned surfaces with primer before visible rust forms on surface. Do not leave blast-cleaned surfaces uncoated for more than 8 hours.
- G. Shop Primer: Prepare shop primer to receive field coat in accordance with manufacturer's instructions. Removal all unknown shop primers and re-prime in accordance with this specification.

3.04 Surface Preparation of Galvanized Steel and Nonferrous Metal

- A. Prepare galvanized steel and nonferrous metal surfaces in accordance with SSPC-SP 16 and the coating manufacturer's instructions.
- B. Check for post treatment of galvanizing using a copper sulfate solution in accordance with ASTM B201.
- C. Ensure surfaces are dry.

3.05 Surface Preparation of Ductile or Cast Iron

- A. Prepare ductile or cast-iron surfaces in accordance with NAPF 500-03-04 Abrasive Blast Cleaning or NAPF 500-03-03 Power Tool Cleaning and the coating manufacturer's instructions.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.

3.06 Surface Preparation of PVC

- A. Prepare PVC surfaces in accordance with manufacturer's instructions.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- C. Scarify PVC surfaces.

3.07 Surface Preparation of Insulated Pipe

- A. Prepare insulated pipe surfaces in accordance with manufacturer's instructions.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.

3.08 Surface Preparation of Concrete

- A. Interior, Wet Substrate:
 - 1. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 310.2.
 - 2. Allow concrete to cure for a minimum of 28 days.
 - 3. Test concrete for moisture in accordance with ASTM D 4263 and, if necessary, ASTM F 1869.
 - 4. Abrasive blast surface to remove laitance and solid contaminants and to provide clean, sound substrate with uniform anchor profile.
 - 5. Verify that the pH of the cleaned concrete surfaces to be coated is within the range of 8 to 11. Application of coating materials outside this range will not be permitted without written approval from the Engineer.
 - 6. Fill holes, pits, voids, and cracks with manufacturer approved surface (TNEMEC Series 217/218 or SW CEMTEC RapidSet Vertical Cement or DuraPlate 2300)
 - 7. Ensure surfaces are clean, dry, and free of oil, grease, chalk, form release agents, and other contaminants.
- B. Exterior and Interior Dry:
 - 1. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 310.2.
 - 2. Allow concrete to cure for a minimum of 14 days.
 - 3. Test concrete for moisture in accordance with ASTM D 4263 and, if necessary, ASTM F 1869.
 - 4. Level concrete protrusions and mortar spatter
 - 5. Verify that the pH of the cleaned concrete surfaces to be coated is within the range of 8 to 11. Application of coating materials outside this range will not be permitted without written approval from the Engineer.
 - 6. Fill hairline cracks less than 1/64 inch (0.4 mm) in accordance with manufacturer's instructions.
 - 7. Prepare cracks wider than 1/64 inch (0.4 mm), moving cracks, gaps, and expansion joints in accordance with manufacturer's instructions.

8. Ensure surfaces are clean, dry, and free of oil, grease, chalk, form release agents, and other contaminants.

3.09 Surface Preparation of Concrete Floors

- A. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 310.2.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- C. Allow concrete to cure for a minimum of 28 days before coating.
- D. Test concrete for moisture in accordance with ASTM D 4263 and, if necessary, ASTM F 1869.
- E. Verify that the pH of the cleaned concrete surfaces to be coated is within the range of 8 to 11. Application of coating materials outside this range will not be permitted without written approval from the Engineer.

3.10 Surface Preparation of Secondary Containment

- A. Prepare secondary containment surfaces in accordance with manufacturer's instructions.
- B. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 310.2.
- C. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- D. Allow concrete to cure for a minimum of 28 days before coating.
- E. Test concrete for moisture in accordance with ASTM D 4263 and, if necessary, ASTM F 1869.
- F. Verify that the pH of the cleaned concrete surfaces to be coated is within the range of 8 to 11. Application of coating materials outside this range will not be permitted without written approval from the Engineer.

3.11 Surface Preparation of Porous Concrete Masonry Units

- A. Prepare porous concrete masonry unit surfaces in accordance with manufacturer's instructions and SSPC-SP 13/NACE 6.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- C. Allow mortar to cure for a minimum of 28 days before coating.
- D. Level protrusions and mortar spatter.

3.12 Surface Preparation of Plaster

- A. Prepare plaster surfaces in accordance with manufacturer's instructions.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- C. Allow plaster to cure and dry out for a minimum of 28 days before coating.
- D. Do not coat over plaster containing free water, lime, or other soluble alkaline salts.
- E. Remove plaster nibs and other protrusions.
- F. Patch voids and cracks with approved materials and after dry, sand flush with surface.

3.13 Surface Preparation of Gypsum Board

- A. Prepare gypsum board surfaces in accordance with manufacturer's instructions.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- C. Sand joint compound smooth and feather edge.
- D. Avoid heavy sanding of adjacent gypsum board surfaces, which will raise nap of paper covering.
- E. Do not apply putty, patching pencils, caulking, or masking tape to drywall surfaces to be painted.
- F. Lightly scuff-sand tape joints after priming to remove raised paper nap. Do not sand through primer.

3.14 Surface Preparation of Wood

- A. Prepare wood surfaces in accordance with manufacturer's instructions.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, surface deposits of sap or pitch, and other contaminants.
- C. Seal knots and pitch pockets.
- D. Sand rough spots with the grain.
- E. Fill cracks and holes with approved materials after primer is dry. Sand flush with surface when filler is hard.
- F. Lightly sand between coats.

3.15 Application

- A. Apply coatings in accordance with manufacturer's instructions.
- B. Mix and thin coatings, including multi-component materials, in accordance with manufacturer's instructions.
- C. Keep containers closed when not in use to avoid contamination.
- D. Do not use mixed coatings beyond pot life limits.
- E. Use application equipment, tools, pressure settings, and techniques in accordance with manufacturer's instructions.
- F. Uniformly apply coatings at spreading rate required to achieve specified DFT.
- G. Apply coatings to be free of film characteristics or defects that would adversely affect performance or appearance of coating systems.
- H. Stripe paint with brush critical locations on steel such as welds, corners, and edges using specified primer. Apply an additional stripe coat of the intermediate coating material in immersion areas.
- I. Roll or backroll the first coat of epoxy or block filler applied to concrete or interior block substrates to work the material into the substrate.

3.16 Repair

- A. **Materials and Surfaces Not Scheduled To Be Coated:** Repair or replace damaged materials and surfaces not scheduled to be coated.
- B. **Damaged Coatings:** Touch-up or repair damaged coatings. Touch-up of minor damage shall be acceptable where result is not visibly different from adjacent surfaces. Recoat entire surface where touch-up result is visibly different, either in sheen, texture, or color.
- C. **Coating Defects:** Repair in accordance with manufacturer's instructions coatings that exhibit film characteristics or defects that would adversely affect performance or appearance of coating systems.

3.17 Field Quality Control

- A. **Required Inspections and Documentation:**
 - 1. Verify coatings and other materials are as specified.
 - 2. Verify environmental conditions are as specified.
 - 3. Verify surface preparation and application are as specified.
 - 4. Verify DFT of each coat and total DFT of each coating system are as specified using wet film and dry film gauges. DFT's shall be measured in accordance with SSPC-PA-2.

5. Coating Defects: Check coatings for film characteristics or defects that would adversely affect performance or appearance of coating systems.
 - a. Check for holidays on interior steel immersion surfaces using holiday detector in accordance with NACE SP0188.
 6. Report:
 - a. Prepare inspection reports daily.
 - b. Submit written reports describing inspections made and actions taken to correct nonconforming work.
 - c. Report nonconforming work not corrected.
 - d. Submit copies of report to Engineer and Contractor.
- B. Manufacturer's Field Services: Manufacturer's representative shall provide technical assistance and guidance for surface preparation and application of coating systems.

3.18 Cleaning

- A. Remove temporary coverings and protection of surrounding areas and surfaces.

3.19 Protection of Coating Systems

- A. Protect surfaces of coating systems from damage during construction.

3.20 One-Year Inspection

- A. Owner will set date for one-year inspection of coating systems.
- B. Inspection shall be attended by Owner, Contractor, Engineer, and manufacturer's representative.
- C. Repair deficiencies in coating systems as determined by Engineer in accordance with manufacturer's instructions.

3.21 Schedules

- A. Color Schedule:

SERVICE	SCHEDULE	SYSTEM COLOR	BANDS
<u>Water Lines</u>			
Raw Water	Olive Green	Generator Green	
Settled or Clarified Water	Aqua	Alloy Aqua	
Finished or Potable Water	Dark Blue	Safety Blue	
Sprinklers	Dark Red	Safety Red	
Suction Line (Pump Stations)	Mid Blue	Robotic Blue	

SERVICE	SCHEDULE	SYSTEM COLOR	BANDS
Pressure Line (Pump Stations)	Safety Blue	Safety Blue	
<u>Waste Lines</u>			
Backwash Waste	Light Brown	Pallet Tan	
Sludge	Dark Brown	Walnut Brown	
Sanitary Sewer or Other	Dark Gray	Anchor Gray	
Sewage Effluent	Clay	Mason Brick	
Raw Sludge	Brown/Black	Bolt Brn	Black
Sludge Recirc	Brown/Yellow	Bolt Brn	Safety Yellow
Sludge Draw Off	Brown/Orange	Bolt Brn	Safety Orange
Sludge Recirc Dischg	Brown	Bolt Brown	
Sludge Gas	Orange-Red	International Orange	
Natural Gas	Orange Red/Black	Intl Orange	Black
NonPotable Water	Blue/Black	Safety Blue	Black
Potable Water	Blue	Safety Blue	
Chlorine	Yellow	Safety Yellow	
Sulfur Dioxide	Yellow/Red	Safety Yellow	Safety Red
Sewage	Gray	Slate Gray	
Compressed Air	Green	Rain Forest	
<u>Chemical Lines</u>			
Alum or Primary Coagulant	Orange	Safety Orange	
Ammonia	White	White	
Carbon Slurry	Black	Black	
Caustic	Yellow with Green	Safety Yellow	Safety Green
Chlorine	Yellow	Safety Yellow	
Fluoride	Light Blue with Red	Hydro Blue	Safety Red
Lime Slurry	Light Green	Emerald Ice	
Ozone	Yellow with Orange	Safety Yellow	Safety Orange
Phosphate Compounds	Light Green with Red	Emerald Ice	Safety Red
Polymers or Coagulant Aids	Orange with Green	Safety Orange	Safety Green
Potassium Permanganate	Violet	Plumb	
Soda Ash	Light Green with Orange	Emerald Ice	Safety Orange
Sulfuric Acid	Yellow with Red	Safety Yellow	Safety Red
Sulfur Dioxide	Light Green with Yellow	Emerald Ice	Safety Yellow
<u>Other Lines</u>			
Compressed Air	Dark Green	Rain Forest	
Gas	Red	Deck Red	

SERVICE	SCHEDULE	SYSTEM COLOR	BANDS
Other Lines	Light Gray	Flint Gray	
Hoists, Trolleys	Yellow	Safety Yellow	
Fire Protection	Red	Safety Red	
Steam	Orange	Safety Orange	
Oil	Ivory	Mill Ivory	

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(SECTION WM 25.2)

COATING SYSTEMS FOR WATER TREATMENT FACILITY

PART 1 GENERAL

1.01 Description

- A. This section covers preparation of surfaces, standard for materials, application standards for interior, exterior, immersed and non-immersed surfaces to be painted. The Contractor shall furnish materials, equipment, tools and labor necessary for total completion. This section is intended to include all work and materials necessary for completion of the work, any incidental item of material, labor or detail required for the proper execution and completion of the work and omitted from this section but obviously required by governing codes, local regulations, trade practices or operational functions, shall be provided as a part of the work without extra charge, even though not specifically detailed or mentioned.
- B. The object of these specifications is to describe the materials and workmanship necessary to provide complete protection of the surface to be coated and to provide a neat finished appearance. Coating shall be done at such times as the Contractor and Engineer may agree upon in order that dust-free and neat work be obtained. All surfaces shall be prepared and all coatings shall be applied strictly in accordance with the most recent manufacturer's printed instructions and shall be performed in a manner satisfactory to the Engineer.
- C. The Contractor shall arrange and conduct a job site conference between the coating manufacturer's representative, the Engineer's representative, and the Contractor's personnel or sub-contractor assigned this work prior to any field surface preparation or coating application.

1.02 References

- A. ASTM B201 - Standard Practice for Testing Chromate Coatings on Zinc and Cadmium Surfaces
- B. ASTM D 16 - Terminology Relating to Paint, Varnish, Lacquer, and Related Products.
- C. ASTM D 4258 - Standard Practice for Surface Cleaning Concrete and Coating.
- D. ASTM D 4259 - Standard Practice for Abrading Concrete
- E. ASTM D 4261 - Standard Practice for Surface Cleaning Concrete Masonry Units for Coatings.
- F. ASTM D 4263 - Indicating Moisture in Concrete by the Plastic Sheet Method.
- G. ASTM F 1869 - Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

- H. International Concrete Repair Institute (ICRI) - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.
- I. NACE SP0188 - Standard Recommended Practice, Discontinuity (Holiday) Testing of Protective Coatings.
- J. ANSI/NSF 61 Drinking Water System Components – Health Effects.
- K. AWWA D-102 Coating Steel Water Storage Tanks, latest revision.
- L. NAPF 500-03-04 Abrasive Blast Cleaning.
- M. SSPC-PA-2 Measurement of Dry Paint Thickness with Magnetic Gauge.
- N. SSPC-SP 1 - Solvent Cleaning.
- O. SSPC-SP 5/NACE 1 - White Metal Blast Cleaning.
- P. SSPC-SP 6/NACE 3 - Commercial Blast Cleaning.
- Q. SSPC-SP 10/NACE 2 - Near-White Metal Blast Cleaning.
- R. SSPC-SP 13/NACE 6 - Surface Preparation of Concrete.
- S. SSPC-SP 16 - Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals

1.03 Qualifications

- A. All coating and surface preparation shall be completed by the Painting Contractor or prior approved sub-contractor. The painter shall be specialized in industrial or heavy commercial painting. For small projects, the Contractor may be allowed to apply the specified coatings if approved by the Owner and Engineer.

1.04 Quality of Materials

- A. Materials applied to each surface shall be compatible and complete system. Any incompatible primers or barrier coats shall be removed and re-primed. The Contractor shall notify the Engineer in writing of any anticipated problems using the specified coating systems with substrates primed by others.

1.05 Sample Areas

- A. Paint sample areas to establish standard on quality workmanship per *PDCA P5 Benchmark Sample Procedures for Paint*, as directed by the Engineer and to establish a basis for acceptability of the coating work. Job mock-ups and samples approved by the Engineer shall stay in place the remainder of the project to provide a standard of quality to which production work will be compared.

1.06 Submittals

- A. Submit Manufacturer's Technical Data Sheets including paint label analysis and application instructions for each material proposed for use. Equivalent materials of other manufacturers may be substituted on approval by the Engineer. Submittals shall include performance data as certified by a qualified testing laboratory. Substitutions that decrease the film thickness, the number of coats applied, change the generic type of coating, or fail to meet the performance criteria of the specified material will not be approved. Prime, intermediate and finish coats on all surfaces shall be furnished by the same manufacturer.

1.07 Color Samples

- A. Submit 4 samples of manufacturer's standard color range.

1.08 Delivery, Storage, and Handling

- A. All materials delivered to the job site shall be in original sealed and labeled containers of the paint manufacturer. Each container shall provide labels with the following information: manufacturer's name, contents by volume for major pigment and vehicle constituents, expiration date after which material should not be used; thinning instructions and application instructions. Containers which are broken, opened, water marked or contain caked, lumpy or otherwise damaged materials are unacceptable and shall be removed from the work site immediately.
- B. The Contractor shall exercise every precaution in the storage of paints, solvents, cleaning fluids, rags and similar materials as to eliminate the risk of spontaneous combustion or other hazardous conditions. Portable fire extinguishing equipment shall be provided in a convenient location for emergency access. All painting materials stored on the job site shall be stored in a location consistent to the manufacturer's storage requirements. The Contractor shall take all safety precautions in accordance with NFPA Bulletin No. 101.

1.09 Environmental Requirements

- A. Weather:
 - 1. Air and Surface Temperatures: Prepare surfaces and apply and cure coatings within air and surface temperature range in accordance with manufacturer's instructions.
 - 2. Surface Temperature: Minimum of 5 degrees F (3 degrees C) above dew point.
 - 3. Relative Humidity: Prepare surfaces and apply and cure coatings within relative humidity range in accordance with manufacturer's instructions.
 - 4. Precipitation: Do not prepare surfaces or apply coatings in rain, snow, fog, or mist.
 - 5. Wind: Do not spray coatings if wind velocity is above manufacturer's limit.
- B. Ventilation: Provide ventilation during coating drying and curing stage in confined or enclosed areas in accordance with AWWA D 102, Appendix A.

C. Dust and Contaminants:

1. Schedule coating work to avoid excessive dust and airborne contaminants.
2. Protect work areas from excessive dust and airborne contaminants during coating application and curing.

1.10 Protection

- A. Provide all required forms of protection necessary to safeguard work of other trades. If necessary, mask and/or cover adjacent surfaces, fixtures, equipment, etc., by suitable means. Method of protection is a contractor's option.

PART 2 PRODUCTS

2.01 Manufacturer

- A. All materials specified herein are manufactured by the Tnemec Company, Inc., Kansas City, MO., the Sherwin Williams Co. (SW), Carboline, **or approved equal**. These products are specified to establish standards of quality and are approved for use on this project. The listing or description of these products shall not be constructed so as to eliminate from competition other materials of equal performance which are similar in design, function and performance. Materials by other Manufacturer's shall be approved for use on a submittal basis as described in this section. Within the submittal process, a three-year limited warranty agreement that includes both labor and material for premature coating failure shall be presented for review and approval.
- B. All products installed on immersion surfaces shall be ANSI/NSF 600 certified.

