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DEFINITIONS

The definitions listed below relate only to the Sanitary Sewer Standard Specifications.

"AASHTO" – American Association of State Highway and Transportation Officials. Whenever AASHTO is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.

“ACI” – American Concrete Institute. Whenever ACI is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.

“ACIL” – American Council of Independent Laboratories. Whenever ACIL is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.

“AISC” – American Institute of Steel Construction. Whenever AISC is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.

"ANSI" – American National Standard Institute (formerly United States of America Standards Institute). Whenever ANSI is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.

“Approved Drawings” – Drawings that have been prepared by or on behalf of the Property Owner or developer, stamped and signed by a licensed professional engineer in the State of Washington AND signed and dated by a Pierce County-Sewer Utility representative.

"Approved Equal" OR "Equal" – An item or material which, in the opinion of the Wastewater Utility Manager, is of equal quality to that item described on the Approved Drawings, the Standard Plans, and in these Specifications.

"As Directed", "As Permitted", "Approved", or words of similar importance mean the direction, requirements, permission, approval or acceptance of the County, unless stated otherwise.

"As Shown", "As Indicated", "As Detailed" or words of similar importance refer to the Approved Drawings unless stated otherwise.

“ASME” – American Society of Mechanical Engineers. Whenever ASME is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.

"ASTM" – American Society for Testing and Materials. Whenever ASTM is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.

“AWS” – American Welding Society. Whenever AWS is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.

"AWWA" – American Water Works Association. Whenever AWWA is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.

"Contractor" – The person, partnership, corporation, association, or affiliation with whom, the Owner has executed an agreement to construct the proposed sanitary sewer improvements.

"County" – Pierce County Department of Public Works and Utilities, Sewer Utility Division.

“EIA” – Electronic Industries Alliance. Whenever EIA is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.

"Engineer” – The Professional Engineer, licensed under Title 18 RCW, State of Washington, in the branch of Civil or Structural Engineering, whose seal is affixed to the Approved Drawings or the as-built drawings.

“EPA” – The United States Environmental Protection Agency.

“Final Acceptance” – The written acceptance issued to the Owner by the County after the Contractor has completed the requirements of the sanitary sewer permit.

“FOP” – Field Operating Procedure.

“Furnish” – To deliver to the job site, or other specified location, any item, equipment, or material.

“His/Her”, “His” OR “Her” – Shall refer to a neuter gender and mean neither a masculine nor feminine gender.

“IBC” – International Building Code. Whenever IBC is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.

“IEEE” – Institute of Electrical and Electronic Engineers. Whenever IEEE is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.

"Independent Testing Laboratory" – A private or public laboratory which is approved by the County and is capable of testing Work, soils, and materials.

"Inspector“ – The engineering or technical inspector duly authorized or appointed by the Wastewater Utility Manager limited to the particular duties entrusted to him.

“Install” – Placing, erecting, or construction complete in place any item, equipment, or material.

“ISAS” – Instrument Systems and Automation Society. Whenever ISAS is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.

“NEC” – National Electrical Code. Whenever NEC is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.

“NEMA” – National Electrical Manufacturers Association. Whenever NEMA is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.

“NFPA” – National Fire Protection Association. Whenever NFPA is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.

“NSF” – National Sanitation Foundation. Whenever NSF is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.
“OSHA” – *Occupational Safety and Health Act*. Whenever OSHA is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.

“Owner” – The Property Owner or developer for whom the Work has been contracted, unless stated otherwise.

“PCA” – Portland Cement Association. Whenever PCA is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.

"Pierce County" – Pierce County, Washington.

"Project" – The undertaking to be performed as provided in the Approved Drawings.

"Property Owner" – The lawful and legal owner of a lot or parcel of land (delineated by parcel number) under single ownership, also noted on the Pierce County Assessor/Treasurer property rolls as the taxpayer.

"Provide" - Means to "Furnish" and “Install”.


"Right-of-Way" – Land, property or property interest, usually in a strip, acquired for or devoted to road and utilities purposes.

"Special Provisions" – Supplemental Specifications, and modifications and amendments to the standard Specifications, which apply to an individual Project and which are Approved by the County.

"Specifications" – Provisions and requirements for the prescribed Work as identified in this document and any Special Provisions, and occasionally refers to manufacturer's Specifications for particular items or provisions and requirements for the prescribed Work.

“SSPC” – Structural Steel Painting Council. Whenever SSPC is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.

“Standard Plans" – The term “Standard Plans" refers to specific plans or drawings adopted by Pierce County, and which show frequently recurring components of Work that have been standardized for use.


"Subcontractor" – A person, partnership, corporation, association or affiliation, other than the Contractor, supplying labor and materials, or labor only, at the site of the Work.

“UL” – Underwriters Laboratories.

“WAQTC” – Western Alliance for Quality Transportation Constructions. Whenever WAQTC is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.
“WISHA” – *Washington Industrial Safety and Health Act*. Whenever WISHA is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.

"Work" – Includes all labor, materials, equipment, Washington State Retail Sales Tax and incidentals necessary to produce the construction required by the Approved Drawings, Standard Plans, Special Provisions, Specifications, and any and all obligations, duties, and responsibilities necessary for the successful completion of the construction undertaken by the Contractor.

"WSDOT" – Washington State Department of Transportation. When reference is made to WSDOT Test Methods (TM), Field Operating Procedures (FOM), the *Materials Manual M 46-01 (WSDOT Materials Manual)*, and the *Standard Specifications for Road, Bridge and Municipal Construction (WSDOT Standard Specifications)*, the most current specification in effect at the time of plan approval.

“WWPA” – Western Wood Products Association. Whenever WWPA is referred to in these Specifications the most current specification in effect at the time of plan approval is to be used.
SECTION 1

GENERAL TECHNICAL REQUIREMENTS

1.1 GENERAL

1.1.1 This Section includes general technical provisions required for the construction of the Work shown on the Approved Drawings and required by these Specifications.

1.2 CONSTRUCTION SCHEDULE

1.2.1 Work Sequence and Constraints

1.2.1.1 The Contractor will be required to complete the Work subject to the time restrictions, permit requirements, and any other requirements as mandated by good construction practice. It is the intention of the County to have the Work completed, in place, and operational within the time constraints as identified in the utility Right-of-Way permit and in accordance with all other permits required for the Work.

1.2.1.2 The Contractor shall be responsible for the by-pass of existing wastewater, if necessary, by means of pumping, during the course of construction. No wastewater shall be permitted to enter the ground. Furthermore, all newly constructed sections of pipeline shall be completely installed, backfilled, cleaned, tested, and accepted by the County prior to discharging flows through the newly constructed section of pipe, unless otherwise approved in writing by the County.

1.2.1.3 The Contractor will be required to have all restoration complete as soon as possible after installation and in accordance with the utility Right-of-Way permit conditions, or as required by easement or agreement with the Property Owner(s). The Contractor shall diligently pursue the restoration, and shall not continue any underground construction until the County is satisfied that the intent of these Specifications has been met. The Contractor shall not be permitted to remove more than 500 feet of existing public roadway at any given time, unless otherwise approved by the County or governing jurisdiction. In addition, all roads must be maintained with a water truck and/or dust palliative for dust control.

1.2.1.4 The Contractor shall permit traffic to pass through the Work with the least possible inconvenience or delay. The Contractor shall maintain existing streets, keeping them open and in a good, clean, and safe condition at all times. If a road closure is required to perform the Work, a Permit for Temporary Road Closure must be approved prior to commencement of the Work. Flagging, signs, and all other traffic control devices and procedures provided shall conform to the standards established in the latest WSDOT adopted edition of the Manual on Uniform Traffic Control Devices (MUTCD) published by the United States Department of Transportation and the Washington State modifications to the MUTCD.
1.2.2 Weekly Look-Ahead Schedule

1.2.2.1 Each week that Work will be performed, the Contractor shall submit a Weekly Look-Ahead Schedule showing the Contractor’s and all Subcontractor’s proposed Work activities for the next two weeks. The Weekly Look-Ahead Schedule shall include the description, duration, and sequence of Work, along with the planned hours of Work.

1.2.2.2 The Weekly Look-Ahead Schedule may be a network schedule, bar chart, or other standard schedule format. The Weekly Look-Ahead Schedule shall be submitted to the Inspector by the midpoint of the week preceding the scheduled Work, or some other mutually agreed upon submittal time.

1.3 CONSTRUCTION SURVEYING

1.3.1 The Contractor shall perform all detailed construction surveying required to properly lay-out the Work. All surveying shall be performed by or under the direct supervision of a professional land surveyor currently licensed to perform land surveying in the State of Washington.