WM 25.2: WATER

SYSTEM	TNEMEC DFT (mils)	SHERWIN-WILLIAMS DFT (mils)	Carboline DFT (mils)
A. Steel – Structural, Tanks, Pipe, Equipment, and Miscellaneous			
1. Submerged			
a. System Type:		MCU or Epoxy	
b. Surface Preparation:		SSPC-SP10 Near-White Metal Blast Clean	
c. Primer:	Series 1; 2.5-3.5	Corothane Galvapac; 2.5-3.5	Carbozinc 621PW; 2.0-3.0
d. Intermediate Coat:	Series 20HS Epoxy; 5.0-7.0	Macropoxy 5500; 5.0-7.0	Carboguard 635 VOC; 4.0-6.0
e. Finish Coat:	Series 20HS Epoxy; 5.0-7.0	Macropoxy 5500; 5.0-7.0	Carboguard 635 VOC; 4.0-6.0
f. Total DFT:	12.5-17.5	12.5-17.5	10.0-15.0
2. Interior Exposed			
a. System Type:		Epoxy	
b. Surface Preparation:		SSPC-SP6 Commercial Blast Clean	
c. Primer:	Series 1; 2.5-3.5	Corothane Galvapac; 2.5-3.5	Carbozinc 621PW; 2.0-3.0
d. Intermediate Coat:	Series 66HS; 4.0-6.0	Macropoxy 5500; 4.0-6.0	Carboguard 635 VOC; 4.0-6.0

SYSTEM	TNEMEC DFT (mils)	SHERWIN-WILLIAMS DFT (mils)	Carboline DFT (mils)
e. Finish Coat:	Series 66HS-Color; 3.0-5.0	Macropoxy 5500; 3.0-5.0	Carboguard 635 VOC; 4.0-6.0
f. Total DFT:	9.5-14.5	9.5-14.5	10.0-15.0
3. Exterior Exposed			
a. System Type:		Epoxy/Polyurethane	
b. Surface Preparation:		SSPC-SP6 Commercial Blast Clean	
c. Primer:	Series 1; 2.5-3.5	Corothane Galvapac; 2.5-3.5	Carbomastic 615 AL; 5.0-10.0
d. Intermediate Coat:	Series 66HS; 4.0-6.0	Macropoxy 646; 4.0-6.0	Carboguard 890; 4.0-6.0
e. Finish Coat:	Series 73U; 2.0-5.0	Hi-Solids Polyurethane; 2.0-5.0	Carbothane 133 LH; 2.0-3.0
f. Total DFT:	8.5-14.5	8.5-14.5	
B. Concrete – Precast, Cast-in-Place, and Dense Concrete Masonry Units			
1. Submerged (System 1)			
a. System Type:		Epoxy	
b. Surface Preparation:		SSPC-SP 13/NACE 6 to achieve a surface profile of ICRI CSP 2 or 3	
c. Primer:	Series 20HS Epoxy; 4.0-6.0 Spray and backroll	Macropoxy 5500; 4.0-6.0 Spray and backroll	Carboguard 635 VOC; 4.0-6.0
d. Intermediate Coat:	Series 20HS Epoxy; 4.0-6.0	Macropoxy 5500; 4.0-6.0	Carboguard 635 VOC; 4.0-6.0
e. Finish Coat:	Series 20HS Epoxy; 4.0-6.0	Macropoxy 5500; 4.0-6.0	Carboguard 635 VOC; 4.0-6.0
f. Total DFT:	12.0-18.0	12.0-18.0	12.0-24.0
2. Submerged (System 2)			
a. System Type:		Elastomeric Polyurethane	
b. Surface Preparation:		SSPC-SP 13 to achieve a surface profile of ICRI CSP 3 or 5	
c. Primer:	Series 66HS-1255; 3.0-5.0 Spray and backroll	Macropoxy 5500 1.5-2.0 mil DFT;	Carboguard 691; 5.0-8.0
d. Finish Coat:	Series 262; 50.0-60.0	Poly-Cote 115; 50.0-60.0	Reactamine 760; 50.0-60.0
e. Total DFT:	53.0-65.0	53.0-65.0	58.0-68.0
3. Interior Exposed			
a. System Type:		Epoxy (Spray Apply)	
b. Surface Preparation:		SSPC-SP 13/NACE 6 to achieve a surface profile of ICRI CSP 2 or 3	
c. Primer:	113/114; 4.0-6.0 Roll or backroll Spray or backroll	Pro-industrial Waterbased Catalyzed Epoxy; 4.0-6.0 Roll or backroll Spray or backroll	Sanitile 555 VOC; 3.0-4.0
d. Finish Coat:	113/114; 4.0-6.0	Pro-industrial Waterbased Catalyzed Epoxy; 4.0-6.0	Sanitile 555 VOC; 3.0-4.0
e. Total DFT:	8.0-12.0	8.0-12.0	6.0-8.0
4. Exterior Exposed			
a. System Type:		Elastomeric Acrylic	
b. Surface Preparation:		SSPC-SP 13/NACE 6 to achieve a surface profile of ICRI CSP 2 or 3. Clean and dry	
c. Primer:	Series 156; 90 to 115 sq. ft. per gallon	Loxon XP; 90 to 115 sq. ft. per gallon	Flexide Elastomer; 6.0-8.0
d. Finish Coat:	Series 156; 90 to 115 sq. ft. per gallon	Loxon XP; 90 to 115 sq. ft. per gallon	Flexide Elastomer; 6.0-8.0

SYSTEM	TNEMEC DFT (mils)	SHERWIN-WILLIAMS DFT (mils)	Carboline DFT (mils)
5. Below Grade (basement & pit walls which must be dry on the inside)			
a. System Type:		Coal Tar Epoxy	
b. Surface Preparation:		SSPC-SP 13 to achieve a surface profile of ICRI CSP 3 or 5	
c. Primer:	Series 66HS-1255; 3.0-5.0	Macropoxy 5000 1.5-2.0 DFT;	Carboguard 890; 4.0-6.0
d. Finish Coat:	Series 46H-413; 16.0-20.0	HiMil Sher-Tar; 16.0-20.0	Bitumastic 300 M; 16.0-24.0
e. Total DFT:	19.0-25.0	19.0-25.0	22.0-30.0
6. Below Grade (Soil Side)			
a. System Type:		Coal Tar Epoxy	
b. Surface Preparation:		SSPC-SP 13/NACE 6 to achieve a surface profile of ICRI CSP 2 or 3. Clean and dry.	
c. Primer:		None	
d. Finish Coat:	Series 46H-413 Tnemec-Tar; 14.0-20.0	Hi-Mil Sher-Tar Epoxy; 14.0-20.0	Bitumastic 300 M; 16.0-24.0
e. Total DFT:	14.0-20.0	14.0-20.0	
f. Finish Color: Black			
C. Porous Concrete Masonry Units (CMU)			
1. Interior Exposed			
a. System Type:		Cementous Acrylic/epoxy	
b. Surface Preparation:		SSPC-SP 13/NACE 6. Clean and dry.	
c. Block Filler:	Series 130 Enviro-fill; Create a pinhole free surface	Cement-Plex 875; Create a pinhole free surface	Sanitile 500; up to 20.0
d. Intermediate Coat:	Series 113/114; 4.0-6.0	ProIndustrial WB Catalyzed Epoxy B73 Series; 4.0-6.0	Sanitile 555 VOC; 3.0-4.0
e. Finish Coat:	Series 113/114; 4.0-6.0	ProIndustrial WB Catalyzed Epoxy B73 Series; 4.0-6.0	Sanitile 555 VOC; 3.0-4.0
f. Total DFT:	8.0-12.0 mils over block filler	8.0-12.0 mils over block filler	6.0-8.0 mils over block filler
g. Finish Color: As selected by Engineer			
2. Exterior Exposed Coating			
a. System Type:		Elastomeric Acrylic	
b. Surface Preparation:		SSPC-SP 13/NACE 6. Clean and dry.	
c. Block Filler:	Series 130 Enviro-fill; Create a pinhole free surface	Cement Plex 875; Create a pinhole free surface	Sanitile 100
d. Primer:	Series 156; 90 to 115 sq. ft. per gallon	Loxon XP; 90 to 115 sq. ft. per gallon	Flexide Elastomer; 6.0-8.0
e. Finish Coat:	Series 156; 90 to 115 sq. ft. per gallon	Loxon XP; 90 to 115 sq. ft. per gallon	Flexide Elastomer; 6.0-8.0
f. Finish Color: As selected by Engineer			
D. Wood			
1. Interior Exposed			
a. System Type:		Latex/acrylic-epoxy	

SYSTEM	TNEMEC DFT (mils)	SHERWIN-WILLIAMS DFT (mils)	Carboline DFT (mils)
b. Surface Preparation:		Clean and dry	
c. Primer:	Series 151; 1.0-1.5	Multi-Purpose Int/Ext Primer B79 Series; 1.0-1.5	Sanitile 120; 1.0-2.0
d. Intermediate Coat:	Series 113/114; 2.0-3.0	Pro-Industrial Waterbased Catalyzed Epoxy B73 Series; 2.0-3.0	Sanitile 555 VOC; 3.0-4.0
e. Finish Coat:	Series 113/114; 2.0-3.0	Pro-Industrial Waterbased Catalyzed Epoxy B73 Series; 2.0-3.0	Sanitile 555 VOC; 3.0-4.0
f. Total DFT:	5.0-7.5	5.0-7.5	5.0-8.0
g. Finish Color: As selected by Engineer			
2. Exterior Exposed			
a. System Type:		Acrylic	
b. Surface Preparation:		Clean and dry	
c. Primer:	Series 151; 1.0-2.0	Multi-Purpose Int/Ext Primer B79 Series; 1.0-2.0	Sanitile 120; 1.0-2.0
d. Intermediate Coat:	Series 1029; 1.0-2.0	SuperPaint Exterior Latex Gloss A84-100 Series; 1.0-2.0	Carbocrylic 3359MC; 2.0- 3.0
e. Finish Coat:	Series 1029; 1.0-2.0	SuperPaint Exterior Latex Gloss A84-100 Series; 1.0-2.0	Carbocrylic 3359MC; 2.0- 3.0
f. Total DFT:	3.0-6.0	3.0-6.0	5.0-8.0
E. Gypsum Wallboard			
1. Interior Exposed (Process Areas)			
a. System Type:		Latex/Epoxy	
b. Surface Preparation:		Clean and dry	
c. Primer:	Series 151; 0.7-1.5	ProMar 200 0 VOC Primer; 0.7-1.5	Sanitile 120; 1.0-2.0
d. Intermediate Coat:	Series 113; 3.0-5.0	ProIndustrial WB Catalyzed Epoxy B73 Series; 3.0-5.0	Sanitile 555 VOC; 3.0-4.0
e. Finish Coat:	Series 113; 3.0-5.0	ProIndustrial WB Catalyzed Epoxy B73 Series; 3.0-5.0	Sanitile 555 VOC; 3.0-4.0
f. Total DFT:	6.7-12.0	6.7-12.0	5.0-8.0
2. Interior Exposed (Office & Occupied Areas)			
a. System Type:		Latex/Vinyl-Acrylic	
b. Surface Preparation:		Clean and dry	
c. Primer:	Series 151; 0.7-1.5	ProMar 200 0 VOC Primer; 0.7-1.5	Sanitile 120; 1.0-2.0
d. Intermediate Coat:	Series 113; 2.0-3.0	ProIndustrial WB Catalyzed Epoxy B73 Series; 2.0-3.0	Sanitile 555 VOC; 3.0-4.0
e. Finish Coat:	Series 113; 2.0-3.0	ProIndustrial WB Catalyzed Epoxy B73 Series; 2.0-3.0	Sanitile 555 VOC; 3.0-4.0
f. Total DFT:	5.0-8.0	5.0-8.0	.0-8.0

SYSTEM	TNEMEC DFT (mils)	SHERWIN-WILLIAMS DFT (mils)	Carboline DFT (mils)
F. Ductile or Cast Iron – Pipe, Pumps, and Valves			
1. Submerged			
a. System Type:		Epoxy	
b. Surface Preparation:		NAPF 500-03-04 Abrasive Blast Cleaning	
c. Shop Prime:	Series N140-1255; 4.0-5.0	Macropoxy 5500; 4.0-5.0	Carboguard 635 VOC; 4.0-6.0
d. Intermediate Coat:	Series 20HS; 4.0-6.0	Macropoxy 5500; 4.0-6.0	Carboguard 635 VOC; 4.0-6.0
e. Finish Coat:	Series 20HS; 4.0-6.0	Macropoxy 5500; 4.0-6.0	Carboguard 635 VOC; 4.0-6.0
f. Total DFT:	12.0-17.0	12.0-17.0	12.0-18.0
2. Interior Exposed			
a. System Type:		Epoxy	
b. Surface Preparation:		NAPF 500-03-03 Power Tool Cleaning	
c. Primer:	Series N140-1255; 4.0-6.0	Macropoxy 646; 4.0-6.0	Carboguard 890; 4.0-6.0
d. Finish Coat:	Series 66HS; 4.0-6.0	Macropoxy 646; 4.0-6.0	Carboguard 890; 4.0-6.0
e. Total DFT:	8.0-12.0	8.0-12.0	8.0-12.0
3. Exterior Exposed			
a. System Type:		Epoxy/Polyurethane	
b. Surface Preparation:		NAPF 500-03-03 Power Tool Cleaning	
c. Primer:	Series N140; 3.0-5.0	Macropoxy 646; 3.0-5.0	Carboguard 890; 4.0-6.0
d. Intermediate Coat:	Series 66HS; 3.0-5.0	Macropoxy 646; 3.0-5.0	Carboguard 890; 4.0-6.0
e. Finish Coat:	Series 73U; 2.0-3.0	Hi-Solids Polyurethane; 2.0-3.0	Carbothane 134HG; 2.0-3.0
f. Total DFT:	8.0-13.0	8.0-13.0	8.0-15.0
4. Below Ground (Buried)			
a. System Type:		Coal tar epoxy	
b. Surface Preparation:		NAPF 500-03-04 Abrasive Blast Cleaning	
c. Primer:		None	
d. Finish Coat:	Series 46H-413; 14.0-20.0	Hi-Mil Sher-Tar Epoxy; 14.0-20.0	Bitumastic 300 M; 16.0-24.0
e. Total DFT:	14.0-20.0	14.0-20.0	
f. Finish Color: Black			
G. Galvanized Steel and Nonferrous Metal – Pipe and Miscellaneous Fabrications			
1. Interior Exposed			
a. System Type:		Epoxy	
b. Surface Preparation:		SSPC-SP 16	
c. Primer:	Series 66HS; 2.0-3.0	Macropoxy 646; 2.0-3.0	Carboguard 890; 4.0-6.0
d. Finish Coat:	Series 66HS; 2.0-3.0	Macropoxy 646; 2.0-3.0	Carboguard 890; 4.0-6.0
e. Total DFT:	4.0-6.0	4.0-6.0	8.0-12.0
2. Exterior Exposed			
a. System Type:		Epoxy/Polyurethane	
b. Surface Preparation:		SSPC-SP 16	

SYSTEM	TNEMEC DFT (mils)	SHERWIN-WILLIAMS DFT (mils)	Carboline DFT (mils)
c. Primer:	Series 66HS; 2.0-3.0	Macropoxy 646; 2.0-3.0	Carboguard 890; 4.0-6.0
d. Finish Coat:	Series 73U; 2.0-3.0	Hi-Solids Polyurethane; 2.0-3.0	Carbothane 134HG; 2.0-3.0
e. Total DFT:	4.0-6.0	4.0-6.0	6.0-9.0
3. Immersion			
a. System Type:		Epoxy/epoxy	
b. Surface Preparation:		SSPC-SP 16	
c. Primer Coat:	20HS Polyamide Epoxy; 5.0-7.0	Macropoxy 5500; 5.0-7.0	Carboguard 635 VOC; 4.0-6.0
d. Finish Coat:	20HS Polyamide Epoxy; 5.0-7.0	Macropoxy 5500 (Color) ; 5.0-7.0	Carboguard 635 VOC; 4.0-6.0
e. Total DFT:	10.0-14.0	10.0-14.0	8.0-12.0
H. PVC			
1. Interior Exposed			
a. System Type:		Acrylic	
b. Surface Preparation:		Scarify	
c. Primer:	Series 1029; 2.0-4.0	SherCryl HPA; 2.0-4.0	Carbocrylic 3359MC; 2.0-3.0
d. Finish Coat:	Series 1029; 2.0-4.0	SherCryl HPA; 2.0-4.0	Carbocrylic 3359MC; 2.0-3.0
e. Total DFT:	4.0-8.0	4.0-8.0	
2. Exterior Exposed			
a. System Type:		Acrylic	
b. Surface Preparation:		Scarify	
c. Primer:	Series 1029; 2.0-3.0	SherCryl HPA; 2.0-3.0	Carbocrylic 3359MC; 2.0-3.0
d. Finish Coat:	Series 1029; 2.0-3.0	SherCryl HPA; 2.0-3.0	Carbocrylic 3359MC; 2.0-3.0
e. Total DFT:	4.0-6.0	4.0-6.0	
I. Concrete Floors			
1. Mild Exposure: (F-1)			
a. System Type:		Silicate Blend	
b. Surface Preparation:		Clean and Dry. No curing compounds.	
c. Primer:	Series 629 CT Densifier; 300-350 sq. ft./gal	Sher-Crete Lithium Silicate Concrete Hardener; 300-350 sq. ft./gal	n/a
d. Finish Coat:	Series 629 CT Densifier; 350-400 sq. ft./gal	Sher-Crete Lithium Silicate Concrete Hardener; 350-400 sq. ft./gal	n/a
e. Total DFT:	N/A	N/A	
f. Finish Color: N/A	N/A	N/A	
2. Heavy Traffic and Chemical Exposure: (F-2)			
a. System Type:		Aggregate-filled epoxy/epoxy	
b. Surface Preparation:		SSPC-SP 13/NACE 6 to achieve a surface profile of ICRI CSP 5 or 6	
c. Primer for concrete:	Series 201; 6.0-8.0	Resuprime 3579 Standard Primer/Binder; 6.0-8.0	Primer 67DTO
d. First Coats:	Series 237v; Double broadcast at nominal 1/8 inch	Resufloor 3561 Epoxy Resin Glaze; Double broadcast at nominal 1/8 inch	SteriFloor GP

SYSTEM	TNEMEC DFT (mils)	SHERWIN-WILLIAMS DFT (mils)	Carboline DFT (mils)
e. Finish Coat:	Series 291 CRU; Series CRU @ 2.0-3.0 General Polymers @ 6.0- 8.0	Resufloor 3746 High Performance CR Epoxy; Series CRU @ 2.0-3.0 General Polymers @ 6.0- 8.0	Sealer 30
f. Total DFT:	Greater than 1/8 inch	Greater than 1/8 inch	
g. Finish Texture: As required by the engineer.			
3. Decorative: (F-3)			
a. System Type:		Ceramic-filled epoxy. Ceramic Carpet.	
b. Surface Preparation:		SSPC-SP 13/NACE 6 to achieve a surface profile of ICRI CSP 5 or 6	
c. Primer for concrete:	Series 201; 6.0-8.0	Resuprime 3579 Standard Primer/Binder; 6.0-8.0	Primer 67DTO
d. First Coats:	Series 222; Double broadcast with decorative quarts. DFT 1/8 inch.	Resufloor 3561 Epoxy Resin Glaze Clear; Double broadcast with decorative quarts. DFT 1/8 inch.	SteriFloor GP
e. Grout Coat:	Series 284; 8.0-10.0	Resufloor 3746 High Performance CR Epoxy Clear; 8.0-10.0	SteriFloor GP
f. Finish Coat:	Series 291 CRU; 2.0-3.0	Resutile 4638 HS Polyurethane Floor Enamel; 2.0-3.0	Sealer 30
g. Total DFT:	Greater than 1/8 inch	Greater than 1/8 inch	
h. Finish Texture:		As required by the Engineer	
4. High-Build Epoxy/Urethane Floor Coating. Mosaic Decorative Flake: (F-4)			
a. Surface Preparation:		SSPC-SP 13/NACE 6 to achieve a surface profile of ICRI CSP 4 or 5	
b. Primer for concrete:	Series 201; 6.0-8.0	Resuprime 3579 Standard Primer/Binder; 6.0-8.0	Primer 67DTO
c. Base Coat:	Series 224; 8.0-10.0 Broadcast flake to refusal or as directed by Engineer	Resufloor 3589 Smooth Epoxy Floor Coating; 8.0-10.0 Broadcast flake to refusal or as directed by Engineer	SteriFlake GP
d. Grout Coat:	Series 284; 8.0-10.0	Resufloor 3746 High Performance CR Epoxy Clear; 8.0-10.0	SteriFlake GP
e. Finish Coat:	Series 291 CRU; 2.0-3.0	Resutile 4638 HS Polyurethane Floor Enamel; 2.0-3.0	Sealer 30
f. Total DFT:	24.0-31.0	24.0-31.0	
g. Finish Color & Pattern:		As selected by Architect from manufacturer's standard colors	

NOTE: Coatings for secondary containment systems are chemical specific. Refer to the Detailed Specifications for coating requirements for secondary containment systems.

PART 3 EXECUTION

3.01 Examination

- A. Examine areas and conditions under which coating systems are to be applied. Notify Engineer of areas or conditions not acceptable. Do not begin surface preparation or application until unacceptable areas or conditions have been corrected.

3.02 Protection of Surfaces Not Scheduled to be Coated

- A. Protect surrounding areas and surfaces not scheduled to be coated from damage during surface preparation and application of coatings.
- B. Immediately remove coatings that fall on surrounding areas and surfaces not scheduled to be coated.

3.03 Surface Preparation of Steel

- A. Prepare steel surfaces in accordance with manufacturer's instructions.
- B. Fabrication Defects:
 - 1. Correct steel and fabrication defects revealed by surface preparation.
 - 2. Remove weld spatter and slag.
 - 3. Round sharp edges and corners of welds to a smooth contour.
 - 4. Smooth weld undercuts and recesses.
 - 5. Grind down porous welds to pinhole-free metal.
 - 6. Remove weld flux from surface.
- C. Ensure surfaces are dry.
- D. Immersion or Below Grade Surfaces: Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 10/NACE 2. Create a blast profile of 1.5 to 2.5 mils.
- E. Exterior Exposed or Interior Exposed Surfaces: Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 6/NACE 3. Create a blast profile of 1.5 to 2.5 mils.
- F. Abrasive Blast-Cleaned Surfaces: Coat abrasive blast-cleaned surfaces with primer before visible rust forms on surface. Do not leave blast-cleaned surfaces uncoated for more than 8 hours.
- G. Shop Primer: Prepare shop primer to receive field coat in accordance with manufacturer's instructions. Removal all unknown shop primers and re-prime in accordance with this specification.

3.04 Surface Preparation of Galvanized Steel and Nonferrous Metal

- A. Prepare galvanized steel and nonferrous metal surfaces in accordance with SSPC-SP 16 and the coating manufacturer's instructions.
- B. Check for post treatment of galvanizing using a copper sulfate solution in accordance with ASTM B201.
- C. Ensure surfaces are dry.

3.05 Surface Preparation of Ductile or Cast Iron

- A. Prepare ductile or cast iron surfaces in accordance with NAPF 500-03-04 Abrasive Blast Cleaning or NAPF 500-03-03 Power Tool Cleaning and the coating manufacturer's instructions.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.

3.06 Surface Preparation of PVC

- A. Prepare PVC surfaces in accordance with manufacturer's instructions.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- C. Scarify PVC surfaces.

3.07 Surface Preparation of Insulated Pipe

- A. Prepare insulated pipe surfaces in accordance with manufacturer's instructions.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.

3.08 Surface Preparation of Concrete

- A. Interior, Wet Substrate:
 - 1. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 310.2.
 - 2. Allow concrete to cure for a minimum of 28 days.
 - 3. Test concrete for moisture in accordance with ASTM D 4263 and, if necessary, ASTM F 1869.
 - 4. Abrasive blast surface to remove laitance and solid contaminants and to provide clean, sound substrate with uniform anchor profile.
 - 5. Verify that the pH of the cleaned concrete surfaces to be coated is within the range of 8 to 11. Application of coating materials outside this range will not be permitted without written approval from the Engineer.
 - 6. Fill holes, pits, voids, and cracks with manufacturer approved surfacer.

7. Ensure surfaces are clean, dry, and free of oil, grease, chalk, form release agents, and other contaminants.
- B. Exterior and Interior Dry:
1. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 310.2.
 2. Allow concrete to cure for a minimum of 14 days.
 3. Test concrete for moisture in accordance with ASTM D 4263 and, if necessary, ASTM F 1869.
 4. Level concrete protrusions and mortar spatter.
 5. Verify that the pH of the cleaned concrete surfaces to be coated is within the range of to 8 to 11. Application of coating materials outside this range will not be permitted without written approval from the Engineer.
 6. Fill hairline cracks less than 1/64 inch (0.4 mm) in accordance with manufacturer's instructions.
 7. Prepare cracks wider than 1/64 inch (0.4 mm), moving cracks, gaps, and expansion joints in accordance with manufacturer's instructions.
 8. Ensure surfaces are clean, dry, and free of oil, grease, chalk, form release agents, and other contaminants.

3.09 Surface Preparation of Concrete Floors

- A. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 310.2.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- C. Allow concrete to cure for a minimum of 28 days before coating.
- D. Test concrete for moisture in accordance with ASTM D 4263 and, if necessary, ASTM F 1869.
- E. Verify that the pH of the cleaned concrete surfaces to be coated is within the range of to 8 to 11. Application of coating materials outside this range will not be permitted without written approval from the Engineer.

3.10 Surface Preparation of Secondary Containment

- A. Prepare secondary containment surfaces in accordance with manufacturer's instructions.
- B. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 310.2.
- C. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- D. Allow concrete to cure for a minimum of 28 days before coating.

- E. Test concrete for moisture in accordance with ASTM D 4263 and, if necessary, ASTM F 1869.
- F. Verify that the pH of the cleaned concrete surfaces to be coated is within the range of 8 to 11. Application of coating materials outside this range will not be permitted without written approval from the Engineer.

3.11 Surface Preparation of Porous Concrete Masonry Units

- A. Prepare porous concrete masonry unit surfaces in accordance with manufacturer's instructions and SSPC-SP 13/NACE 6.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- C. Allow mortar to cure for a minimum of 28 days before coating.
- D. Level protrusions and mortar spatter.

3.12 Surface Preparation of Plaster

- A. Prepare plaster surfaces in accordance with manufacturer's instructions.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- C. Allow plaster to cure and dry out for a minimum of 28 days before coating.
- D. Do not coat over plaster containing free water, lime, or other soluble alkaline salts.
- E. Remove plaster nibs and other protrusions.
- F. Patch voids and cracks with approved materials and after dry, sand flush with surface.

3.13 Surface Preparation of Gypsum Board

- A. Prepare gypsum board surfaces in accordance with manufacturer's instructions.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- C. Sand joint compound smooth and feather edge.
- D. Avoid heavy sanding of adjacent gypsum board surfaces, which will raise nap of paper covering.
- E. Do not apply putty, patching pencils, caulking, or masking tape to drywall surfaces to be painted.

- F. Lightly scuff-sand tape joints after priming to remove raised paper nap. Do not sand through primer.

3.14 Surface Preparation of Wood

- A. Prepare wood surfaces in accordance with manufacturer's instructions.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, surface deposits of sap or pitch, and other contaminants.
- C. Seal knots and pitch pockets.
- D. Sand rough spots with the grain.
- E. Fill cracks and holes with approved materials after primer is dry. Sand flush with surface when filler is hard.
- F. Lightly sand between coats.

3.15 Application

- A. Apply coatings in accordance with manufacturer's instructions.
- B. Mix and thin coatings, including multi-component materials, in accordance with manufacturer's instructions.
- C. Keep containers closed when not in use to avoid contamination.
- D. Do not use mixed coatings beyond pot life limits.
- E. Use application equipment, tools, pressure settings, and techniques in accordance with manufacturer's instructions.
- F. Uniformly apply coatings at spreading rate required to achieve specified DFT.
- G. Apply coatings to be free of film characteristics or defects that would adversely affect performance or appearance of coating systems.
- H. Stripe paint with brush critical locations on steel such as welds, corners, and edges using specified primer. Apply and additional strip coat of the intermediate coating material in immersion areas.
- I. Roll or backroll the first coat of epoxy or block filler applied to concrete or interior block substrates to work the material into the substrate.

3.16 Repair

- A. Materials and Surfaces Not Scheduled To Be Coated: Repair or replace damaged materials and surfaces not scheduled to be coated.

- B. Damaged Coatings: Touch-up or repair damaged coatings. Touch-up of minor damage shall be acceptable where result is not visibly different from adjacent surfaces. Recoat entire surface where touch-up result is visibly different, either in sheen, texture, or color.
- C. Coating Defects: Repair in accordance with manufacturer's instructions coatings that exhibit film characteristics or defects that would adversely affect performance or appearance of coating systems.

3.17 Field Quality Control

- A. Required Inspections and Documentation:
 - 1. Verify coatings and other materials are as specified.
 - 2. Verify surface preparation and application are as specified.
 - 3. Verify DFT of each coat and total DFT of each coating system are as specified using wet film and dry film gauges.
 - 4. Coating Defects: Check coatings for film characteristics or defects that would adversely affect performance or appearance of coating systems.
 - a. Check for holidays on interior steel immersion surfaces using holiday detector.
 - 5. Report:
 - a. Submit written reports describing inspections made and actions taken to correct nonconforming work.
 - b. Report nonconforming work not corrected.
 - c. Submit copies of report to Engineer and Contractor.
- B. Manufacturer's Field Services: Manufacturer's representative shall provide technical assistance and guidance for surface preparation and application of coating systems.

3.18 Cleaning

- A. Remove temporary coverings and protection of surrounding areas and surfaces.

3.19 Protection of Coating Systems

- A. Protect surfaces of coating systems from damage during construction.

3.20 One-Year Inspection

- A. Owner will set date for one-year inspection of coating systems.
- B. Inspection shall be attended by Owner, Contractor, Engineer, and manufacturer's representative.
- C. Repair deficiencies in coating systems as determined by Engineer in accordance with manufacturer's instructions.

3.21 Schedules

A. Color Schedule:

SERVICE	SCHEDULE	SYSTEM COLOR	BANDS
<u>Water Lines</u>			
Raw Water	Olive Green	Generator Green	
Settled or Clarified Water	Aqua	Alloy Aqua	
Finished or Potable Water	Dark Blue	Safety Blue	
Sprinklers	Dark Red	Safety Red	
Suction Line (Pump Stations)	Mid Blue	Robotic Blue	
Pressure Line (Pump Stations)	Safety Blue	Safety Blue	
<u>Waste Lines</u>			
Backwash Waste	Light Brown	Pallet Tan	
Sludge	Dark Brown	Walnut Brown	
Sanitary Sewer or Other	Dark Gray	Anchor Gray	
Sewage Effluent	Clay	Mason Brick	
Raw Sludge	Brown/Black	Bolt Brn	Black
Sludge Recirc Suction	Brown/Yellow	Bolt Brn	Safety Yellow
Sludge Draw Off	Brown/Orange	Bolt Brn	Safety Orange
Sludge Recirc Dischg	Brown	Bolt Brown	
Sludge Gas	Orange-Red	International Orange	
Natural Gas	Orange Red/Black	Intl Orange	Black
NonPotable Water	Blue/Black	Safety Blue	Black
Potable Water	Blue	Safety Blue	
Chlorine	Yellow	Safety Yellow	
Sulfur Dioxide	Yellow/Red	Safety Yellow	Safety Red
Sewage	Gray	Slate Gray	
Compressed Air	Green	Rain Forest	
<u>Chemical Lines</u>			
Alum or Primary Coagulant	Orange	Safety Orange	
Ammonia	White	White	
Carbon Slurry	Black	Black	
Caustic	Yellow with Green	Safety Yellow	Safety Green
Chlorine	Yellow	Safety Yellow	
Fluoride	Light Blue with Red	Hydro Blue	Safety Red
Lime Slurry	Light Green	Emerald Ice	
Ozone	Yellow with Orange	Safety Yellow	Safety Orange
Phosphate Compounds	Light Green with Red	Emerald Ice	Safety Red
Polymers or Coagulant Aids	Orange with Green	Safety Orange	Safety Green

SERVICE	SCHEDULE	SYSTEM COLOR	BANDS
Potassium Permanganate	Violet	Plumb	
Soda Ash	Light Green with Orange	Emerald Ice	Safety Orange
Sulfuric Acid	Yellow with Red	Safety Yellow	Safety Red
Sulfur Dioxide	Light Green with Yellow	Emerald Ice	Safety Yellow
<u>Other Lines</u>			
Compressed Air	Dark Green	Rain Forest	
Gas	Red	Deck Red	
Other Lines	Light Gray	Flint Gray	
Hoists, Trolleys	Yellow	Safety Yellow	
Fire Protection	Red	Safety Red	
Steam	Orange	Safety Orange	
Oil	Ivory	Mill Ivory	

END OF SECTION

PART C

DETAILED SPECIFICATIONS

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DETAILED SPECIFICATIONS

**INDIANA DEPARTMENT OF ADMINISTRATION/INDIANA DEPARTMENT OF NATURAL
RESOURCES**

LINCOLN LAKE DAM REHABILITATION

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Note: Detailed specifications herein are certified by the plan sheet noted electrical, mechanical, instrumentation and control, structural and process engineers for which work is applicable.

SECTION 00

GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 CDC Guidelines

- A. All contractors must follow the CDC Guidelines, as well as Indiana Governor's Emergency Executive Order as applicable at time of bidding project.

1.02 Description of Work

- A. Under this Contract, the Contractor shall provide the labor, tools, equipment and material necessary to construct the improvements complete with all equipment in place and operating in accordance with the intent of the Drawings, Detailed Specifications, and the Workmanship and Materials Specifications. All work, equipment and materials as described in the Contract Documents, as illustrated on the drawings, and as outlined in the specifications shall be provided under this contract.
- B. All trees shall be cut prior to April 1st. Tree segments under 8" shall be chipped and located on property at the discretion of the Owner. Tree segments larger than 8" shall be located on property at the discretion of the Owner. Tree stumps shall be disposed of by the contractor.

1.03 Bid

- A. The Base Bid shall include all work and requirements indicated by the Bidding Documents.
- B. This is a Lump Sum project. Payment will be based on the accepted schedule of values for the project. No separate measurement will be performed for Lump Sum work. All work described in the Specifications and / or shown on the Drawings shall be included in the Lump Sum Bid. Only items are included in the Supplemental Unit Prices will be measured for payment.
- C. Builder's Risk Insurance requirements as specified in the General Conditions (11.25) are waived for this project.
- D. The Base Bid shall include all work and requirements for the following:
 - 1. 150 SF Concrete Patching, Full Depth
 - 2. 1,677 SYS Milling Asphalt, 1.5 Inches
 - 3. 160.00 Ton HMA
 - 4. 15,000 LB Polyurethane Grout
(installed material only – Mobilization is to be included in the Base Bid)

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- E. Provide Supplemental Unit Price Form (Page 2A – Bid Form) with bid.
1. Supplemental Unit Price is an amount proposed by bidders, stated on the Bid Form, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.
 2. Supplemental Unit Prices include all necessary material, plus cost for delivery, installation, insurance, overhead, and profit.
 3. Mobilization for each item is to be included in the Base Bid.
- F. Remediation Allowance
1. DS-11, Remediation Allowance, is included with this specification and contains information which will directly affect the amount of the Contractor's bid. The amount of the Remediation Allowance must be added to the Contractor's determined cost for performing the work, and included in the bid price for the project. **If any portion of the Remediation Allowance is not used during the project, that portion will revert to the Owner and will not be included in the Contractor's final payment.**

1.04 Payment

- A. The unit or lump sum prices stated in the Contract for the respective Items shall be payment in full for the completion of all work specified and described to be included in the respective Items, complete and ready for use and operation, including testing (if required), as shown on the plans and as specified.
- B. Costs for items not specified herein, or necessary for completion of work shall be included in the bid costs for items listed on the Bid Schedule. No additional payment will be made for items not specifically listed on the Bid Schedule.
- C. Three (3) mobilizations are anticipated for this project. Mobilizations will NOT be paid individually. Contractor shall include multiple mobilizations as necessary as part of their base bid.
1. All trees shall be cut by April 1st. Work at this time shall include cutting all trees necessary for work between April 1st and September 30th. No compensation will be made for compliance with the Indiana Bat Rules between these dates for additional trees needing to be cut.
 2. The Group Camp will be closed on August 1st for the remainder of the season. Contractor can mobilize as necessary for the continuation of the contractual work at that time.
 3. The polyurethane will be paid on a supplemental unit basis per pound of product installed. Mobilization for the polyurethane work shall be included in the base bid only.

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1.05 Operation During Construction

- A. Prior to commencing work, Contractor shall stake-out locations of new facilities for Owner's examination.
- B. Construction of the Improvements shall not inhibit the operation of the existing facilities at any point during construction activities. If necessary, bypassing individual unit operations with a continuously operating pumping system at or above present levels will be the responsibility of the Contractor. It is imperative that the Contractor must ensure and maintain the Owner's ability to properly convey and treat all flows to the levels required by the Owner's existing permit throughout the entire construction period. Access must be maintained for the Owner's staff. A proposed schedule for the construction work shall be submitted and approved prior to implementing any onsite activities. The Contractor is responsible for providing any and all temporary equipment, pumps, piping, electrical power, water, telephone service, internet service, portable toilets, manpower, etc. at their own expense.
- C. The Contractor shall prevent spills, discharges, or soil erosion runoff to area streams and drains. This shall include control of silt entry into streams from erosion from the construction sites. The Contractor shall comply with all local, state, and federal agency requirements relative to the control of erosion during and immediately following construction and containment of siltation in adjacent streams and ditches. Any in-stream silt traps as may be required by the [Indiana Department of Natural Resources] shall be installed and maintained by the Contractor.
- D. All equipment proposed for this facility shall perform and operate in a manner to meet the requirements for reliable transportation of water and/or wastewater to the standards by State and Federal regulations.
- E. Owner shall be provided notice at least 72 hours prior to any water main, sewer, or process equipment being temporarily removed from service.
- F. Working hours for the Contractor will be between 8:00 AM and 5:00 PM, Monday through Friday, excluding State Holidays. All work performed outside of this time shall be by written approval of the Owner, and shall not constitute a change in the contract price.

1.06 Site Visits Prior to Mobilization

- A. Coordinate and provide advance notice of any site visits prior to Bidding, Award of Contract, or Mobilization for Construction with Joseph Compton, Property Manager, Lincoln State Park.

1.07 Quality Assurance

- A. Codes. Perform all work in compliance with all federal, state and local codes, rules, regulations and ordinances in which the work is constructed.

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- B. Standards. All materials used shall be new, of high grade, and with properties best suited to the working environment. Materials and workmanship shall be in accordance with applicable standards.
- C. Regulatory Agencies. Perform all work in compliance with the requirements of the applicable regulatory agencies.
- D. It shall be noted that only **ONE (1) CERTIFICATE OF SUBSTANTIAL COMPLETION** will be issued.
- E. The warranty period for all equipment shall be 1 year and begin with final approval of all equipment and work associated with the project (**i.e., upon the issuance of the Certificate of Substantial Completion**).
- F. The Contractor shall be responsible for the removal and lawful disposal of all materials, debris, grit, sludge, etc. resulting from or required due to construction activities. The Contractor shall be responsible for obtaining all necessary permits (if applicable) prior to removing any materials. Removed materials having to be temporarily stockpiled shall be located away from drainage ways and depressional areas to prevent contamination. The material shall be covered prior to any precipitation or if odors develop.
- G. All removed/demolished items shall become the property of the Contractor except as noted otherwise on the plans and in the Detailed Specifications.
- H. All laboratory testing and documentation of materials to be disposed of shall be provided by the Contractor. Actual disposal and application of materials shall be performed by an individual qualified to perform such work and who is familiar with State and Federal requirements.
- I. It is the Contractor's responsibility to notify and coordinate with the equipment manufacturers in a timely manner in order for them to conduct their required inspection, servicing, operation testing and instruction as required in this specification section.
- J. Operate equipment to verify that it operates as required and as specified. Testing procedures shall be submitted to the Engineer for approval. Testing shall be coordinated with the Engineer's and Owner's representative. A qualified representative of the equipment manufacturer shall inspect the completed installation, service the equipment and operate the equipment under all design conditions, instruct the Owner's personnel in proper operating and maintenance procedures, and provide the Owner with a written certificate of approval.
- K. The Contractor shall be responsible for any additional work, activities, etc. that are beyond the current work and expense for the operation of the current system. The Contractor shall furnish any additional labor necessary to assist the Owner in the operation and maintenance of temporary facilities provided that such additional labor is beyond that normally required or anticipated to be required for permanent operations.

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PART 2 SITE CONDITIONS

2.01 Sub-Surface Conditions

- A. A soil investigation was conducted at the proposed construction site, and the results of the investigation are included in Appendix A of these Detailed Specifications. Soil Reports have been provided for informational purposes only and do not relieve the Contractor of his responsibility to completely acquaint himself with the conditions as they exist prior to the bid.
- B. The Soil Boring Logs are not presented as representative samples for the entire job. The Soil Boring Logs are samples only for the specific location of the soil boring itself. If the bidder desires additional soils information for the preparation of his Bid, he shall obtain this information at his own expense and coordinate the use of the Owner's right-of-way or easement rights with each individual property owner. The information given in these logs applies only to conditions encountered at the indicated locations and to the depths shown. The Contractor shall examine the site personally and make such additional investigations as he may deem necessary for estimating costs, planning and execution of the work.

PART 3 PLAN OF OPERATION

3.01 General

- A. The Contractor shall provide a Plan of Operation, as a shop drawing, within thirty (30) days of the execution of the Agreement. This Plan of Operation shall describe the scheduling of all work activities, shall detail the critical path of construction, shall describe the methods anticipated to be utilized in completing each section of the work, and shall describe in detail; (i) the safety measures to be used to protect the public from Contractor's work, and (ii) the timing and level of service desired for Contractor's work from permanent utilities to be installed under other associated contracts. The Engineer will review and find this Plan of Operation acceptably developed and implementable prior to the initiation by the Contractor of any work activities at the site.
- B. It is the Contractors responsibility to coordinate with the utility companies for new and upgrades of services. This is inclusive of coordination with the following utilities: Gas, Electrical, Telephone, Cellular, Water, and Wastewater. The Contractor is encouraged to contact these utilities at the commencement of the project and to determine the schedule and coordination requirements for each utility. Ultimately it is the Contractors responsibility to coordinate and have the utilities installed in a timely manner that does not negatively impact the schedule of the project.