1.3.2 Staking shall be set as necessary to provide proper horizontal and vertical construction control. These stakes and marks shall govern the Contractor’s Work.

1.3.3 The elevations shown on the Approved Drawings shall be based on the North American Vertical Datum of 1988 (NAVD88), as published by the United States National Geodetic Survey.

1.3.4 Monuments located within the public Rights-of-Way that are removed, disturbed, or destroyed by the Contractor’s operations shall be replaced by the Contractor with a Pierce County standard monument or standard monument adopted by the governing jurisdiction. All other disrupted monuments or property corners shall be replaced as required by the County or the governing jurisdiction.

1.3.5 Pursuant to RCW 58.24.040 (8) and WAC 332-120, no survey monument shall be removed or destroyed before a permit is obtained from the Washington State Department of Natural Resources. The Contractor’s surveyor shall establish reference points as necessary to replace all removed or destroyed monuments as a result of the Contractor’s operations within public Rights-of-Way, and it is the Contractor’s responsibility to preserve these reference points during construction. Monument restoration shall be in accordance with the Standard Plans, or as required by the governing jurisdiction.

1.4 AS-BUILT SURVEYING

1.4.1 Upon completion of all sanitary sewer Work and prior to Final Acceptance of the Project, the Contractor’s surveyor or Engineer shall provide the County with as-built drawings that have been stamped, signed, and dated by a professional land surveyor or engineer licensed to perform land surveying or engineering, as applicable, in the State of Washington.

1.4.2 The as-built drawings shall be in accordance with the latest Sanitary Sewer As-built Standard Plan. The as-built drawings shall be submitted to the County on sheets measuring 22 inches by 34 inches.
1.4.3 The as-built drawings shall show all manhole, vault, and pump station rim and invert elevations, manhole base and riser section liner material(s), bearings and distances of all sewer lines installed, locations of the terminus of all stubs as measured from the nearest downstream manhole (including length and depth), locations of all vertical and horizontal bends of force mains, and location of monumentation utilized for control, all to the coordinates provided on the Approved Drawings. The as-built drawings shall also show locations of the pump station wet well, valve and electrical vaults, electrical panel(s), telemetry pole, and extents of paving, as well as elevations for the wet well and valve vault access doors, inlet and outlet pipe inverts, floors, floats, and grating, if applicable.

1.4.4 Upon request by the County, the Contractor’s licensed surveyor or engineer shall submit survey notes to the County for review.

1.5 SUBMITTALS

1.5.1 The Contractor shall submit four copies of a complete submittal package which shall include the necessary catalog cuts, shop drawings and details of all items specified, including quantity and location of use. The County may, at its discretion, require electronic submittals in PDF format in order to facilitate review and the dissemination of review comments. All submittals shall include the contact information for the Contractor and the Supplier, and shall be neat, legible, and at a reasonable scale, as determined by the County.

1.5.2 Submittals shall be made for the following items:

1. Items not specifically called out on the Approved Drawings.
2. Items proposed as an Approved Equal.
3. Items noted in these Specifications and in the Standard Plans.
4. Items requested by the County.

1.5.3 The exact requirements for each submittal item are identified in their appropriate Section and shall not be satisfied by the Contractor until approved by the County.

1.5.4 The County will, within 30 calendar days after plan approval, provide the Engineer and/or Contractor with a master submittal list, identifying all items for which submittals are required. The Contractor shall provide submittals organized by Specification Section number and include the following information for all listed items:

1. Item description.
2. Specification Section number.
3. Identification of those items which are proposed as an Approved Equal, Substitution, or Deviation.
4. Identification of those items which require other jurisdictional agency review and approval.
5. Columns for future use as information becomes available shall be provided for the following items:
   a. Trade name, model, and catalog designation.
   b. The scheduled need dates for control purposes.
   c. Date submitted.
   d. The date approval is needed.
   e. The date on which material is needed.
1.5.5 The Contractor shall be solely responsible for the following:

1. Accuracy and completeness of the information contained in each submittal.
2. Verifying that the material and/or equipment described in each submittal conforms to the requirements of the Approved Drawings and these Specifications prior to submittal. All extraneous materials shall be crossed out or otherwise obliterated.
3. Ensuring that the material, equipment, and methods of Work used shall be as described in the submittal.
4. Calling out all deviations from the Specifications and Approved Drawings wherever applicable in the body of the submittal.
5. Ensuring there is no conflict with other submittals. The Contractor shall notify the County where such submittal may affect the Work of another submittal.
6. Ensuring coordination of submittals among the suppliers, related crafts, subcontractors, and with the planned Work.
7. Coordinating submittals with other Work so that Work will not be delayed. The Contractor shall coordinate and schedule different categories of submittals so that one will not be delayed for lack of coordination with another.