3.02 Public Safety

- A. Addressed in the public protection provisions of the Plan of Operation shall be: traffic control; maintenance of service; storage of equipment and materials; and protection of excavations from access.

3.03 Permanent and Alternate Utility Services

- A. Addressed in the Plan of Operation shall be; (i) the timing and level of service desired from permanent utilities to be installed, (ii) an identification of the type of service desired, (iii) the date and location at which the service is desired, and (iv) the plans for alternate utility services for the work if permanent utility service is not available. Contractor shall be responsible for providing any utility services necessary for his work which are not otherwise available and shall address the anticipated means of providing such alternate utility services.

3.04 Continuity of Public Services

- A. It is imperative that the public service of the plant and/or distribution system continues to operate during all phases construction. It is necessary that all work be performed in such a manner to provide to the greatest extent reasonably possible, a continuous service and the availability of utilities and other facilities required by other Contractors when they are required. The Contractor shall be fully responsible for, and shall provide, any and all temporary piping, pumping, controls, electrical power, containment and transportation equipment, and other equipment and work so as to maintain these public services. Plan for this shall be addressed in the Plan of Operation.

3.05 Disinfection

- A. It shall be the Contractor's responsibility to ensure the new water facilities are disinfected complete as required by the [Indiana Department of Environmental Management] and per the standards and procedures set forth in the American Water Works Association Standard for Disinfection of Water Treatment Plants (AWWA C653), Field Dechlorination (AWWA C655), Disinfection of Water Storage Facilities (AWWA C652), and Disinfecting Water Mains (AWWA C651). Disinfection and return of facilities to service is required prior to Substantial Completion.

PART 4 SUBMITTAL REQUIREMENTS

4.01 General

- A. Handling of project-related documentation (i.e. O&M Manuals, shop drawings, RFIs, change orders, payment applications, as-builts, etc.) shall be conducted electronically unless noted otherwise.
- B. A listing of required submittals for the various detailed specification items is presented at the end of this section. Operation and maintenance (O&M) manuals **prepared by the manufacturer** shall be furnished for those items indicated and shall be furnished to the Engineer for review, approval and use **on or prior to the fifty percent (50%) project completion point**. All submittals shall be submitted via electronic submission for Engineer's review prior to submission of hard copies. Two (2) hard copies and one electronic copy shall be provided. All references in these specifications to submittals at or before a fifty percent (50%) point of completion shall relate to the total project and not to the particular item of

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construction. Under all circumstances shop drawings shall be submitted and approved by the Engineer prior to the initiation of construction of the particular item.

C. Each Manufacturer's Operation and Maintenance Manual shall include a Table of Contents and have each section marked by a divider tab. Each O&M Manual shall have, as a minimum, the following sections:

1. Purpose
2. Relationship to adjacent equipment/processes
3. Delineation of equipment furnished
4. Name, address, telephone number and e-mail address of nearest service center.
5. Name, address, telephone number and e-mail address of manufacturer's representative.
6. Serial Numbers of Equipment supplied.
7. Copy of equipment warranty
8. Control systems
9. Operation
10. Preventive Maintenance Schedule and Instructions
11. Repair Maintenance Instructions
12. Bill of Materials
13. Schedule of Lubricants
14. Schedule of Parts replacement
15. Identification of all Parts by Manufacturer's parts numbers
16. Trouble-shooting operational problems
17. Monitoring requirements
18. Safety
19. Emergency procedures
20. Equipment Data Sheets

D. Shop Drawings. Shop drawings shall be submitted to the Engineer for approval in accordance with the General Conditions and shall include:

1. Manufacturer's name and model numbers.
2. Equipment specifications.
3. Materials of construction.
4. Dimensional layouts and required clearances.
5. Weights.
6. Anchor bolts.
7. Bill of material.
8. Repair parts.
9. Power/utility requirements.
10. Manufacturer's instructions.
11. Coatings.
12. Warranty.
13. Complete description in sufficient detail to permit an item by item comparison with the specifications.

E. Electronic Documentation – PROCORE

1. The Owner and Engineer have elected to utilize a cloud-based operating system, PROCORE, during construction phase activities to facilitate document and data file transfer, submittal reviews, and RFIs. If awarded a construction contract, and upon issuance of a Notice to Proceed, the successful Contractor will receive guidance from the Engineer on procedures required for the implementation and use of PROCORE.
2. PROCORE is a free, cloud-based, application that will be made available to the successful Contractor for this project.

PART 5 PERFORMANCE REQUIREMENT

5.01 Comply with all performance requirements set forth in the Detailed Specifications. Contractor shall submit performance data to the Engineer for preliminary review of the equipment to be furnished. Such data shall be based on actual tests of similar equipment and include sufficient data to demonstrate suitability of the equipment for the conditions specified.

PART 6 OPERATION AND MAINTENANCE STARTUP SUPPORT

6.01 The Contractor shall include for all items, equipment, systems, and processes noted, sufficient manufacturer training and support of the Owner's staff so as to assure proper instruction on the performance, operation, management and control of such facilities.

6.02 All start-up and training activities shall be properly scheduled to permit adequate coordination between all parties (Contractor, Manufacturer, Owner and Engineer). The Contractor shall furnish to the Engineer a minimum of two (2) proposed dates for each start-up and training event for selection. The Engineer shall coordinate with the Owner in establishing which dates are most appropriate and shall, in turn, notify the Contractor accordingly. The Contractor shall submit primary and alternate dates for start-up and/or training to the Engineer in writing at least seven (7) calendar days prior to the primary dates to permit adequate coordination. Failure to follow the above described procedures shall result in rescheduling of start-up and/or training activities. All costs and liabilities resulting from such circumstances shall be the responsibility of the Contractor. A listing of start-up support requirements is presented at the end of this section.

PART 7 BASE BID EQUIPMENT MANUFACTURERS

7.01 The Contractor's Base Bid shall be for the equipment named in these Detailed Specifications when specifically identified.

PART 8 ALTERNATE EQUIPMENT MANUFACTURERS

8.01 It shall be the manufacturer's responsibility to thoroughly inspect the plan sheets (in addition to the entire set of contract documents) specific to the equipment being submitted. The Contractor's submittal of equipment shop drawings shall include as a cover page any and all required additions to facilitate alternative equipment for consideration by the Engineer prior to shop drawing review. Lack of said sheet shall be taken to infer no

additions / modifications in piping, foundation, valves, electrical, instrumentation, etc. Any such required modifications that arise after said submission shall be the sole responsibility of the Contractor at no additional cost to the Owner.

8.02 In addition to the requirements of the Contract Documents, the Contractor shall adhere to the following paragraphs when proposing Alternate Manufacturers:

- A. If the equipment the Contractor proposes to furnish differs from that indicated on the drawings or specified or requires different arrangement, the Contractor shall prepare and submit for review detailed structural, mechanical, and electrical drawings and equipment lists showing all such changes. If accepted by the Engineer, any changes to the contract drawings and specified equipment and any other additional costs involved including any engineering, structural, electrical or changes in interfacing work that are required as a result of using the alternate equipment shall be made by the Engineer and the cost for these changes paid for by the Contractor. There shall be no additional costs to the Owner.
- B. If the installation Contractor and / or Equipment Manufacturer fail to disclose all of the deviations and exceptions to the alternate equipment and / or the alternate equipment does not meet the performance requirements of the specifications, it will be at the Owner's discretion whether or not the Contractor is required to remove and replace the installed equipment with equipment that will meet all the requirements of the specification at no cost to the Owner. The Contractor shall make all necessary supporting systems changes in order to provide a properly installed and operating system. No contract time extensions will be granted for testing, retesting, modifications or replacement of equipment.
- C. Shop drawings for alternate equipment differing from the named equipment in these specifications shall include a separate section which details ALL differences between these specifications and the alternate equipment. This section should be placed at the beginning of the shop drawing submittal.

PART 9 AS-BUILT DRAWINGS

9.01 Complete as-built drawings shall be kept on-site by the Contractor and are subject to review by the Engineer's representative for completeness prior to the release of the Contractor's Application for Partial Payment. No partial payments will be made without the Engineer's review and acceptance of complete up to date as-builts. No retainage monies will be considered for release prior to the Contractor's submission of and Engineer's review and acceptance of complete project as-built drawings.

9.02 For pipeline work, the Contractor shall prepare as-built records for all pipe installations to include:

- A. The location and depth of all new pipe, fittings and valves;
- B. Pipe invert elevations if they differ than shown on plans;
- C. The location, depth, clearance and type of existing utility crossed.

- D. For all directional drill pipe installations, the Contractor shall supply a successful pipe drill record log maps. The system must be an electronically recorded system and show existing ground elevation along with pipe elevation. Contractor shall tie the pipe plan stationing to the bore log.
- 9.03** For lift station or manholes, the Contractor shall prepare as-built records of all installed structures to include:
- A. The location of all corners of a rectangular structure;
 - B. The center of circular structures;
 - C. Top of slab elevations;
 - D. Finished floor elevations;
 - E. Corners of all fences.
- 9.04** Locations shall be recorded by northing and easting coordinate in the official State Plane Coordinate System or datum utilized within the plan set.
- 9.05** Depths of new and existing utilities shall be to top of pipe and tied to the datum of the project.
- 9.06** Clearance measurements shall be from bottom of pipe to top of pipe. As-built crossing records shall indicate which utility was on top.
- 9.07** As-built submittal shall include marked up construction drawings as well as a digital version in .PDF format.
- 9.08** Electrical, instrumentation and control work as-built drawings shall be submitted to the Engineer on reproducible drawings prior to release of retainage. Colors, location, and sizes of all wiring (including yard) shall be shown.

PART 10 TESTING

- 10.01** All equipment and materials incorporated into the work will be tested by the Contractor in accordance with the recommendations of the manufacturer in addition to those tests specified under this Contract. Certified results of all of these tests shall be provided to the Engineer.
- 10.02** Before substantial completion will be considered, all site system functions, including control system and process equipment shall be run and fully operational.

REQUIRED SUBMITTALS

Section Number	Item Description	Shop Drawings and Descriptive Literature	O&M Manual	Design Calculations	Test/Start-Up Report	Sample of Color Chart
DS-00	General Requirements					
DS-01	Mobilization, Bond, and Start-up					
DS-02	Salvage, Demolition, Removal, Renovation, and Relocation					
DS-03	Reinforced Concrete Structures	X				
DS-04	Piping, Valves, and Gates	X	X		X	
DS-05	Temporary Erosion and Sediment Control					
DS-06	Lake Drawdown Precast Structures, Pipe, and Appurtenances	X	X		X	
DS-07	Lake Drawdown and Dewatering	X				
DS-08	Blanket Drain	X	X			
DS-09	Fence	X				
DS-10	Polyurethane	X				
DS-11	Remediation Allowance	X				

END OF SECTION

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SECTION 01

MOBILIZATION, BOND, AND START-UP

PART 1 GENERAL

1.01 Description of Work

- A. The Contractor shall furnish all materials and perform all work necessary to mobilize onto the project site. This item should include the expense related to the purchase of required insurance and bonds and cost for a pre-construction audio-video survey (above ground – existing condition survey). Shop drawing assembly and contractor “engineering” / “layout” / “preparation” work shall also be included (i.e. – any work not resulting in a tangible construction result whose percent complete can be readily assessed through visual inspection on site).

1.02 Measurement and Payment

- A. A portion of the lump sum payment may be included in the first and last progress estimates after work is started.
1. The Mobilization, Bond, and Start-up amount shall not exceed a maximum of five percent (5%) of the total base bid. A request for Mobilization payment greater than 5% of the Base Bid will result in a pay limit of 5% for mobilization and a subsequent adjustment of other Contract Items to equate to 100% Contract value. The Mobilization amount shall be shown on the Contractor provided Schedule of Values.
 2. Payment for Mobilization may be included in the first progress estimate after work is started. No more than 95% of the mobilization, bond and startup amount shall be included in the first pay request. The remaining 5% may be requested in the final progress estimate. No additional payment will be made for de-mobilization or remobilization initiated by the Contractor due to shutdowns, suspensions of the work or for other mobilization activities.

PART 2 INSURANCE AND BONDS

- 2.01 Required insurance and bonds (performance and payment) shall be provided as set forth in the following Sections of the Contract Documents: Information for Bidders, General Conditions, Supplemental Conditions, Special Provisions or Contract Documents.

PART 3 EXECUTION

3.01 Pre-Construction Audio-Video Survey (Above Ground)

- A. Engineer and Owner shall be notified a minimum of 48 hours prior to scheduled Pre-Construction Audio-Video Survey.

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- B. Prior to each construction phase (tree removal and dam rehabilitation separately), the Contractor shall video/audio record the construction area to document its condition. The purpose is to establish conditions prior to construction. The area documented shall include all areas where work is to be performed, all areas within a 250-foot radius of the project site, and areas the Contractor anticipates local project related trucking traffic may create damage that requires documentation of existing conditions. The contractor shall thoroughly document the condition of all existing roads, signs, driveways, culverts, structures, grounds and/or any other items which could be damaged during construction.
- C. The product shall be high quality audio and video recorded on digital video disc (DVD) or flash drive. The video portion shall present bright, sharp, clear pictures with accurate colors. The picture shall be free from distortion or other picture imperfection. The audio portion shall be of proper volume and clarity. The audio commentary shall be precise with concise explanatory notes.
- D. The entire construction area and any contiguous areas which may be adversely affected by construction activities shall be video recorded with digital video camera capable of producing a 'HD quality' resolution of 1920 x 1080 resolution.
- E. The audio part of the video shall provide a precise and concise summary. An audio summary shall be provided at the beginning of each video, at each street, and at intervals of not more than 100 lineal feet. Audio summary shall include video number, job title, job location, positional location, date and time, weather and any other notable condition.
- F. The recording shall be completed prior to the start of each construction phase (tree removal and dam rehabilitation separately) and the placement of any construction materials or equipment on the proposed site. However, recording shall not precede the start of each construction phase (tree removal and dam rehabilitation separately) by more than seven days.
- G. The Contractor shall provide the Owner and Engineer each with a copy of the recordings prior to mobilizing to the construction site. Any recordings not conforming to the specifications may be rejected with re-recording to be done at no additional cost to the Owner. Each video shall be properly labeled. An index shall be provided describing the contents of each video.

3.02 Construction Survey

- A. The Contractor shall be responsible to perform a construction survey prior to beginning construction or ordering materials under the direction and supervision of a registered Land Surveyor in the State of Indiana and include, but not be limited to:
 - 1. The right of way and easement offset stakes shall be set at a maximum at 25 feet intervals.
 - 2. Limits of each site shall be marked or staked at a maximum spacing of 25 feet. Locations of structures shall be staked or marked. Rectangular

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structures shall be marked or staked at each corner. Circular structures shall be marked or staked at the center and the outside diameter indicated.

3. Establish survey control points and run a level circuit to confirm elevation of project benchmarks and existing structures.
4. If any discrepancy is discovered by the Contractor or his subcontractor, the Contractor shall notify the Engineer within 24 hours.
5. Lack of Contractor performing construction survey, confirming elevations and locations, and/or notifying engineer of discrepancies identified as a result prior to ordering materials and performing work shall result in no additional cost to the Owner for any/all corrective actions, re-stocking fees, etc. that may arise as a result.
6. Field notes shall be kept in field notebooks in a clear, orderly, and neat manner consistent with standard engineering practices, including title, numbers, and indexes. Such notebooks shall be bound and shall adequately document all survey information. Copies of field notes shall be furnished to the Engineer along with the survey with Contractor certification construction survey matches design. Any discrepancies noted shall be clearly denoted to Engineer for consideration. **Construction survey/certification shall be a shop drawing submittal requirement.** The original field books shall become the property of the Owner upon completion of work. Accuracy of the construction engineering may be checked by the Engineer at any time. This shall not waive the responsibility of the Contractor for the accuracy of the construction layout. The supervision of the Contractors construction engineering personnel shall be the responsibility of the Contractor. All error resulting from the operations of such personnel shall be corrected with no additional payment.

END OF SECTION

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SECTION 02

SALVAGE, DEMOLITION, REMOVAL, RENOVATION, AND RELOCATION

PART 1 GENERAL

1.01 Description of Work

- A. Scope of Work. The Contractor shall provide the labor, tools, equipment and material necessary for all salvage, demolition, removal, renovation, and relocation in accordance with the plans and as specific herein. All Items required to be demolished shall be demolished and removed complete and disposed of lawfully as described herein, except items noted herein as being salvaged for the Owner.
- B. Payment for all demolition work is included in the base bid and shall include all demolition work specified under this section and as indicated on the plans.
- C. PCB and Mercury Removal and Disposal: The handling of any fluorescent lighting fixtures and ballasts containing PCB or mercury is subject to all applicable state and federal mandates and regulations. The Contractor shall be responsible for the removal and disposal of the material in accordance with applicable regulations. All costs associated with said removal and disposal shall be considered incidental and shall be included in the lump sum bid for demolition.

PART 2 PRODUCTS

2.01 Salvage, Demolition, Removal, Renovation, and Relocation

- A. See the project plans for salvage, demolition, renovation, removal, and relocation items.

PART 3 EXECUTION

3.01 Installation

- A. All items not removed by the Owner and not specifically identified on the plans as salvageable shall become the property of the Contractor. The Contractor may salvage or dispose of these items at their discretion, except that disposed items shall be lawfully disposed of in accordance with all Federal, State and local laws and regulations.

3.02 Salvage

- A. The plans show items that the Owner would like to salvage prior to the commencement of any demolition activities at the site. The Contractor is required to provide the Owner with a minimum of 7 days advance notice prior to salvaging these items.

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- B. The Contractor shall assume that all remaining un-salvaged items, both mechanical and electrical, will be removed by the Contractor at no additional cost to the Owner.
- C. Any equipment which is to be removed and reused in the facility as described in these specifications and shown on the plans shall be the responsibility of the Contractor to maintain, protect, and store until such equipment has been installed by the Contractor and placed into service.
- D. Existing riprap removed from below the spillway may be reused for the pad under the siphon intake or along the shoreline. Riprap reused shall be of appropriate size and quality for the application and free of deleterious material.

3.03 Demolition

- A. Abandoned items shall be demolished to the limits shown on the drawings. Demolition of any item shall be complete unless otherwise agreed to by the Engineer.
- B. The Contractor shall be responsible so that demolitions take place in the safest possible environment. No demolition shall occur which would present a potential hazard to adjacent equipment, tankage, etc., and/or personnel safety. The Contractor shall be fully liable to the Owner for complete restoration and any damages that occur due to Contractor negligence. Demolition procedures on any such item or associated item that is to be reused under this project shall be agreed upon by the Owner/Engineer prior to the start of unit demolition.
- C. All work shall be done in a manner to assure safety of all possibly affected persons.
- D. The Contractor shall be responsible for keeping an accurate record of all demolition and abandonment performed, noting which items were removed from the site and which salvage items were stored at the designated site; the quantity, size, and quality of the salvaged items and the Engineer's indication that said items have been inspected.
- E. The Contractor shall perform demolition work shown on the drawings and as described herein. The items included in the demolition work shall be limited to that shown on the drawings and to the extent as described elsewhere in these specifications, and as necessary to complete the intended construction, modifications, and installations.
- F. New openings shall be neatly cut or drilled to prevent face chipping or spalling. All damaged areas shall be repaired to a condition equivalent to that which existed prior to the start of the work at a minimum.
- G. Any adjacent walls, floors, ceiling, etc., damaged during demolition shall be restored to original condition or better by Contractor.
- H. All steel and concrete to remain that has been marred, damaged or defaced as a result of demolition shall be repaired. Saw cut and remove concrete to a depth of

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not less than 4-inches below grade where applicable unless noted otherwise on the drawings. Remove exposed reinforcing to preclude it from exiting new surface. Apply appropriate bonding agent to the surface. Patch with non-shrink, non-metallic grout to match the existing surface unless otherwise noted.