1.5.6 Product Data Submittals

1.5.6.1 Product Data Submittals are those which can only be provided after the manufacture of the material and/or equipment, or which describe the Contractor’s design and planning for certain Work methods.

1.5.6.2 Where specified, the Contractor shall furnish product data to the County for review. The acceptability of such information shall be determined under the normal inspection and testing procedures described in these Specifications.

1.5.7 Approved Equal

1.5.7.1 Item(s) of material and/or equipment for which the Contractor submits a proposal to use as an “Approved Equal” shall have the same function, quality, durability, appearance, strength, and design characteristics equal to that identified by the Approved Drawings, the Standard Plans, and these Specifications, and shall be sufficiently similar so that no change in related Work is required. The item(s) of material and/or equipment shall reliably perform at least equally well for the function imposed by the design concept of the completed Work as a functioning whole.

1.5.7.2 Acceptance of the Contractor’s proposal shall be in writing, as expressly indicated in the County's review of the submittal, at the sole discretion of the County. The decision whether to accept or reject the proposal shall be final. The Contractor shall not assume acceptance at any time prior to the rendering of decision in writing by the County.

1.5.8 Substitutions

1.5.8.1 Item(s) of material and/or equipment for which the Contractor submits a proposal to use as a “Substitution” shall be a material, equipment, or means, method, technique, sequence, or procedure which functionally meets the requirements of the Approved Drawings, the Standard Plans, and these Specifications, but does not exactly meet the Specification and is equal to or better than the specified item.
1.5.8.2 The Contractor shall submit a properly completed Substitution/Deviation Request Form as provided by the County, along with the submittal transmittal for all items for which a Substitution is proposed. The proposal shall include complete specifications or means and methods for the item, including all descriptive and cost data.

1.5.8.3 Acceptance of the Contractor’s proposal shall be in writing, as expressly indicated in the County’s review of the submittal, at the sole discretion of the County. The decision whether to accept or reject the proposal shall be final. The Contractor shall not assume acceptance at any time prior to the rendering of decision in writing by the County.

1.5.9 Deviations

1.5.9.1 Item(s) for which the Contractor proposes to use as a “Deviation” shall be a material, equipment, or means, method, technique, sequence, or procedure that does not fully conform to the requirements of the Approved Drawings, the Standard Plans, and these Specifications, but which can be shown to accomplish the intent and functional requirements of the end product.

1.5.9.2 The Contractor shall submit a properly completed Substitution/Deviation Request Form as provided by the County, along with the submittal transmittal for all items for which a Substitution is proposed. The proposal shall include complete specifications or means and methods for the item, including all descriptive and cost data. Failure to identify any Deviation and subsequent acceptance of the submittal by the County shall not relieve the Contractor from complying with the Approved Drawings, the Standard Plans, and these Specifications.

1.5.9.3 Acceptance of the Contractor’s proposal shall be in writing, either as expressly indicated in the County’s review of the submittal, at the sole discretion of the County. The decision whether to accept or reject the proposal shall be final. The Contractor shall not assume acceptance at any time prior to the rendering of decision in writing by the County.

1.5.10 Changes to Submittals – Changes to submittals containing a certification and/or stamp and signature by a licensed engineer, shall be resubmitted with the requisite certification and/or stamp and signature as was required by the previous review.

1.5.11 Review Procedure – Unless otherwise specified, the County will, within 30 calendar days after receipt of each submittal or resubmittal, return a redlined copy of the submittal or resubmittal to the Contractor. The returned submittal will indicate one of the following designations:

“NO EXCEPTIONS TAKEN” is assigned when there are no notations or comments on the submittal. When returned with this designation, the Contractor may release the equipment and/or material for manufacture.