- I. All abandoned pipe shall be plugged at each end. Plugging of interior piping shall be with blind flange with gasket or equivalent method. For interior piping, drill weep holes at lower elevations to keep water from sitting in the line. Exterior piping shall be plugged with a mechanical joint plug, or equivalent, encased in concrete for corrosion protection.
- J. All embedded anchors of removed items shall be cut flush with the existing surface and sealed. If the area of the existing anchors must be reused for new anchors, remove anchors and concrete and replace as required by equipment manufacturer.

3.04 Removal

- A. The Contractor shall be responsible for coordinating with the Engineer which items shall be removed from location or from the site. The Contractor shall be responsible for transportation and lawful disposal of all removed items.
- B. The Contractor shall remove unsalvageable debris, equipment, conduit, wiring, and other unusable materials as described herein. The items to be included in the removal work shall be as described elsewhere in these specifications, and as necessary to complete the intended construction, modifications, and installations.

3.05 Renovation

- A. Contractor shall make modifications to the existing equipment and infrastructure as shown on the plan sheets and where applicable as required by the equipment suppliers.
- B. All cleaning, surface preparation, and coatings shall be per Workmanship and Materials Specifications Section WM 25.1 and 25.2 as applicable.
- C. Waterproofing (See DS & W&M Coatings Specifications for new structures)
 - 1. Specific to renovations, areas of existing buildings, etc. where work is being performed shall be waterproofed at the conclusion of the new work
 - 2. Note, no mention of “new” structures is made under this section. New structures require coatings as indicated under the applicable DS and W&M Sections.
- D. Caulking and Sealing – to be performed as required. All construction/contraction joints shall be caulked/sealed.
 - 1. Caulking and sealing shall include exterior perimeters; expansion or construction joints; joints in all horizontal surfaces; metal to masonry, metal

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to metal, and other specific job requirements of existing concrete structures to be re-used. Sealing for all new structures shall be included under DS & W&M Coatings Specifications.

2. Sealant to be polysulfide base sealant based on liquid polymer.

E. **Abandoned Piping: All piping to be abandoned shall be completely filled and sealed with non-shrink grout. Wastewater shall be evacuated from line and properly disposed of prior to grouting.**

3.06 Contractor's Responsibilities

A. Risk of Loss

1. The Contractor shall accept the site in its present condition and shall inspect the site for its character and the type of structures to be demolished. The Owner will assume no responsibility for the condition of existing buildings, structures, and other property within the demolition area. No adjustment of proposal price or allowance for any change in conditions that occur after the acceptance of the bid will be allowed.

B. Permits and Fees

1. The Contractor shall obtain all the necessary permits and pay all permit fees that are required by state or local authorities in conjunction with the demolition work.

3.07 Buried Objects

A. Partially Buried Objects: All piping, posts, walls and footers, reinforcing bars, anchor bolts, railings and all other partly buried objects protruding from the ground shall be removed. The remaining voids shall be filled with soil and compacted in accordance with these specifications.

B. Vegetation: The Contractor shall protect all trees not to be removed from damage by the demolition operation.

C. Fuel Tanks: Fuel tanks, above or below ground, shall be carefully removed and disposed of in a safe manner in accordance with the State Fire Marshal's regulations and those of the [Indiana Department of Environmental Management]. Fuel tanks, above or below the ground, or tanks which have been used for storage of gasoline, kerosene, benzene, oils or similar volatile materials shall be carefully removed and disposed of in a safe manner. The time, place and manner of disposal will be as set forth in the Contract Documents.

D. All other tanks or receptacles shall be pumped out or emptied in a safe manner, and then shall be flushed out immediately with water until they are gas-free before the work of removal is begun.

END OF SECTION

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SECTION 03

REINFORCED CONCRETE STRUCTURES

PART 1 GENERAL

1.01 Description of Work

- A. The Contractor shall provide the labor, tools, equipment and materials necessary to furnish and install all reinforced concrete structures including furnishing and installing complete all expansion and construction joints, water stops, grout fills, forms, curing materials, waterproofing materials, rubbed finish work, floor hardening materials, concrete, anchor bolts, bulkheads, bracing and conduits required to be embedded in the concrete, precast concrete manhole sections, joint kent-seal, exterior joint mac-wrap, excavation and stockpiling of materials, non-significant relocation of conflicting existing pipes, dewatering of trenches, protection of existing structures, protection of existing utilities, connecting of sewer pipes, disposal of excess excavated material, granular bedding, backfilling and compaction other than that covered under Granular Backfill requirements, maintaining trench surfaces, dust control, testing, and any additional incidental work required to properly complete the work as shown on the plans and as specified herein. In general, the products and methods of execution are presented in WM 5.1 "Concrete Formwork", WM 5.2 "Cast-In-Place Concrete", WM-9 Standard Manholes, and WM 21 "Expansion and Construction Joints and Waterstops". Provide all materials and equipment as specified herein, as shown on the drawings, and as necessary.
- B. **All** reinforced concrete structures on this project which are to contain water and/or are noted on the drawings (cast-in-place **and** precast) shall have **Crystalline Waterproofing** as described in this Section. Reinforced concrete structures with crystalline waterproofing will **not** require the concrete coatings as described in WM-25.1 and WM-25.2. All other concrete shall require the coatings as described in WM-25.1 and WM-25.2 with the following exceptions:
1. Lift Station Wet Wells shall receive both Crystalline Waterproofing and coatings per WM 25.1.
 2. Forcemain discharge manholes shall receive interior coatings per WM 25.1.
- C. All new equipment shall have standard housekeeping pads unless otherwise noted on Plans or Specifications.

PART 2 PRODUCTS

2.01 Cast-In-Place Concrete Structures

- A. All reinforced concrete structures formed and poured in place shall be constructed with Class E concrete as specified in section WM-5.2-2.03 unless otherwise indicated in these Detailed Specifications or on the Structural Drawings.

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- B. All concrete process structures shall be watertight concrete as described in WM 5.2. Waterstops must be used for all water bearing or soil retaining in colds joints below the retained soil, below the structure's high-water line and/or below the 100-year flood elevation.
- C. Concrete Mix Classes shall be as shown on the Structural Drawings.

2.02 Pre-Cast Concrete Structures

- A. Where concrete structures are noted as "precast" on the plans and do not classify as a standard manhole as specified in WM 9 "Standard Manhole", the Contractor shall supply the structure as specified herein and as noted on the structural plans.
- B. Precast structures shall be designed, detailed, fabricated, and constructed in accordance with the latest editions of ACI 318: Building Code Requirements for Reinforced Concrete as published by the American Concrete Institute.
- C. Penetrations are not permitted in precast concrete except where inserts and sleeves are cast-in-place. Core drilling of precast concrete shall not be permitted. Conduit cast within precast structures is not permitted.
- D. Grout or concrete containing chlorides shall not be used.
- E. The precast concrete manufacturer shall prepare detailed working or shop drawings to enable fabrication, erection, and construction of all parts of the work in accordance with the drawings and specifications and shall submit drawings, including calculations, buoyancy calculations and design, and concrete mix designs, to the structural engineer for review and approval prior to fabrication. These shop drawings shall show the design loads, plans, elevations, sections, connections, locations of cast-in-place inserts/sleeves, details, assumed water table, and any required anti-flotation necessary for the precast concrete manufacturer to fabricate and the contractor to construct all parts of the structure. These shop drawings, calculations, and concrete mix designs will be reviewed for design concepts only. The precast manufacturer shall be responsible for all dimensions, accuracy, and fit of work. **The precast structure shall be designed by, and the shop drawings and calculations shall bear the seal and signature of a registered professional engineer in the State of Indiana.**

2.03 Crystalline Waterproofing

- A. Manufacturers
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the specified product made by Xypex Chemical Corporation, or a comparable product by one of the other manufacturers listed:
 - a. Crystalline Waterproofing: Basis-of-Design Product – Xypex Admixture C-1000 (without Fly Ash) or C-500 (with Fly Ash), Xypex Chemical Corporation:

- 1) Xypex Chemical Corporation; Xypex Admixture.
- 2) Kryton International, Inc.; Krystol Internal Membrane (KIM)
- 3) Master Builders Solutions; MasterLife 300 Series
- 4) Penetron International, Ltd; Penetron Admix SB

B. A prepackaged, gray-colored proprietary blend of Portland cement, specially treated sand, and active chemicals that, when mixed with concrete and reacts chemically in the presence of water to develop crystalline growth within concrete capillaries to produce an impervious, dense, waterproof concrete with properties having proven to meet or exceed the following criteria:

1. The admixture must be a Permeability Reducing Admixture for Hydrostatic Conditions (PRAH) as indicated by ACI 212.3R-10 (Chapter 15).
2. Permeability:
 - a. The coefficient of permeability for admixture treated concrete will be reduced by a minimum of 70% compared to untreated concrete when tested using BS EN 12390-8.
 - b. Treated specimen does not exhibit any water leakage when tested at 150 psi (1.05 MPa) head pressure for 5 days according to COE CRD-C 48 (Mod).
 - c. Shall reduce or have no penetration of water compared to an identical concrete mixture without the admixture, when tested in accordance with DIN 1048 for a duration of 72 hours.
3. Compressive Strength: Treated concrete must have compressive strength equal or higher than plain concrete when tested in accordance with ASTM C 39/C 39M at 28 days.
4. Drying Shrinkage: There shall be no increase in drying shrinkage for treated concrete compared to untreated concrete when tested according to ASTM C157 or equivalent.
5. Self-Sealing: Autogenous crack sealing of treated concrete for cracks with width of 0.016 inches (0.4mm) or smaller; verified by independent testing.
6. Potable Water Contact Approval: Certified by NSF to NSF/ANSI Standard 61 Drinking Water System Components - Health Effects for use in structures holding potable water.
7. Shall conform to ASTM C 494/C 494 M, Type S

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PART 3 EXECUTION

3.01 Installation

- A. Precast structures shall be installed and tested in accordance with the manufacturer's written instructions and Section WM-9.
- B. Crystalline Waterproofing: Comply with waterproofing manufacturer's written instructions for application.

END OF SECTION

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SECTION 04

PIPING, VALVES, AND GATES

PART 1 GENERAL

1.01 Description of Work

- A. Scope of Work. The Contractor shall provide the labor, tools, equipment and material necessary to furnish, install, and test all piping, valves, and gates in accordance with the plans and as specific herein. All piping, valves, and gates shall be completed in conformance with the applicable Workmanship and Materials Specifications.
- B. All piping, valves, and gates shall be as described in this specification unless otherwise denoted on the drawings.
- C. **Wherever new pipe is to be connected to existing pipe, the Contractor shall confirm the existing pipe size, material, and elevation prior to ordering new pipe and fittings.**
- D. **All flanged valves, meters, and pumps shall be directly bolted to a flanged coupling adapter on at least one side.**

PART 2 PRODUCTS

2.01 Water Mains

- A. Buried water main shall be per WM-14.
- B. Water main shall have restrained joints.
- C. Water main shall meet pressure class 150 or greater.

2.02 Sanitary Force Mains

- A. All buried sanitary force mains shall be HDPE pipe in accordance with WM-8. All HDPE pressure pipe shall have a minimum rating of DR-11 (200 psi) unless otherwise noted.
- B. All force main piping shall use restrained joints.

2.03 Gate Valves

- A. All gate valves shall be in accordance with WM-16.

2.04 Butterfly Valves

- A. All butterfly valves shall be in accordance with WM-16, Paragraphs 2.06.A and 2.06.B.

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2.05 Through Wall Piping

- A. The Contractor shall furnish and properly install all wall or floor castings, wall pipes, sleeves, etc. Penetrations of piping through walls will normally be provided by the utilization of either a cast iron wall pipe or link seal modular system (for small diameter pipes only; 4" or less – without specific exception request from Contractor with noted cause and approval by Engineer).
- B. Wall pipes shall be constructed of ductile iron. The length of the wall pipes will be as shown on the plans, as approved by the Engineer, and as required to facilitate installation. Contractor shall confirm required lengths prior to ordering. The type of joints on the wall pipe will be as shown on the plan or as approved by the Engineer. All wall pipes in construction will be located accurately in the wall before the initial concrete pour and they will be held accurately in place during the wall pours. Wall pipes will be provided with intermediate wall collars except where specifically exempted by the Engineer.
- C. Link-Seal Modular System
 - 1. The link-seal shall include the sleeve end caps, seal elements and hardware material and shall include:
 - a. HDPE sleeve and end caps, as manufactured by Century Line, or equal.
 - b. Links constructed of nitrile or EPDM
 - c. Reinforced nylon polymer pressure plates
 - d. Type 316 stainless steel bolts and nuts.
 - e. Modular link seal system shall be Link Seal, Innerlynx, or equal.
- D. Where new pipes will pass through existing walls and as shown on the plans, a link-seal modular system shall be inserted to provide a watertight seal. The wall shall be cored to minimize damage and material a smooth and round passage. The link-seal system shall be installed and then both sides of said core shall be grouted smooth. The link-seal shall be the same as stated above, except no sleeve is required.

2.06 Pipe Sleeves

- A. Pipe sleeves shall be ductile iron designed for a minimum working pressure of 350 psi. Pipe sleeve end connections shall be as shown on the plans and length as required as shown on the plans.

2.07 Expansion and Flexible Couplings

- A. Expansion couplings shall be arch type, constructed of a single piece of synthetic or natural rubber with wire reinforcing and integral full faced flanges. Pressure rating shall be the same as the piping it is connected to. The wall thickness, dimensions, exterior coating, control rod requirements and number of arches shall be in accordance with manufacturer's recommendations.

- B. Unless otherwise noted, joints shall allow for a minimum of 0.625 inches pipe expansion (joint compression) and 0.25 inches pipe compression (joint compression). Flexible connectors for air piping shall be suitable for 250°F service.
- C. Flexible connectors for water, wastewater and sludge service shall be constructed with a filled arch to eliminate sedimentation of solids in the arched area. Flexible connectors for air service shall not have the arched filled.
- D. Movement of the flexible connectors shall be restricted by tie rods of sufficient size and strength to restrain the connection. The flexible connectors and adjacent piping shall be adequately supported, placing no strain on the flexible connector itself.
- E. Joints shall be flanged in accordance with ANSI B12.1. Flanges shall be constructed of resilient rubber, full face, with galvanized metal retaining rings providing a metal backup ring behind the rubber flange.
- F. Expansion couplings shall be as manufactured by General Rubber Corporation, Mercer Rubber Company, Red Valve Company, or equal.

2.08 Sleeve Couplings

- 1. Sleeve couplings shall tightly seal piping without leakage and allow for deflection and vibration within the pipe line.
- 2. Sleeve couplings shall be constructed of cast iron. Bolts shall be of a corrosion resistant material. Gaskets shall cushion vibration and safely accommodate for pipe deflection or longitudinal pipe movement without leakage.
- 3. The coupling shall be restrained with joint harness as called out on the plans or as necessary to prevent longitudinal movement.
- 4. Couplings shall be pressure rated for the same pressure as that of the piping it is connected to.
- 5. Manufacturer shall be Dresser, Inc. (Style 38 or 138), Smith Blair, Inc., (Series 411), or equal.

2.09 Flanged Coupling Adapters

- 1. Flanged coupling adapters shall be one-end flanged and on-end sleeve type flexible coupling. They shall provide clearance between plain end pipe and neat flange, allowing easy disassembly of pipe when the flanged coupling adapter is removed.
- 2. For 12-inch diameter or less adapters, harnessing shall be with 1/2-inch stainless steel anchor studs. Number of studs shall be according to manufacturer's recommendations.

3. For adapters larger than 12-inch diameter, harnessing shall be with a minimum of four (4) corrosion resistant alloy steel bolts tied to adjacent flange or lugs on the pipe. Number of bolts shall be according to manufacturer's recommendations.
4. Where called out on the plans (restrained), the coupling adapters shall be restrained by use of lock pins constructed of high strength steel or joint harness to prevent longitudinal movement of pipes.
5. Flanged coupling adapters shall be pressure rated the same as the piping it is connected to.
6. Flanged coupling adapters shall be as manufactured by Dresser, Inc. (Style 127), Smith Blair, Inc., or equal.

2.10 Connections to Existing Water Mains

- A. Prior to making connections, the contractor shall contact the appropriate representative of the Owner to establish a schedule for making connections.
- B. No connection shall be made without approval of the Engineer and the Owner. When such approval is requested, the Contractor shall advise as to the method of operations, materials and equipment on hand to do the work, and estimate completion time to allow proper scheduling of the existing water utility operations.
- C. Tapping Sleeve
 1. The tapping sleeve body shall be fabricated from 18-8 type 304 premium grade stainless steel to minimize corrosion. The body shall be of the full circumference band configuration. The tapping sleeves shall be designed for a water working pressure of 150 pounds and shall be provided with the necessary test plugs for pressure testing. Dimensions shall be such that the tapping sleeves are installed so as to properly fit the O.D. of the existing pipes. All material shall be in accordance with AWWA Specifications including AWWA C223.
 2. Flanges shall be stainless steel, standard AWWA C207 Class D ANSI 150 lb. drilling. Flange shall be recessed to accept tapping valve.
 3. Bolts and nuts shall be 18-8 type 304 stainless steel with heavy hex nuts and 18-8 type 304 stainless steel stud bolts. Nuts shall be teflon coated to prevent galling. Washers shall be plastic lubricating type. Bridge plate shall be 18-8 type 304 and bonded to the gasket to assure even distribution of gasket pressure.
 4. Tapping sleeves shall be as manufactured by Rockwell International, or equal.

D. Tapping Valve

1. The tapping valve shall have M.J./flanged connection and shall meet all appropriate requirements of the Detailed Specification and WM specifications.
2. Valve shall meet AWWA C509/515 and shall be designed for 250 psig.
3. Body sealing gasket shall be BUNA-N.
4. Stem shall be two (2) inch square steel wrench nut.

E. Type "A" Connections

1. Connections shall be made under pressure by means of a tapping sleeve unless otherwise noted or directed by the Engineer.
2. The work shall include the furnishing and installation of the tapping sleeve; all makeup pipes between the new main and the tapping valve; the tapping valve; any required reducer or elbow fittings; and completion of the tap. Work shall also include all excavation, backfill, compacting of backfill, disposal of water and excess excavated material, sheeting and shoring, protection of existing structures and utilities, concrete thrust blocking at bends, tees and valves, testing and chlorination, clean-up, and all other operations necessary to complete the work.
3. Acceptance of a connection will be contingent upon the installation being in accordance with the standards, rules and regulations of the appropriate County and State Departments of Health and these construction specifications. It shall be the responsibility of the Contractor to maintain liaison with the appropriate stated agencies and water utility company.
4. The Contractor shall, after the tapping sleeve and valve are installed and properly supported on concrete pads, pressure test the installation as recommended by the tapping sleeve manufacturer. After this test and before the tap is made, the Contractor shall provide a placed concrete thrust block behind the tapping sleeve.
5. The Contractor shall provide competent personnel to make all pressure taps.

F. Type "B" Connections

1. Each Type "B" connection will include cutting into an existing main and installing a tee or bend, cut-in-sleeve, plugging, concrete blocking, and all other related work required to provide a complete connection at each location. Any corresponding valve shall not be included under this item.
2. Type "B" connection shall include cutting into an existing water main and installing a cutting-in sleeve, tee, bend, or any other fittings necessary to

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connect to the existing main. For each installation, the pay item shall also include the permanent capping, sealing, and concrete blocking of any existing water mains at that location which are to be abandoned in place. All related work required to provide a complete, tested, and operating connection shall be included in the Contractor's cost for the pay item.

G. Type "C" Connections

1. Each Type "C" connection shall include all related work required to connect to the end of an existing main or valve.
2. Type "C" connection shall include the furnishing and installation of any required couplings or fittings, and all other work required to connect to the end of an existing water main, existing valve, or valved pipe stub, including removal of any temporary caps, concrete thrust blocking, or other pipe sealing or restraint materials which may exist at the point of connection.

H. Consideration of Existing Main

1. The Contractor shall include in the unit price for each connection the cost of valving off the existing main, bleeding air from and sterilizing the existing line once the connection is made if the existing main is contaminated. Existing water mains shall not be isolated until the Contractor has all necessary equipment, materials, and personnel at the site to make the proper connection.

2.11 Spare Parts

- A. Provide the following spare parts to the Owner, boxed, marked and ready for long term storage:
- B. One (1) set of stem gaskets for each size and type of valve.
- C. Provide one (1) set of special tools as required.

PART 3 EXECUTION

3.01 Piping, valves, and gates shall be installed and tested in accordance with the manufacturer's written instructions and the Workmanship and Materials Specifications. All gravity sewer pipe shall be tested in accordance with WM-7. All force mains and water mains shall be tested in accordance with WM-15.

3.02 All valves shall be coated the same as specified for ductile iron piping in WM-11.

3.03 New potable water lines shall be chlorinated in accordance with Section WM-14 of the Workmanship and Materials Specifications. Disposal of chlorinated water must be neutralized first per WM-14.

3.04 Pipe Coating and Markers

- A. Piping shall be painted in conformance with the applicable Ten State Standards recommendations.
- B. After coating of exposed pipe, pipe identification markers and arrows shall be added. Labeling shall include service name, direction of flow and/or other identification of the pipe line as directed by the Engineer. The pipe identification markers shall appear at least once every 50 feet, and between all sections of pipes with bends, if straight length is larger than 10 feet.
- C. All pipe labels shall be painted using pre-cut stencils and epoxy paint per WM 25. The coating shall be suitable for moist areas or outdoor environments.
- D. The labeling system shall adhere to Federal OSHA requirements and ANSIA 13.1, latest edition, 'Scheme for the Identification of Piping System'.
- E. The size of the labeling shall meet the following minimum sizing:

Pipe O.D.	Marker Letter Size
3/4" – 1 1/4"	1/2"
1 1/2" – 2"	3/4"
2 1/2" - 6"	1 1/4"
8" - 10"	2 1/2"
Over 10"	3 1/2"

3.05 Tracer Wire

- A. The Contractor shall provide a continuous wire buried in the pipeline trench directly above the PVC or DI main to facilitate main location. Tracer wire shall be a 12 or 10 AWG Solid extra-high-strength copper-clad steel conductor (EHS-CCS) insulated with a 45 mil minimum, high-density, high molecular weight polyethylene (HDPE) insulation, and rated for direct burial use at 30 volts. EHS-CCS conductor must be a 21% conductivity for locating purposes. HDPE insulation shall be RoHS compliant and utilize virgin grade material. Insulation color shall meet the APWA color code standard for identification of buried utilities. Tracer wire materials shall comply with ASTM B-3, B170, D1248, D1238, and B869. The tracer wire shall also include 2 pound anodes soldered to the tracer wire every 500 feet.
- B. The tracer wire shall be spliced using a watertight connection and shall be brought to surface at a minimum of 100 feet by a PVC riser pipe with a cast iron cap.

3.06 Thrust Blocking

- A. All pressure piping and drain shall be provided with thrust blocking.
- B. Hydrants and mains at each tee, bend, and dead end shall be blocked or anchored per AWWA C600, latest version.

3.07 Depth of Cover for Water Mains

- A. All water mains shall be constructed with a nominal earth cover of 60" over the top of the pipe except as follows:
1. Where rock is encountered on the trench bottom at the normal laying depth, the pipe shall be protected by a 5-inch layer of sand bedding between the pipe and the rock surface. Where rock is encountered above the trench bottom elevation that would provide the normal laying depth, the rock shall be excavated to a depth such that the pipe will have a minimum of 36 inches of cover at its centerline and 5 inches of approved bedding below it. In this case for PVC pipe, the approved protection shall be laid around the pipe for the full width and depth of the rock excavation but not more than 5 inches above the pipe.
 2. For purpose of avoiding direct interference with existing structures or utilities, the Engineer may authorize decreased depth of cover. The condition shall be brought to the Engineer's attention.
 3. For the purpose of making grade changes within tolerable limits, the depth may be increased.
 4. Unless otherwise shown on the plans or permitted by the Engineers, the new mains shall cross beneath the existing mains, except in cases where the specified cover can be maintained by crossing above the existing mains.
 5. Where connections to existing mains dictates changes in the required depth of cover.

END OF SECTION

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SECTION 05

TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 Description of Work

- A. The Contractor shall provide the labor, tools, equipment and material necessary to furnish and install, in proper operating condition, all temporary erosion and sediment controls in accordance with the plans and as specific herein for the life of the project.
- B. The Contractor shall provide and furnish all material, labor, and equipment necessary to dewater the project site and maintain dry working conditions for all aspects of working, including but not limited to the installation of the sanitary sewer force main and all related structures, as shown on the Plans, as specified herein and as ordered by the Engineer or Owner. Work shall include, but not limited to: dewatering of all excavations or foundations as required; dewatering of in-channel construction areas (where required or approved); maintain storm discharges during the project; all other dewatering mechanisms to allow installation for all new facilities; cleanup; and all other miscellaneous or incidental work required for complete installation for the life of the project. Surface and/or groundwater controls may necessitate the use of temporary diversion ditches, cofferdams and/or dewatering by the use of pumping. Discharge water must filter through an approved erosion control measure prior to leaving the project site or entering another waterway.
- C. Comply with all requirements of the Construction Stormwater General Permit, local jurisdictional or Regulatory Authority, and Owner's requirements for this Project.
- D. Contractor shall follow Stormwater Pollution Prevention Plan and/or guidelines and specific stormwater quality measures established by the Indiana Storm Water Quality Manual latest edition.

1.02 Quality Assurance

- A. Comply with all applicable sections of the WM and DS Specifications.
- B. Store and protect miscellaneous erosion control items at the project sites as required by the manufacturer.

1.03 Submittals

- A. Submit shop drawings for materials, all installation details and recommendations from manufacturer.
- B. Include all performance data such as temporary seed mixtures, strengths for silt fence, silt fence posts, and other material specifications normally available and provided from the manufacturer.

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- C. Submit temporary in-channel pump around details including pump data, flow rates, sound attenuation (if required), sediment filtering plan, and velocity dissipation plan.
- D. Contractor shall submit resume of trained individual completing Self-Monitoring Program reports prior to beginning construction.
- E. Contractor shall submit weekly self-monitoring program reports and event inspection reports as required within 24 hours of every ½" rain event. Reports shall comply with Construction Stormwater General Permit (where applicable). Reports shall be submitted with monthly project pay applications. Payment for Temporary Erosion and Sediment Control work will not be approved without submittal of monthly reports.
- F. Upon final completion, Contractor shall provide one hard copy binder and one pdf digital copy of Project Management Log of reports. Retainage shall not be released until Project Management Log of reports has been submitted and reviewed.

1.04 Project Notification

- A. Contractor shall provide Construction sign and notice at a publicly accessible location near the project that displays the following information:
 - 1. A copy of the NOI letter and the NPDES number.
 - 2. Location of the construction plans.
 - 3. Name, company name, telephone number, email address (if applicable) and address of the project site owner.
 - 4. Name of the construction project and an address or general location of the project.
 - 5. Name of the receiving water(s).
 - 6. Contact information (phone and email) of Contractor where questions may be directed.
 - 7. Date the notice was posted.
 - 8. Be legible and on an 8 ½" x 11" sheet at a minimum.
 - 9. Contractor shall be responsible for contacting the local SWCD, MS4 or local jurisdiction, prior to start of construction.

1.05 Project Documentation

- A. Contractor shall maintain a project management log that contains:
 - 1. Location of each activity related to all off-site borrow sites, disposal areas, and staging areas that are off-site and meet criteria noted in Construction Stormwater General Permit.
 - 2. Information related to all project activities including, but not limited to:
 - a. Self-Monitoring Program (SMP) Reports

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- 1) SMP Reports must be completed by a trained individual as described in the Construction Stormwater General Permit. Contractor shall retain a copy of the resume of the trained individual completing the reports within the project management log.
 - b. Regulatory Inspections
 - c. Responses to a compliance action or enforcement action.
 - d. Records showing the dates of all Stormwater Pollution Prevention Plan (SWP3) modifications. The records must include the name of the person authorizing each change and send a summary of all changes.
- B. Contractor shall ensure SWP3 and all supporting documentation associated with the SMP and project management log are accessible at the project site office or in the possession of on-site individuals with responsibility for the overall project management or associated with the management and operations of construction activities. All information must be provided to IDEM or the inspecting authority within 48 hours of a request.

PART 2 PRODUCTS

2.01 General

- A. All products shall be in accordance with the Indiana Storm Water Quality Manual (latest version), INDOT Standard Specifications (latest version), and/or local jurisdictional requirements.

2.02 Silt Fences

- A. 2 x 2 in. hardwood posts (or steel fence posts) shall be used for anchoring.
- B. Fabric shall be buried a minimum of 8-inches. Fabric shall be a minimum of 18 inches above ground level (30 inches maximum).
- C. Fence fabric shall be either woven or non-woven, geotextile fabric with minimum 85% filtering efficiency. Where applicable, 14-gauge, six (6) inch mesh wire fence shall be used.
- D. The fence fabric shall contain UV inhibitors and stabilizers to insure six (6) month minimum life at temperatures between 0°-120° F.
- E. Silt fence shall have the following minimum material properties: grab strength of 90 lbs and elongation at 45 lbs of 50% max per ASTM D4632, apparent opening size of No. 20 sieve per ASTM D4751, permittivity of 0.01 sec-1 per ASTM D 4491 and UV resistance of 70% per 500 hours per ASTM D 4533.

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2.03 Filter Sock / Fiber Roll

- A. Filter socks / fiber rolls shall consist of a fabric sock or a non-biodegradable netting matrix filled with acceptable permeable material.
- B. Permeable material shall be straw, wood / excelsior fiber, or coconut fiber.
- C. Socks / rolls shall be a premanufactured product.
- D. 2 x 2 in. hardwood posts (or steel posts) shall be used for anchoring.

2.04 Temporary Stone Construction Entrance

- A. Temporary stone construction entrances shall be constructed of INDOT No. 53 stone on INDOT No. 2 stone.
- B. Geotextile fabric shall be installed for stabilization.
- C. Geotextile fabric for subgrade stabilization shall have the following properties: minimum grab tensile strength of 200 lbs and grab elongation less than or equal to 50% per ASTM D4632, minimum CBR puncture strength of 175 lbs per ASTM D6241, minimum trapezoid tearing strength of 75 lb per ASTM D4533, apparent opening size (AOS) of 50 sieve per ASTM D 4751, permittivity of 0.05 sec⁻¹ per ASTM D 4491 and UV resistance of 70% per 500 hours per ASTM D 4533.

2.05 Rock Check Dams

- A. Rock check dams shall be constructed of INDOT Revetment Riprap, INDOT No. 5 aggregate and geotextile fabric.
- B. Geotextile fabric for rock check dams shall have the following properties: minimum grab tensile strength of 200 lbs and grab elongation greater than 50% per ASTM D4632, minimum CBR puncture strength of 500 lbs per ASTM D6241, minimum trapezoid tearing strength of 80 lb per ASTM D4533, apparent opening size (AOS) of less than 80 sieve, for soils greater than 40% passing the No. 200 sieve per ASTM D 4751, permittivity of 1.2 sec⁻¹ per ASTM D 4491 and UV resistance of 70% per 500 hours per ASTM D 4533.

2.06 Traversable Check Dams

- A. Traversable check dams shall be constructed of filter socks or fiber rolls.
- B. 2 x 2 in hardwood posts (or steel posts) shall be utilized for anchoring.
- C. If undercutting is identified, Contractor shall install compacted INDOT #5 or #8 stone.

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2.07 Temporary Erosion Control Blankets

- A. Temporary Erosion Control Blankets design permissible shear stress shall be minimum of 2.10 lbs/ft² and design permissible velocity shall be a minimum 8.00 ft/s for unvegetated conditions.

2.08 Permanent Turf Reinforcement Mats

- A. Permanent Turf Reinforcement Mats design permissible shear stress shall be minimum of 4.0 lbs/ft² and design permissible velocity shall be a minimum 12.5 ft/s, both for vegetated and unvegetated conditions.

2.09 Temporary In-Channel Pump Around

- A. Sandbags or other approved non-erodible materials shall be used for the cofferdam. Cofferdams shall be installed at the upstream and downstream ends of the work area, with channel flow being bypass pumped around the work area.
- B. Pumps/generators, left overnight within neighborhoods, shall have noise attenuation devices. The pump intake, shall wither be “floated”, installed within a casing or other approved filtering device to ensure sediment is not being pumped.
- C. The pump should discharge onto a stable velocity dissipater made of riprap or sandbags. Water pumped from the work area should be pumped to a sediment filtering measure such as a sediment filter bag, dewatering basin or other approved source.

2.10 Dewatering Filter Bags

- A. Dewatering bag shall be either single-usage or reusable. Bag shall be constructed of a non-woven geotextile, non-biodegradable material able to handle varying flow rates. Material shall be 8 oz/per square yard and have the following material properties: tensile strength of 205 lbs. and elongation of 50% per ASTM D 4632, trapezoidal test of 85 lbs per ASTM D 4533, CBR Puncture strength of 535 lbs. per ASTM D 6241, apparent opening size (AOS) of 80 sieve per ASTM D 4751, permittivity of 1.35 sec-1 per ASTM D 4491 and UV resistance of 70% per 500 hours per ASTM D 4533.

2.11 Concrete Washout

- A. Concrete washout shall be constructed of sandbags and polyethylene lining (2 layers – 10 millimeters thick min.)
- B. Concrete washout area shall be clearly marked by a 1 x 1 ft. white sign with red text reading “Concrete Washout Area”.

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PART 3 EXECUTION

3.01 General Installation

- A. All temporary erosion and sediment controls shall be installed in accordance with the manufacturer's written instructions.
- B. Prior to construction, all erosion control measures shall be installed to control erosion and prevent sediment-laden water from exiting the site. This shall include, but not be limited to, the installations of silt fences, check dams, inlet protection, concrete washout, and all other items that are needed to control sediment from leaving the project site.
- C. The facility shall be inspected no less than once per week and after every rainfall event and shall be maintained on a bi-monthly basis for erosion control measures during construction. Both temporary and final seeding is required. Should any areas outside of the project area remain inactive for a period of 7 days or more, they shall be seeded with a temporary vegetative cover such as oats, wheat, or rye.

3.02 Silt Fences

- A. Silt fences shall be installed by the Contractor to retain sediment from disturbed areas.
- B. Fence shall approximately follow the contour of the land to avoid channelization and be located at least ten (10) feet from toe of slope to provide broad, shallow sediment pool.
- C. Access to the area shall be provided for sediment clean-out.
- D. A maximum of eight (8) foot spacing shall be used if support wire is provided, or six (6) foot spacing if no supporting wire is used.
- E. The fence shall be installed per the manufacturer's recommendations to insure acceptable performance.
- F. When work area has been reestablished with approximately 70% density of permanent vegetation, the silt fence may be removed.
- G. Silt fence may be limited to areas where force main is installed via open-cut installation or bore and receive pit locations. Plans indicate silt fence required if entire force main is installed via the open-cut method of installation.

3.03 Filter Sock / Fiber Roll

- A. Filter socks / fiber rolls shall be installed by the Contractor to retain sediment from disturbed areas.

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- B. Socks / rolls shall approximately follow the contour of the land to avoid channelization and be located at least ten (10) feet from toe of slope to provide broad, shallow sediment pool.
- C. Socks / rolls shall be installed per Manufacturer's recommendation.
- D. If more than one sock or roll is placed in a row, the product should be overlapped not abutted.
- E. The products should be anchored by driving a wooden or metal post through the barrier and into the underlying soil material. Posts should be spaced no more than five (5) feet apart and driven through the middle of the product. The posts should be driven a minimum of 18 inches deep and should be flush with the top of the product.

3.04 Temporary Stone Construction Entrance

- A. Temporary stone construction access drives shall be provided where necessary, to maintain stable entrance and exit conditions from the construction sites and to keep mud and sediment off public roads.
- B. Contractor shall remove all vegetation and other objectionable material from the foundation area.
- C. Install geotextile fabric on graded foundation to improve stability.
- D. Temporary stone construction access drives shall be constructed of a minimum of 8" of INDOT No. 2 stone or 4" of INDOT No. 53 stone placed on a minimum of 6" of INDOT No. 2 stone.
- E. If necessary, Contractor shall install a culvert pipe under the entrance to maintain proper road drainage.
- F. Temporary stone construction entrance shall be at least 20-feet wide beyond the entrance turn radius and of sufficient length to properly access and traverse the jobsite.

3.05 Rock Check Dams

- A. Rock check dams shall be installed in accordance with the plans and as specified here in.
- B. Rock check dams shall be used below construction activities within the channel.
- C. Rock check dams shall be spaced such that the top of the downstream check dam is at the same elevation as the toe of the adjacent upstream check dam.

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3.06 Traversable Check Dams

- A. Check dams shall be installed in accordance with the plans and as specified here in.
- B. Check dams shall be placed perpendicular to the flow of water.
- C. Check dam ends shall be positioned such that the storm water flows over the weir low point and does not flow around the ends.
- D. Check dams shall be spaced such that the top of the downstream check dam is at the same elevation as the toe of the adjacent upstream check dam.

3.07 Temporary Erosion Control Blankets

- A. Temporary erosion control blankets shall be installed where specifically shown on the plans and for ALL construction activities within storm conveyances, including roadside swales.
- B. The blankets shall also be installed for all slope's steeper than 4:1.
- C. Installation shall be per manufacturers recommendation, which includes all mat anchoring, staple requirements and patterns and mat overlaps. Note, longer anchors may be required where soft soils are encountered. Heavy duty anchor fasteners may be required in channels with hard soils to ensure adequate anchoring is provided.

3.08 Permanent Turf Reinforcement Mats

- A. Permanent Turf Reinforcement Mats shall be installed where specifically shown on the plans.
- B. Installation shall be per manufacturer's recommendation, which includes all mat anchoring, staple requirements and patterns and mat overlaps. Note, longer anchors may be required in soft soils. Hard soils may require heavy duty anchor pins or rebar to ensure minimum anchor depths are attained.

3.09 Temporary In-Channel Pump Around

- A. Temporary In-Channel Pump Around work shall stay within the limits of the disturbance as shown on the plans and minimize disturbances within the work area whenever possible.
- B. Upon installation of all sediment control measures, Contractor shall begin work on the upstream cofferdam and work downstream.
- C. The measure should be located such that the water drains back into the channel below the downstream cofferdam.

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- D. Traversing a channel reach with equipment in the work area where no work is proposed should be avoided.
- E. All channel restoration measures shall be installed as indicated by the plans and all banks graded in accordance with the grading plans and typical cross sections. After an area is completed and stabilized, the cofferdams shall be removed. If necessary, due to disturbance of the upstream cofferdam, the upstream cofferdam shall be removed to allow for a first flush, then reinstall a new cofferdam above the old upstream cofferdam to allow for restoration of the sump and cofferdam.
- F. The Temporary In-Channel Pump Around shall be installed on any tributary or channel or storm drain outfall that contributes baseflow within the work area. After construction, all disturbed areas shall be regraded and revegetated per the plans or within applicable Detailed Specification or as specified within the Temporary Erosion and Sediment Control specification or permit. Note, for temporary pump around installations that may last more than one day, Contractor may be required to temporarily remove cofferdams, prior to rain events, to allow channel to adequately convey the surface waters, to reduce flooding, eliminate property damage or increase site safety. Contractor is responsible for temporary pump around facilities for 24 hours, 7 days a week. If work is expected to take one day, work shall be conducted during low flow conditions, when rain is not forecasted.

3.10 Dewatering Filter Bags

- A. Dewatering Filter Bags, where utilized or specified, shall be securely connected to the end of the discharge hose. Dewatering bags shall be installed per manufacturer's requirements. General instructions are provided here-in: Lay bag flat in designated area. Securely fasten bag to pump discharge hose, with the use of wire, clamps or another securing device. Contractor may place the bag on aggregate or straw bales to improve performance. Pump into the bag and monitor to ensure pump is working and filtering effectively at rates and levels the bag can handle. The bag will be filled when it stops filtering or no longer able to pass water at a reasonable rate. When dewatering process is complete or bag is full, remove the hose and allow bag to dry. Remove the bag and material in an upland area or per specific project requirements.