“MAKE CORRECTIONS NOTED” is assigned when a confirmation of the notations and comments is not required by the Contractor. The Contractor may release the equipment and/or material for manufacture; however, all notations and comments must be incorporated into the final product.
“AMEND AND RESUBMIT” is assigned when notations and comments are extensive enough to require a resubmittal of the package. The resubmittal shall address all comments, omissions, and non-conforming items as noted. The Contractor shall not implement any of the Work covered by the submittal until the information has been revised, resubmitted, and returned to the Contractor with a “NO EXCEPTIONS TAKEN” or “MAKE CORRECTIONS NOTED” designation. 

“REJECTED” is assigned when the submittal does not meet the intent of the Approved Drawings, the Standard Plans, and/or these Specifications. The Contractor shall resubmit the entire package, revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer or vendor. The Contractor shall not implement any of the Work covered by the submittal until the information has been revised, resubmitted, and returned to the Contractor with a “NO EXCEPTIONS TAKEN” or “MAKE CORRECTIONS NOTED” designation.

“RECEIPT ACKNOWLEDGED” is assigned to acknowledge receipt of a submittal that is not subject to approval by the County, and is being submitted for information purposes only. This designation is generally used to acknowledge receipt of means and methods of construction Work plan, field conformance test reports, and Health and Safety plans.

1.5.12 Effect of Review of Submittals

1.5.12.1 Review of submittals shall not relieve the Contractor of his/her responsibility for errors therein, and shall not be regarded as an assumption of risk or liability by the County.

1.5.12.2 Unless specifically identified by the Contractor on the submittal, no disposition of the submittal by the County changes the requirements of the Specifications and/or Approved Drawings.

1.6 SAFETY

1.6.1 The Contractor shall provide adequate safety systems that meet the requirements of the Washington Industrial Safety and Health Act, RCW 49.17. The County is not responsible for enforcement of State requirements. The Contractor shall be solely responsible for worker safety, and the County assumes no liability.

1.6.2 The Contractor shall certify compliance with Safety Standards for Construction Work (WAC 296-155, or most current edition adopted by Washington State), General Safety and Health Standards (WAC 296-24, or the most current edition adopted by Washington State), and all other safety requirements necessary for the successful completion of the Work.

1.6.3 The Contractor shall comply with all current OSHA, EPA, DOE, PSAPCA, WISHA, and other applicable safety and health regulations.

1.6.4 The Contractor shall submit a copy of his/her safety procedures to the County at or before the pre-construction conference. In addition, the Contractor shall submit a Confined Space Rescue and Retrieval Systems Plan for review by the County prior to commencing with the Work.
SUBMITTAL TRANSMITTAL

Submittal Description: ____________________________ Submittal No: ____________
Spec Section: ____________________________

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Attached
Under separate cover via _______________
For your information
For your review and comment

Remarks:

Bid Item No. | Copies | Date | Spec/Section No. | Description | Review Action | Reviewer Initials | Review Comments Attached
--- | ------ | ---- | ---------------- | ----------- | ------------- | ----------------- | ---------------------

NET = No Exceptions Taken; MCN = Make Corrections Noted; A&R = Amend and Resubmit; R = Rejected; RA = Receipt Acknowledged

Contractor:
Certify either A or B.

A. We have verified that the material or equipment contained in this submittal meets all the requirements, including coordination with all related work, as specified (no exceptions).

B. We have verified that the material or equipment contained in this submittal meets all the requirements specified except the attached deviations.

No. | Deviation
--- | ------

Certified by: ____________________________
Contractor’s Signature | Date

Pierce County Sanitary Sewer Development Specifications
## Deviation/Substitution Request

**Submittal Description:**

**Contract/SWLE #**

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<th>We hereby submit for your consideration the following item instead of the specified item or procedure:</th>
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<th>Specified Item or Procedure</th>
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**Proposed Deviation/Substitution**

Completed data, including laboratory test results as applicable, are attached. Also included are complete information regarding changes to Contract Drawings and/or Specifications which the proposed deviation/substitution will require for its proper installation.

Fill in blanks below:

A. How will the deviation/substitution affect the dimensions shown on the Contract Drawings?

B. What effect does the deviation/substitution have on the Baseline or Update Schedule?

C. What are the quality and performance differences between the proposed deviation/substitution and the specified item or procedure?

D. What is the cost difference between the proposed deviation/substitution and the specified item or procedure? (Attach estimate/quote and indicate net change.)