3.11 Concrete Washout

- A. Concrete washout shall be a self-contained sturdy containment system constructed of leak proof materials which is sized to prevent the discharge and/or overflow of concrete wash water.
- B. Concrete washout shall be designed and placed to divert run-off away from the washout.
- C. Concrete washout areas shall be identified for the site and clearly posted.

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3.12 Field Quality Control

- A. The Contractor shall prevent any wind-borne soil particles, which could create a health and / or visibility hazard from leaving the disposal sites. The Contractor shall apply an approved dust preventative, as necessary, to avoid and eliminate a health and / or visibility hazard due to wind-borne soil particles. The dust preventative must be approved by the Owner prior to use.
- B. Construction operations shall be carried out in such a manner and sequence that erosion and air and water pollution will be minimized and held within acceptable limits. It is important that material excavated from this project be contained.
- C. Temporary seeding shall be applied immediately after grading activities at rates below:

Temporary Seeding Recommendations			
Seed Species *	Rate/Acre	Planting Depth	Optimum Dates **
Wheat or Rye	150 lbs.	1 to 1-1/2 in.	9/15 to 10/30
Spring Oats	100 lbs.	1 in.	3/1 to 4/15
Annual Ryegrass	40 lbs.	1/4 in.	3/1 to 5/1 8/1 to 9/1
German Millet	40 lbs.	1 to 2 in.	5/1 to 6/1
Sudan grass	35 lbs.	1 to 2 in.	5/1 to 7/30
*Perennial species may be used as a temporary cover, especially if the area to be seeded will remain idle for more than a year.			
**Seeding done outside the optimum dates increases the chances of seeding failure.			

- D. The following Erosion Control Schedule shall be used for this project:

Erosion Control Schedule		
CONTROL MEASURE	MAINTENANCE	INSTALLATION SEQUENCE
Stone Entrance	Minimum of 1 Entrances shall be Provided per site	Prior to Clearing and Grading
Silt Fence / Filter Sock / Fiber Roll	Weekly, after Storm Events and as Needed	Prior to Clearing and Grading
Existing Inlet/Drain Pipe Protection	Weekly, after Storm Events and As Needed	Prior to Clearing and Grading
Rock and/or Traversable Check Dam	Weekly, after Storm Events and As Needed	Prior to Clearing and Grading
Tree Protection	Weekly, after Storm Events and as Needed	Along with Rough Grading
Temporary Seeding	Water as Needed	After Rough Grading and/or Within 7 Days of Inactivity

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Erosion Control Schedule		
CONTROL MEASURE	MAINTENANCE	INSTALLATION SEQUENCE
Permanent Seeding	Water as Needed	After Finish Grading and/or Within 7 Days of Inactivity
Temporary Erosion Control Matting	Weekly, after Storm Events and as Needed	After Finish Grading, immediately after work within a channel
Permanent Erosion Control Matting	Weekly, after Storm Events and as needed	After Finish Grading, immediately after work within a channel
Inlet Protection	Weekly, after Storm Events and as Needed	Prior to Clearing and Grading for Existing Inlets and After Each New Inlet is Placed
Concrete Washout	Maintain to provide adequate holding and capacity with a minimum freeboard of 12 inches.	Prior to concrete installations
Seed, Sod and Landscape Around Inlets Completed	Water as Needed	After Finish Grading Around Finished Inlets
Removal of Inlet Protection	N/A	After All Areas Draining to These Areas Have 70% Density of Permanent Vegetation or permanent stabilization has been installed.
Removal of Silt Fence / Fiber Roll / Filter Sock	N/A	After All Areas Draining to These Areas Have 70% Density of Permanent Vegetation or permanent stabilization has been installed.
Removal Rock and/or Traversable Check Dam	N/A	After All Areas Draining to These Areas Have 70% Density of Permanent Vegetation or permanent stabilization has been installed.

PART 4 MEASUREMENT AND PAYMENT

- A. Payment for Temporary Erosion and Sediment Control, shall be included in the base bid. This item cost shall include all labor, materials and equipment to install all erosion control materials and measures as generally shown on the plans and specified here within, in order to prevent sediment transport of disturbed soils from construction activities. Work shall include ongoing maintenance of such facilities, modifications as necessary to protect water resources, weekly inspection reporting, clean-up and all other ancillary work associated with soil erosion control practices, including but not limited to: excavation, compaction, backfill, miscellaneous grading, concrete washout facilities, rock check dams, silt fences, site access, all erosion control facilities associated with access and staging areas, inlet protection, discharge filtering system (where applicable); temporary seeding, removal of items after project completion, and all other ancillary costs.

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END OF SECTION 05

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SECTION 06

LAKE DRAWDOWN PRECAST STRUCTURES, PIPE AND APPURTENANCES

PART 1 GENERAL

1.01 Scope

- A. The Contractor shall furnish all material, labor and equipment and do all work necessary to construct lake drawdown facility as shown on the plans, as specified herein and as ordered by the Engineer or Owner. Work shall include but not limited to: installation of precast manhole structures, valves, pipes, fittings and appurtenances, ball valve, lake drawdown anchor, pipe collars and associated drawdown piping. Contractor shall test the facility to demonstrate facility will work as intended and provide Standard Operating Procedure and Operation and Maintenance Manuals. Excavation, including rock removal, and subgrade/foundation preparation work, and soil backfill is included under the Excavation and Embankment Specification.
- B. In general, the structures and installation shall be in accordance with the Workmanship and Materials Specifications, Section 9, "Standard Manholes" and Section 16, "Valves, Gates, and Hydrants". This Section shall address only revisions, additions or clarifications.

1.02 Standard Operating Procedure and Operation and Maintenance Manual

- A. The Contractor shall provide a step by step Standard Operating Procedure to detail the operation of the lake drawdown facility.
- B. Contractor shall provide Operation and Maintenance Manuals for the Gate Valves.

1.03 Submit

- A. The Contractor shall provide installation procedures and quality control plan to ensure pipe deflections are not exceeded within lake and downstream embankment.
- B. Contractor shall submit shop drawings on all structures, pipe and valving.

PART 2 PRODUCTS

2.01 Reinforced Concrete Manhole Structure

- A. Reinforced concreted manholes shall conform to the Workmanship and Materials Specifications, Section 9, "Standard Manholes".

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- B. The pre-cast concrete manhole, including base, barrel sections, flat tops or concentric cones and adjusting rings shall have, Xypex Admix C-Series or approved equivalent, added to the concrete at the time of batching for concrete waterproofing by crystallization. All manufacturer's recommendations for concrete waterproofing by crystallization products shall be followed. A pink dye shall be added to any concrete mix that has the Xypex additive.
- C. Structure 503 manhole frame and cover shall East Jordan model V-1800-4 (30" clear opening and min. 4" frame height) or approved equal. Casting shall have Heavy Duty frame and solid cover meeting requirements of AASHTO M306. Casting shall be watertight assembly with dual hinges, locking device and spring assist. Casting shall be bolted to concrete manhole structure.
- D. Structure 502 manhole frame and cover shall be East Jordan model V-1600-5 (36" clear opening and 6" frame height) or approved equal, Heavy Duty frame and cover (min. 36" clear opening) meeting requirements of AASHTO M306. Casting shall be provided with dual hinges, locking device and spring assist. Casting shall be bolted to concrete manhole structure.

2.02 Gate Valve

- A. Gate Valve shall generally conform to the Workmanship and Materials Specifications, Section 16, "Valves, Gates, and Hydrants" except where specifically indicated here-in. Gate Valve shall have full body consisting of ductile iron. Wedge shall be made from ductile iron. Wedge shall be totally encapsulated rubber wedge. O-ring seals shall be provided at all pressure retaining joints. Interior coating shall comply with AWWA C550. Exterior coating shall be NSF61 certified fusion-bonded epoxy. A non-rising operating stem shall be located to 6" below the structure to allow the owner to operate the valve with a T-handle above grade. Contractor to provide Owner a T-handle (for each valve) for operation of the gate valves.

2.03 Ductile Iron Drawdown Pipe

- A. Flanged Pipe
 - 1. Flanged pipe shall be installed in all exposed applications (structures), unless specifically noted on the plans.
 - 2. Ductile Iron Pipe shall meet all standards of AWWA C151 with bolt hole aligned per AWWA C115 conforming to the drilling and facing of ANSI B16.1 Class 125 flanges. Ductile Iron Pipe shall be provided with minimum 1/8" thick gaskets with three (3) bulb type rings. Flat rubber gaskets are not considered equal in performance. Rubber-gasket joints shall be per AWWA C111. Pipe and fittings shall have exterior coated with an asphaltic coating approximately 1 mil thick. Provide interior lining for all pipe and fittings, consisting of ceramic epoxy.
 - 3. Exterior Coating for Ductile Iron Pipe and Fittings (Within Structures)

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- a. Refer to Workmanship and Material Section 25.1 for coating materials, requirements and preparation. Refer to Section 2.02 Coating Requirement per paragraph F. Ductile Iron Pipe for Submerged Applications.
 - b. DO NOT paint over bituminous shop coating.
 - 4. Provide polyethylene encasement for retaining wall drain pipe.
 - 5. Standard Fittings shall meet all standards of AWWA C110, ductile iron with bolt holes in bell.
 - 6. Compact Fittings shall meet all standards of AWWA C153, with bolt holes in bells.
- B. Interior Lining for Ductile Iron Pipe and Fittings**
- 1. Lining material of quality is Protecto 401™ Ceramic Epoxy. The material shall be an amine cured novolac epoxy containing at least 20% by volume of ceramic quartz pigment. Any request for substitution must be accompanied by a successful history of lining pipe and fittings for sewer service, a test report verifying the following properties, and a certification of the test results.
 - 2. A permeability rating of 0.00 when tested according to Method A of ASTM E-96-66, Procedure A with a test duration of 30 days.
 - 3. The following test must be run on coupons from factory lined ductile iron pipe:
 - a. ASTM B-117 Salt Spray (scribed panel) - Results to equal 0.0 undercutting after two years.
 - b. ASTM G-95 Cathodic Disbondment 1.5 volts @ 77°F. Results to equal no more than 0.5 mm undercutting after 30 days.
 - c. Immersion testing rated using ASTM D-714-87.
 - A. 20% Sulfuric acid—No effect after two years.
 - B. 140°F 25% Sodium Hydroxide—No effect after two years.
 - C. 160°F Distilled Water—No effect after two years.
 - D. 120°F Tap Water (scribed panel)—0.0 undercutting after two years with no effect.
 - d. 4. ASTM G-22 90 Standard practice for determining resistance of Synthetic Polymeric materials to bacteria. The test should determine the resistance to growth of Acidithiobacillus Bacteria and should be conducted at 30 degrees centigrade for a period of 7 days

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on a minimum of 4 panels. The growth must be limited only to trace amounts of bacteria.

4. An abrasion resistance of no more than 3 mils (.075 mm) loss after one million cycles using European Standard EN 598: 1994 Section 7.8 Abrasion Resistance.
5. Condition of Ductile Iron Pipe Prior to Surface Preparation
 - a. All ductile pipe and fittings shall be delivered to the application facility without asphalt, cement lining, or any other lining on the interior surface. Because removal of old linings may not be possible, the intent of this specification is that the entire interior of the ductile iron pipe and fittings shall not have been lined with any substance prior to the application of the specified lining material and no coating shall have been applied to the first six inches of the exterior of the spigot ends.

6. Application

a. Applicator

The lining shall be applied by a certified firm with a successful history of applying linings to the interior of ductile iron pipe and fittings. All applicators must be independently inspected at least two times per year to insure compliance with the requirements of this specification. This inspection must be coordinated and reviewed by the manufacturer of the lining material and any deviation from the application and/or quality requirements shall be corrected by the applicator. All inspections shall be in writing and a permanent record maintained.

b. Surface Preparation

Prior to abrasive blasting, the entire area to receive the protective compound shall be inspected for oil, grease, etc. Any areas with oil, grease, or any substance that can be removed by solvent, shall be solvent cleaned to remove those substances. After the surface has been made free of grease, oil or other substances, all areas to receive the protective compounds shall be abrasive blasted using sand or grit abrasive media. The entire surface to be lined shall be struck with the blast media so that all rust, loose oxides, etc., are removed from the surface. Only slight stains and tightly adhering oxide may be left on the surface. Any area where rust reappears before lining must be re-blasted.

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c. Lining

After surface preparation and within 12 hours of surface preparation, the interior of the pipe shall receive 40 mils nominal dry film thickness. No lining shall take place when the substrate or ambient temperature is below 40°F. The surface also must be dry and dust free. If flange pipe or fittings are included in the project, the lining shall not be used on the face of the flange.

d. Number of Coats

The number of coats of lining material applied shall be as recommended by the lining manufacturer. However, in no case shall this material be applied above the dry thickness per coat recommended by the lining manufacturer in printed literature. The maximum or minimum time between coats shall be that time recommended by the lining material manufacturer. To prevent delamination between coats, no material shall be used for lining which is not indefinitely recoatable with itself without roughening of the surface.

e. Touch-Up and Repair

Protecto 401™ Joint Compound shall be used for touch-up or repair in accordance with manufacturer's recommendations.

7. Inspection

- a. All ductile iron pipe and fitting linings shall be checked for thickness using a magnetic film thickness gauge. The thickness testing shall be done using the method outlined in SSPC PA-2 Film Thickness Rating.
- b. The interior lining of all pipe barrels and fittings shall be tested for pinholes with a non-destructive 2,500 volt test. Any defects found shall be repaired prior to shipment.
- c. Each pipe joint and fitting manufacturer must supply a certificate attesting to the fact that the applicator met the requirements of this specification, and that the material used was as specified.

8. Handling

- a. Lined pipe and fittings must be handled only from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe and fittings for lifting, positioning, or laying. The pipe shall not be dropped or unloaded by rolling.

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- b. Care should be taken not to let the pipe strike sharp objects while swinging or being off loaded. Ductile iron pipe should never be placed on grade by use of hydraulic pressure from an excavator bucket or by banging with heavy hammers.

2.04 Fusible HDPE Drawdown Pipe

- A. HDPE shall generally be per Workmanship and Material Section 14 Pressure Pipe – Water. HDPE pipe shall be per PE 4710, DR 11 200 psi (Ductile Iron Pipe Size) pressure pipe. HDPE shall be butt fused.

2.05 Stainless Steel Screen

- A. Stainless steel drum screen shall be joined to the pipe via flanged connection. Bolts for flange shall be stainless steel. Stainless steel screen shall be a minimum of 12” in diameter and 18” in screen length. Mesh shall be 1.5” x 1.5”.

2.06 Ball Valve

- A. Ball Valve shall be 1-1/2” in diameter, made from 316 stainless steel. Body shall be inline with min. 250 psi working pressure with FNPT x FNPT connections.

2.07 Concrete Pipe Collar and Lake Drawdown and Intake Concrete Anchor

- A. Concrete and reinforcement shall be per Detailed Specification Section Reinforced Concrete Structures. Lake Drawdown and Intake Concrete Anchor shall be installed on Revetment Riprap per Detailed Specification Section Riprap, minimum thickness of 30”. Pipe collar connections shall be made with stainless steel straps and hardware.

PART 3 EXECUTION

3.01 Installation

- A. The manholes shall be installed in accordance with the Workmanship and Materials Specifications, WM-9, "Standard Manholes". The structures shall be installed so that the top of the structure lid and frame is set one inch above final grade.
- B. Contractor shall provide a removable support or blocking under valves and tees.
- C. Gate Valve nut shall be located to the edge of the manhole frame lid to allow operation from above and to maintain man access to the valve. Stem shall be securely anchored or fastened to the manhole structure as required or necessary per manufacturer’s recommendation. Valves, provided with fusion bond epoxy, may not require field coat painting.
- D. Pipe collars shall be installed at minimum intervals and minimum amount of total collar required as shown on the plans.

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- E. Lake Drawdown Anchor shall be installed plumb on revetment riprap foundation as required to create a firm, stable base.
- F. Ductile Iron Drawdown pipe, ball and socket within lake, shall not exceed pipe deflection (12 degrees maximum). No joints shall be installed in a final position in a fully deflected state. Fittings shall be utilized where necessary. Contractor shall install a laying chute if required to maintain such alignment. Chute shall require Engineer or Owner approval and shall not consist of excavating into embankment – only adding approved materials.
- G. For fusible HDPE pipe installation, Contractor shall provide pressure rated restrained coupling for specific outside pipe diameter differences. Pipe shall not exceed allowable tolerances or restrained fittings shall be provided.

3.02 Testing

- A. Once Contractor deems the facility is ready for operation, Contractor shall test, with Owner and Engineer present to ensure the facility works as intended. Contractor shall make all necessary repairs or adjustments, if required, and re-test until operations are deemed satisfactory by Owner and Engineer.

END OF SECTION 06

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SECTION 07

LAKE DRAWDOWN AND SITE DEWATERING

PART 1 GENERAL

1.01 Scope

- A. The Contractor shall furnish all material, labor, and equipment necessary to dewater the project site and lower and maintain existing lake levels as shown on the Plans, as specified herein and as ordered by the Engineer or Owner. Work shall include, but not limited to: sequentially lowering and maintaining the existing lake level below the project work limits; dewater all excavations or foundations as required; dewater general excavations or swale construction areas; dewater shoreline construction areas; maintain storm discharges during the project; all other dewatering mechanisms to allow installation of new facilities; cleanup; and all other miscellaneous or incidental work required for complete installation for the life of the project.
- B. Surface and groundwater controls shall be accomplished in coordination with the required excavation and embankment construction. Surface and/or groundwater controls may necessitate the use of temporary diversion ditches, cofferdams and/or dewatering by the use of pumping. Methods for care of surface water and for controlling the surface and groundwater levels shall be subject to approval of the Engineer.
- C. Once work on the dam is completed and accepted by the Owner, the Contractor shall allow the lake to refill using natural, upstream channel flows. Filling the lake should be accomplished at a gradual pace so as not to erode the upstream embankments or cause undue stresses to the dam. Contractor shall monitor the dam embankments, shorelines and other structures during this time period and report any concerns to the Engineer or Owner.

1.02 Continuation of Drainage

- A. The Contractor shall take special care to maintain upstream drainage as construction of the new structures progress and until downstream work items are completed and accepted for carrying drainage.

1.03 Related Specifications

Comply with applicable portions of the following WM Specifications:

- A. WM-2 Excavation
- B. WM-3 Backfill, Fills and Embankments
- C. WM-4 Restoration of Surfaces

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PART 2 PRODUCT

2.01 General

Existing 18" drawdown pipe is available for Contractor's use. Contractor responsible for working with Owner on use of the drawdown facility.

PART 3 EXECUTION

Rapid draw down of the lake can result in a build-up of hydrostatic pressures in the upstream slope of the dam which can lead to slope failure. Lowering the lake water level slowly allows these pressures to dissipate gradually. Also, as the elevation of the lake is lowered, the volume of water per inch may also decrease resulting in a greater lowering rate. Contractor shall continuously monitor the lake levels and surrounding embankment conditions.

3.01 Lake Drawdown

A. Lake Drawdown:

1. The lake may be drawn down as follows:

- (a) Drawdown of the lake shall be no more than six (6) inches per day to elevation **438.0** or (14.0 feet below normal pool). Contractor shall continuously monitor the upstream side slopes for sloughing during the drawdown period.
- (b) The Contractor shall continuously monitor and keep a daily field record of the drawdown, including rise and fall during rainfall events.

B. Should rainfalls bring lake levels back up, Contractor shall use extreme caution to again lower the lake. Contractor may request additional time, without compensation, for delays due to lake drawdown impacts.

C. The drawdown may be accomplished using the Owner's existing drawdown facility and in order to minimize flooding and sedimentation downstream.

D. The existing side slopes of the dam shall be protected from possible erosion and sloughing to downstream areas. Erosion control silt fences shall also be placed below all areas that are disturbed during construction and that drain to waterways.

E. Install rock riprap check dams or sediment basins or filtering devices as required to control sediments from the project site to areas downstream of the lake.