Page 1 of 2
E. List the manufacturer's name and address, trade name of product, and model or catalog number.

F. The manufacturer's guarantees for the proposed deviation/substitution and the specified items are:
   Same          Different (explain on attachment)

G. Other information as required by the Engineer.

The undersigned states that the function, appearance and quality of the proposed deviation/substitution is equivalent or superior to that of the specified item and authorizes payment to the County for all design changes including Engineer, detailing and County Processing costs.

The undersigned further states that there is a waiver of all claims for additional costs related to the deviation/substitution which may subsequently arise during the work.

Submitted by:

Contractor's Signature                  Title                  Date

To be completed by Owner:

The aforementioned request for deviation/substitution is hereby:

Accepted            Accepted as Noted
Rejected            Received Too Late

Remarks:

Owner's Signature                  Title                  Date
1.7 EXISTING SERVICES AND UTILITIES

1.7.1 The Contractor shall safeguard all existing utilities, whether they are shown on the Approved Drawings or located in the field. Where the construction crosses or is adjacent to existing utilities, the Contractor shall exercise extreme care to protect such utilities from damage.

1.7.2 The Contractor shall contact the Utilities Underground Location Center at 1-800-424-5555 prior to any ground breaking, as required by RCW 19.122.

1.7.3 The Contractor shall provide written notice to all local school districts, local fire districts, law enforcement agencies, emergency vehicle operators, and transit companies who do business in the general area of the construction site(s), and shall otherwise keep these utility and/or special districts aware of the construction schedule. The Contractor shall further give evidence to the County of compliance with this requirement if so directed.

1.7.4 The Contractor shall notify local refuse collector(s) and postal service(s) serving the adjacent properties a minimum of 7 calendar days in advance of any construction. The Contractor shall keep the solid waste disposal company and postal service informed of the construction schedule, and shall further provide access to the company’s patrons and their property. The Contractor shall neither hinder nor prevent these services.

1.7.5 Prior to construction activities, the Contractor shall expose and verify the existing underground utilities as required in order to perform construction of the new improvements.

1.7.6 The Contractor shall protect all structures, facilities, and utilities adjacent to the Work and ensure that they are not removed, damaged, destroyed, or prevented from being used unless otherwise shown on the Approved Drawings or approved by the County, the affected utility, or the governing jurisdiction.

1.7.7 If damage is done to an existing utility, the Contractor shall immediately notify the utility company involved and the Utilities Underground Location Center as required by RCW 19.122 to coordinate the scheduling of repairs and payment.

1.7.8 All damage done to existing facilities or improvements during the progress of the Work covered by the Approved Drawings and these Specifications shall be repaired or restored by the Contractor to the satisfaction of the County, the affected utility, or the governing jurisdiction. If the Contractor fails to furnish the necessary labor and materials for such repair when so ordered, the County may cause said labor and materials for such repairs to be furnished by other parties and the cost thereof shall be billed to the Contractor or the Contractor’s Surety.

END OF SECTION
SECTION 2

SITE PROTECTION

2.1 GENERAL

2.1.1 This Section includes provisions for the clearing, grubbing, stripping, demolition and the disposal of all objectionable material from the Project site and the erosion/sedimentation control measures required for construction of the Work shown on the Approved Drawings, required by these Specifications, and as identified on the approved site development plans/permits.

2.1.2 Clearing, grubbing, and land disturbing activities shall be limited to the extent shown on the Approved Drawings and the approved site development plans. The activities shall be limited to only as much land area as can receive appropriate protective cover, or be otherwise stabilized, after having been cleared or otherwise disturbed. Seasonal limitations on clearing and land disturbing activities, and best management practices for preventing and controlling stormwater pollution runoff shall be in accordance with the most current site development regulations, the Approved Drawings, and the approved site development plans.

2.1.3 When shown on the Approved Drawings or required by the County, the Contractor shall excavate unstable natural ground before building embankments or laying pipe. This unstable material may include peat, muck, swampland, buried logs and stumps, or other deleterious material that may interfere with proper execution of the Work.

2.1.4 The Contractor shall protect private and public property on or in the vicinity of the Project site, and shall ensure that it is not damaged, destroyed, or prevented from being used unless the Approved Drawings specify otherwise. Property includes land, utilities, trees, landscaping, improvements legally on the Right-of-Way, markers, monuments, buildings, structures, pipe, conduit, sewer or water lines, signs, and other property of all description whether shown on the Approved Drawings or not. If the Contractor (or agents/employees of the Contractor) damages, destroys, or interferes with the use of such property, the Contractor shall restore it to original condition or better.

2.1.5 The Contractor shall be responsible for restoration of all areas disturbed by their operations in conformance with the requirements of the recorded easement documents and these Specifications, and to conditions equal to or better than those that existed prior to the Work.

2.2 TREE, SHRUB, AND STUMP REMOVAL

2.2.1 The Contractor shall cut, remove, and dispose of trees, shrubs, and stumps which occur in the areas required for construction. Trees to be removed shall be felled within the clearing limits. Unless otherwise designated on the Approved Drawings, the Contractor shall not remove trees without authorization by the County.
2.2.2 The Contractor shall conduct their operations and exercise all necessary precautions throughout the life of the Project to prevent injury or damage to existing trees that are to remain. The Contractor shall bear sole responsibility for damage.

2.2.3 Grubbing shall consist of removing and disposing of all unwanted vegetative matter from underground, such as trees, brush, downtimber, or other natural material in areas to be occupied by structures or pavements.

2.2.4 Depressions made by grubbing shall be filled with suitable foundation material as described in Section 3.6, and compacted to make the surface conform to the original adjacent surface level of the ground.

2.2.5 The upper 2 to 6 inches of soil containing vegetation and root growth shall be stripped from areas to be excavated or from areas that will receive landscaping.

2.3 PAVEMENT REMOVAL

2.3.1 Pavement to be removed shall be sawcut in neat, straight lines with vertical edges along the limits of pavement removal. Changes in pavement width shall be made by cutting perpendicular and parallel to the centerline of the trench. The cut line for removal of pavement shall be approved by the County in the field prior to cutting. Wheel cutting or jackhammering are not an acceptable means of pavement cutting. Any existing pavement designated to remain that is damaged during the removal of other pavement shall be removed and replaced.

2.3.2 The Contractor shall dispose of all removed asphalt and concrete materials at an approved or permitted site in accordance with Section 2.4 and all federal, state, and local regulations.

2.4 DISPOSAL OF SURPLUS MATERIAL AND DEBRIS

2.4.1 When possible, surplus material and debris should be sold or recycled, or otherwise hauled to a suitable waste site and disposed of in a manner that will meet all requirements of the applicable federal, state, and local regulations. The waste site shall be provided by the Contractor and approved by the waste site owner and the County. The Contractor shall be responsible for obtaining all local, state, and federal permits and approvals necessary for securing use of the waste site.

2.4.2 The Contractor shall provide the County, at the pre-construction conference, a list identifying the location of waste site(s) to be used and copies of all local, state, and federal permits or approvals necessary for securing use of the waste site(s).

2.4.3 Air, noise, and other types of pollution caused by the Contractor’s operations shall be the responsibility of the Contractor, and the Contractor agrees to indemnify and hold harmless the County from any damages, claims of damages, and fines imposed by local or state agencies, such as the Puget Sound Air Pollution Control Board, arising from the Contractor’s operations.
2.5 EXISTING DRAINAGE FACILITIES

2.5.1 The Contractor shall be required to preserve existing ditches, culverts, drainage channels, etc., and perform the Work with no adverse impact to existing storm drainage facilities.

2.5.2 Trench spoils or import material shall not be stockpiled in or adjacent to ditches. Stockpiled materials shall neither impede nor prevent stormwater runoff from entering ditches, swales, drainage channels or culverts, or otherwise alter stormwater runoff patterns. In addition, stockpiled materials and equipment shall not create ponding or entrapment of stormwater.

2.5.3 The Contractor shall immediately restore ditches and drainage facilities that are damaged, plugged or blocked, and provide temporary pumping if directed by the County or governing jurisdiction.

2.5.4 The Contractor shall provide temporary Erosion and Sedimentation Control (ESC) facilities for all existing storm systems, whether public or private, piped or open channel, in accordance with Section 2.6.

2.6 EROSION AND SEDIMENTATION CONTROL (ESC)

2.6.1 The Contractor shall utilize Best Management Practices (BMPs) for controlling and maintaining stormwater runoff from the construction site. ESC facilities shall be constructed in accordance with the Approved Drawings, the approved site development permit, and the Pierce County Stormwater Management and Site Development Manual or similar standards adopted by the governing jurisdiction.