3.02 General Site Dewatering

A. For general construction dewatering, for excavations, trench excavations, structure placement, etc., discharging of ground or surface water shall be filtered prior to leaving project site or entering another waterway.

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- B. Refer to Detailed Specification Temporary and Erosion and Sediment Control for additional sedimentation measures.

END OF SECTION 07

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SECTION 08

BLANKET DRAIN

PART 1 GENERAL

1.01 Scope

- A. The Contractor shall furnish all material, labor, equipment and do all work necessary to complete the blanket drain installation for the project as shown on the plans, as specified herein and as ordered by the Engineer or Owner. Work shall include but not limited to hauling and stockpiling of materials, installation of fine and coarse aggregates, compaction of said aggregates, testing of aggregates (by Contractor's hired geotechnical engineer), installation of drain pipe, clean outs, connections through wall or structures, clean up and all other miscellaneous or incidental work required for complete installation. Excavation, including rock removal, and subgrade/foundation preparation work, and soil backfill is included under the Excavation and Embankment Specifications.

1.02 Submittals

- A. Submit shop drawings for all collector pipe, connections, and other appurtenances.
- B. Include all performance data such as strengths for all pipe and fitting material items. Provide maximum pipe deflections for pipe joints.
- C. Submit rodent screen shop drawings or manufacturer's drawings.
- D. Submit samples and gradation of fine and coarse aggregate material to be used for this item.
- E. Submit selected geotextile product data sheet.
- F. Submit compaction test or geotechnical reporting or observation as required.
- G. Include within quality control plan, details on how to limit segregation of fine and coarse aggregates and installation procedure of filter drain.

1.03 Related Specifications

Comply with applicable portions of the following WM Specifications:

- A. WM-2 Excavation
- B. WM-3 Backfill, Fills and Embankments
- C. WM-5.2 Cast-In-Place Concrete
- D. WM-12 Storm Sewer Structures
- E. WM-13 Storm Sewer Pipe
- F. WM-17 Miscellaneous Pipe and Fittings

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PART 2 PRODUCT

2.01 Collector Pipe Materials

The following collector pipes shall be used for this project:

A. Drain Pipe

1. Dual Wall HDPE pipe shall be Type 'N-12' as manufactured by Advanced Drainage Systems, Inc. or approved equivalent. Pipe shall have a smooth interior and annular exterior corrugations. Pipe shall meet requirements of ASTM D-F2648 and pipe joint shall be soil tight. Fittings shall conform to ASTM F-2306.
2. Perforations shall conform to AASHTO Class II Perforation, M252. Perforation pattern shall be at 45- or 60-degree pattern (8 or 6 equally spaced perforations around the entire collector pipe circumference). Minimum water inlet area shall be 1.0 in²/foot or per AASHTO M252. Perforations shall be installed on the outside valley of the corrugations.
3. Drain pipe shall be wrapped in a double layer of Tencate Miramesh GR biaxial geosynthetic, or approved equal. Performance specifications for the biaxial geosynthetic are described below:

MECHANICAL PROPERTIES	TEST METHOD	UNIT	GR
(MINIMUM AVERAGE ROLL VALUES)			
Tensile Strength MD @ Ultimate	ASTM D4595	lbs/ft (kN/m)	1440 (21.0)
Tensile Strength CD @ Ultimate	ASTM D4595	lbs/ft (kN/m)	1733 (25.3)
Creep Reduced Strength MD	ASTM D5262	lbs/ft (kN/m)	471 (6.9)
Creep Reduced Strength CD	ASTM D5262	lbs/ft (kN/m)	566 (8.3)
Long Term Allowable Design Load ¹ MD	GRI GT-7	lbs/ft (kN/m)	407 (5.9)
Long Term Allowable Design Load ¹ CD	GRI GT-7	lbs/ft (kN/m)	490 (7.2)
Aperture Size MD	--	in (mm)	0.08 (2)
Aperture Size CD	--	in (mm)	0.08 (2)
Color	--	--	Green
Flame Resistance	NFPA-701 California State Fire Marshall		--
UV Resistance (at 500 hours) ³	ASTM D4355	% Strength Retained	100
Design Life	See Note ² below	years	75

2.02 Clean-Out

A. 6" Clean-Out

1. 6" Ductile Iron Grate rated for heavy duty wheel load traffic. Material shall conform to ASTM A48 – Class 30B. Concrete collar shall be installed around casting as shown on the plans; however, minimum requirements are: greater of min. thickness of 18-inches or to pipe adapter and min. width of 32" or 12-inches beyond the outside surface edge of the casting.

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2. Clean-outs shall be placed at the upper end of the perforated pipe and shall be formed by a 45 degree elbow at the end of the perforated section, connected to a length of solid wall 6" pipe, followed by another 45 degree elbow connecting to a short length of solid wall 6" pipe connected to the cleanout casting.
3. A total of two (2) cleanouts are required: one at the upstream end of each perforated pipe section.

2.03 Rodent Screens

- A. Rodent Screens mounted to the outlet side of the 6" perforated drain.
 1. Rodent screen shall be manufactured in conformance with INDOT Standard Drawing No. E-718-UNDR-06, or approved equal.

2.04 Filter Materials

- A. Fine (Filter) Aggregate
 1. Fine Aggregate shall be ASTM C33 sand

TABLE 1 Grading Requirements for Fine Aggregate

Sieve (Specification E11)	Percent Passing
9.5-mm (3/8-in.)	100
4.75-mm (No. 4)	95 to 100
2.36-mm (No. 8)	80 to 100
1.18-mm (No. 16)	50 to 85
600-µm (No. 30)	25 to 60
300-µm (No. 50)	5 to 30
150-µm (No. 100)	0 to 10
75-µm (No. 200)	0 to 3.0 ^{A,B}

^A For concrete not subject to abrasion, the limit for material finer than the 75-µm (No. 200) sieve shall be 5.0 % maximum.

^B For manufactured fine or other recycled aggregate, if the material finer than the 75-µm (No. 200) sieve consists of the dust of fracture, essentially free of clay or shale, this limit shall be 5.0% for concrete subject to abrasion, and 7% maximum for concrete not subject to abrasion.

- B. Coarse Aggregate
 1. Coarse Aggregate shall be Pea Gravel
 2. Gradation shall be per INDOT Standard Specifications 904.03(e), Coarse Graded 93PG

2.05 Geotextile

- A. Geotextile shall be placed around the Pea Gravel used in the pipe trench. Geotextile shall be placed only between the pea gravel and existing soil. No geotextile shall be placed between the Pea Gravel and the Fine Aggregate filter sand.
 1. Geotextile shall be Carthage Mills 15% woven (or approved equal).
 2. Performance data shall be as below:

PROPERTY	TEST METHOD	DATA	
		METRIC	ENGLISH
<input type="checkbox"/> Mechanical			
Grab Tensile Strength	ASTM D 4632	1.62 x 0.89 kN	365 x 200 lbs
Grab Tensile Elongation		24% x 10%	
Trapezoidal Tear	ASTM D 4533	0.51 x 0.33 kN	115 x 75 lbs
CBR Puncture	ASTM D 6241	3.00 kN	675 lbs
<input type="checkbox"/> Endurance			
UV Resistance	ASTM D 4355	90% @ 500 hrs	
<input type="checkbox"/> Hydraulics / Filtration			
Permittivity ⁽¹⁾	ASTM D 4491	2.10 sec ⁻¹	
Water Flow Rate ⁽¹⁾		5907 lpm/m ²	145 gpm/ft ²
Percent Open Area	CW-02215	10-15%	
Apparent Opening Size (AOS) ^{(1) (2)}	ASTM D 4751	0.425 mm	40 US Std. Sieve
<input type="checkbox"/> Physical			
Standard Roll Sizes / Packaging / Weight (Custom fabrication and packaging are available.)	Measured (Typical)	1.83 m x 91.5 m 167 m ² 39.6 kg	6.0 ft x 300 ft 200 yd ² 87.5 lbs
		3.65 m x 91.44 m 334.4 m ² 79 kg	12.0 ft x 300 ft 400 yd ² 175 lbs
		3.81 m x 91.44 m 348.39 m ² 81 kg	12.5 ft x 300 ft 416.7 yd ² 178 lbs

PART 3 EXECUTION

3.01 General Filter Drain Installation

- A. Collector pipe shall be laid and tested in accordance with the Workmanship and Materials Specifications, Section WM 13, "Storm Sewer Pipe".
- B. Fine (filter) and Coarse (drain) aggregate shall meet the gradation and requirements as specified and shown on the plans.
- C. Care shall be taken to prevent contamination of drains and filters by runoff containing sediment, dust, construction traffic, and mixing with nearby fine-grained materials during placement and compaction. Contaminated filters shall be removed and replaced at the Contractor's expense.
- D. Construction traffic shall be minimized to only that needed to properly construct the filter drains. Haul roads shall NOT be constructed over the filter drain. Any damage to the filter drains shall be repaired at the Contractor's expense.
- E. Contractor shall minimize and prevent aggregate segregation, with particular attention for the coarse filter, during handling and placement. Material handling shall be minimized. Filter and drain material shall be placed or stockpiled in a manner that limits the "free fall" of materials onto the site and filter installation. Max, acceptable "free fall" shall be 3 feet.
- F. Fine and coarse aggregate shall be compacted to a minimum of 70 percent relative density. Observational testing and reporting shall be completed under the direction of the Contractor's hired geotechnical engineer. Observation and reporting shall be completed to review soil subgrade and subsequent aggregate installations. Contractor's hired geotechnical engineer, may make

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recommendations on procedural compaction changes, for Engineer and Owner review, during installation.

- G. Fine Aggregate shall be placed uniformly in layers not to exceed 6 inches thick before compaction. Each layer shall have sufficient moisture to limit “bulking” during compaction. Each layer of fine aggregate shall be compacted by a mechanical compactor having a plate width of 17 in. or larger that delivers 3,000 to 9,000 lb per blow. Each lift shall be compacted with minimum of six passes of the compactor.
- H. Coarse aggregate shall be placed uniformly in layers not to exceed 12 inches loose measurement (prior to compaction). Each layer of coarse aggregate shall be compacted by a mechanical compactor having a plate width of 17 in. or larger that delivers 3,000 to 9,000 lb per blow. Each lift shall be compacted with minimum of two passes of the compactor.
- I. Placed fine and coarse aggregates shall be clean, washed aggregate without clay and silt coatings and no clay ball inclusions or organics. Unacceptable filter materials shall be removed from the filter drain system.
- J. Contractor shall maintain alignment and grade of collector pipes. Contractor shall take care to maintain the continuity and separation of the filter and drain. At no point shall the filter (fine aggregate) be less than 6-inches in thickness.

END OF SECTION 08

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SECTION 09

CHAIN LINK FENCE

PART 1 GENERAL

1.01 Description of Work

- A. The Contractor shall furnish and install new chain link type security fence and gate at the locations shown on the plans and specified herein. The Contractor shall replace existing fencing removed for the work with new fencing. New fencing shall match design of existing fence as much as possible.
- B. Work shall also comply with Section WM 23 "Chain Link Fences and Gates".

1.02 Product Handling

- A. Store and protect miscellaneous fence and related metal items at the project site as recommended by the manufacturer and the specifications.

1.03 Submittals

- A. Submit shop drawings for chain link and woven wire fabric, barbed wire, gates, posts, locking devices, concrete and related anchors and fasteners.
- B. Do not fabricate until shop drawings are approved.
- C. Include all performance data such as strengths for concrete and metal items.

PART 2 PRODUCT

2.01 Fence and Gates

- A. Chain link fence materials shall be per Workmanship and Material Section 23 Chain Link Fence and Gate with exceptions or additions contained here-in. All materials shall be new and unused.
- B. Chain Link Type Fence (CLTF) shall be 48" in height (min.). Material product shall be per Workmanship and Material Section 23 Chain Link Fence and Gate Section 2.02 PVC Coated Steel Chain Fence. The PVC coated Wire can be Class 1, 2a or 2b. Diameter of the wire mesh and fabric shall be 0.148". The color of the fabric and posts shall be black. PVC coated tension wire shall be heavy duty gauge 7 metallic coated wire. No barb wire is required. Type II round posts shall be used. Terminal or corner pull post shall be min. 2 ½" in diameter with intermediate post min. 2" in diameter. Top and intermediate brace rails (min. 1 ½" diameter) shall be provided.
- C. All mounting hardware to aluminum or concrete shall be stainless steel.
- D. A protective (bituminous) coating shall be applied between all aluminum and concrete.

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PART 3 EXECUTION

- 3.01** Installation shall be per WM-23 "Chain Link Fence and Gates," as recommended by the manufacturer and as approved in the shop drawing.

- 3.02** Chain link posts shall be mounted on the top wall of concrete structures (including reinforced concrete outlet headwall). Posts on concrete shall be mounted with a malleable or adjustable (for sloping walls) floor flanges with concrete stainless steel anchor screws that will support the dynamic weight of persons who may lean over the fence.

END OF SECTION

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SECTION 10

POLYURETHANE

PART 1 GENERAL

1.01 Description of Work

- A. The (sub)contractor shall furnish and install all work necessary for the performance of undersealing the concrete spillway, utilizing a two-part 1:1 by volume, water resistant, high-density polyurethane foam (HDPF) at the locations shown on the plans and specified herein.
- B. This work shall consist of furnishing and injecting expansive polyurethane material beneath the concrete spillway through holes, as shown on the plans or as directed by the Engineer, while monitoring for movement at the surface.
- C. Contractor shall provide a Quality Control (QC) Plan for execution of polyurethane application.
- D. The (sub)contractor for the polyurethane work must be prequalified with IDOA.

1.02 Product Handling

- A. Store and protect as recommended by the manufacturer and the specifications.

1.03 Submittals

- A. Professional Experience **(items must be included in the Bid Submission)**
 - 1. Have a minimum 3 years of experience injecting 1:1 by volume, two-part, expansive polyurethane through holes or tubes into soils while monitoring at the surface of the concrete for movement to demonstrate sufficient densification of the soils. Submit evidence of prior experience: 5 awarded contracts within each of the previous 3 years.
 - 2. Have as an employee of the company, a licensed Professional Engineer (P.E.) with a minimum of 3 years of experience in stabilization of concrete foundation soils by injecting 1:1 by volume, two-part, expansive polyurethane through holes or tubes into soils while monitoring at the surface of the pavement for movement to demonstrate sufficient densification of the soils. Submit the name, hire date, and resume of the licensed Professional Engineer.
- B. Performance
 - 1. Certification by the manufacturer that the polyurethane to be used meets all the requirements in the MATERIAL section, including that it is a 1:1 by volume, two-part, water blown polyurethane.

2. Toxicity Testing Results by an independent laboratory demonstrating that the polyurethane shows a lack of toxicity at 200 ppm TCLP leachate and show non-toxic for all test species.
 3. Certification by a third-party testing lab that the polyurethane has passed the Panel Test for Hydro-Insensitivity of High-Density Polyurethane Grout confirming that the polyurethane is effective in wet or dry conditions.
 4. Certifications from the manufacturer (or an independent third party) demonstrating that each flow meter intended for use has been tested within the past 12 months.
- C. Quality Control (QC) Plan
1. QC Plan shall include details of the method of placement.
 2. QC Plan shall provide contractor's plan to prevent material entry into the existing perforated drains under the spillway slab.
 3. QC Plan shall provide contractor's plan to protect the underdrain system from being compromised.

PART 2 PRODUCT

2.01 High Density Polyurethane Foam

- A. Certify that the material conforms to the following requirements listed in this section:

PROPERTY	TEST	RESULTS
Density, lbs./cu. ft.	ASTM D1622	3.5 - 4.5
Compressive Strength, psi (min.)	ASTM D1621	55
Tensile Strength, psi (min.)	ASTM D1623	90
Shear Strength, psi (min.)	ASTM C273	45
Flexural Strength, psi (min.)	ASTM D790	90
Closed Cell content (%)	ASTM D6226	+85

2.02 Pumping Units

- A. Ensure that all pumping units used are equipped with certified flow meters to precisely measure the amount of each component injected, so that the 1:1 ratio by volume is maintained for quality control ensuring proper mixing and a certified volume of injected polyurethane material is obtained for proper payment if unit price. Flow meters must be recertified annually (once every 12 months) to ensure accuracy. Certifications from the manufacturer (or an independent third party) demonstrating that each flow meter intended for use has been tested within the past 12 months must be submitted with the bid documents.

PART 3 EXECUTION

3.01 High Density Polyurethane Foam

- A. HDPF shall reach 90% compressive strength within 30 minutes of injection. The material used shall be a two-part 1:1 by volume HDPF, such as URETEK 486 STAR. Other polyurethanes submitted must meet all of the required specifications and be preapproved by the Owner. The material shall be water blown, not chemically blown. The material shall be a polyurethane-forming mixture, having water insoluble diluents, which permits the formation of polyurethanes in the presence of water. Water insoluble diluents shall provide polyurethane foam with improved dimensional stability properties. The presence of water insoluble diluents and the characteristics and properties listed above must be certified by the manufacturer (paragraph 3). The certification from the polyurethane manufacturer must be submitted with the bid documents.

3.02 Aquatic and Terrestrial Toxicity Testing

- A. Polyurethane must pass aquatic and terrestrial toxicity testing and chemical analysis (RCRA metals, TOC, and COD). The polyurethane must show a lack of toxicity at 200 ppm TCLP leachate and show non-toxic for all test species. Testing must have been performed by an independent third-party testing laboratory. The certification from the independent third-party testing laboratory must be submitted with the bid documents.

3.03 Panel Test for Hydro-Insensitivity of High-Density Polyurethane Grout

- A. Polyurethane must pass the Panel Test for Hydro-Insensitivity of High-Density Polyurethane Grout (see the attached testing protocol). The Panel Test must be performed by an independent third-party testing laboratory, under the supervision and review of a licensed Professional Engineer, and must certify that the polyurethane material meets or exceeds the limits set forth in the panel test specification. The certification from the independent third-party testing laboratory must be submitted with the bid documents.

3.04 Non-shrink grout to patch drill holes

- A. Non-shrink grout must be supplied by a manufacturer on the approved products list and must be used within the shelf life and temperature limitation set by the manufacturer.

3.05 Quality Management

- A. Drilling Holes.
 - 1. Drill injection holes in the pattern shown on the Standard Drawings, or as indicated on the approved field Quality Control (QC) plan, as approved by the Owner's Representative. Drill 5/8" diameter holes, vertical and round, and to a depth indicated on the approved field QC plan.

B. Injection of the HDPF.

1. Inject the HDPF through holes to fill voids beneath the concrete to the prescribed injection depth(s). Continuously monitor for movement of the structure. Concrete is sufficiently stabilized when movement of the structure is detected. If necessary, injection of material shall continue as needed to lift the concrete to grade.

C. Hole Patching.

1. Install a rapid set, non-shrink patching material into the drilled-out hole and strike patches flush with the surface of the surrounding concrete.

END OF SECTION

SECTION 11

REMEDIATION ALLOWANCE

PART 1 GENERAL

A. RELATED DOCUMENTS

- A.1 DAPW 13 Contractor's Bid Form
- A.2 DAPW 26 General Conditions of the Contract
- A.3 DAPW 33 Standard Agreement for Construction Projects

B. SUMMARY – An allowance required by Public Works Division, Department of Administration, acting, as Owner shall be included in the base bid.

C. REMEDIATION ALLOWANCE

1. Contractor shall include an allowance of \$50,000.00 in the Base Bid for Owner directed remediation of unforeseen constraints. **This amount shall be included as a separate item in the Schedule of Values, adding up to the total bid price.**
2. Such constraints may include but are not necessarily limited to: unforeseen subsurface conditions particular to this construction site; improperly recorded or unrecorded physical properties and conditions at the site; obstruction of or delays to reasonable work sequences by the Owner; uncommon adverse weather or site conditions; and conflict within or omissions from the Contract Documents.
3. All remediation work shall be proposed to and authorized in writing by the Owner prior to execution, jointly documented by Contractor and Designer, and recorded in Contractor's as-builts and Designer's project record documents.
4. **If any portion of the remediation allowance is not used during the project, that portion will revert to the Owner, and will not be included in the Contractor's final payment.**

END OF SECTION 11

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