2.6.2 ESC facilities shall be constructed and maintained for controlling and maintaining stormwater runoff quality from a development or artificially altered site during construction. ESC facilities shall not be allowed to fall into disrepair. Upon completion of the Work and permanent stabilization of all disturbed areas, ESC facilities shall be removed and properly disposed of. ESC facilities shall only be removed in those locations specifically designated by the County or governing jurisdiction.

END OF SECTION
3.1 GENERAL

3.1.1 This Section includes all excavation, backfill, embankment, grading, foundation preparation, and bedding classifications required for the construction of the Work shown on the Approved Drawings and required by these Specifications.

3.2 PROTECTION AGAINST WATER

3.2.1 All pipeline, manhole, vault, and pump station construction, including casing pipe and placement of concrete encasement and backfill, shall be kept free of water during construction. Groundwater shall be maintained continuously at an elevation below the bottom of the excavation, at such level that will permit the Work to be carried out in the dry and enable construction equipment to function properly until piping and structures are complete to above the ground water level, including placement and compaction of backfill material, and safe from uplift and horizontal water pressure.

3.2.2 The Contractor shall dewater the excavation by whatever means necessary. It may be necessary to provide well points, header piping and pumps, as identified below, where the subsoil is pervious or granular and extends below the invert of pipe. It may also be necessary to dewater in areas where perched water drains to the pipe trench at a higher elevation due to the subsoil turning from granular to impervious material. Such conditions may require undercutting of the pipe subgrade, adding drain rock or foundation rock and removing water directly from the pipe placement location.

3.2.3 If dewatering is necessary, a Dewatering Plan indicating the location and methods to be employed for dewatering shall be developed by the Contractor and submitted to the State Department of Ecology for review and approval prior to commencing dewatering activities. In addition, the Contractor shall be responsible for acquiring all necessary permits for dewatering and will be responsible for any adverse effects that may occur due to the dewatering process. All water shall be deposited in an approved discharge location only after appropriate approvals have been received.

3.2.4 The Contractor shall dispose of the water so as not to cause damage to public or private property, or to cause a nuisance to the public. Protection of basements, vaults, reservoirs, and tanks where buoyancy or floor failures may occur due to uplift from storm or ground water shall be provided. The Contractor shall provide any and all erosion and sedimentation control provisions in accordance with Section 2.6 prior to pumping or disposing of any water due to dewatering operations. Neither the existing sanitary sewer system nor the storm water system will be available for disposal of groundwater unless otherwise approved by the County or the governing jurisdiction.

3.2.5 The Contractor shall provide and maintain all bulkheads, sheet piling, well points, pumps, and other equipment as may be required for dewatering the excavation during construction. Furthermore, the Contractor shall have sufficient pumping equipment in good
working condition and competent workmen for the operation of pumping equipment available at all times for emergencies, including power outages.

3.2.6 Electric pumps shall be used for control of water during non-working hours. The Contractor shall provide an emergency generator with a 5-day fuel tank and automatic transfer switch to power the dewatering system during a power outage. After temporary dewatering structures and equipment have served their purpose, they shall be removed from the Project site by the Contractor.

3.3 EXCAVATION

3.3.1 Work described in this Section, regardless of the nature or type of materials encountered, includes clearing, excavating, loading, hauling, and disposing of all excavated materials in order to construct all sanitary sewers and appurtenances to the lines, grades, and locations shown on the Approved Drawings.

3.3.2 All excavation for structures shall be done to the dimensions and levels indicated on the Approved Drawings or specified herein. Excavations shall be made to such width outside the lines of the pipe or structure to be constructed as may be required for proper working methods, the erection of forms, and the protection of the Work.

3.3.3 Roadway excavation, embankment, and construction shall conform to the applicable provisions of the Approved Drawings, the Standard Plans, and these Specifications.

3.3.4 The Contractor shall notify the County when excavation for compacted fills and structures is complete, and no forms, reinforcing steel, or concrete shall be placed until the excavation has been inspected by the County.

3.3.5 Pipeline trenches and excavations for manholes, wet wells, and vaults shall be adequately supported to meet all requirements in the current rules, orders and regulations prescribed by the Washington State Department of Labor and Industries, Division of Safety, and the United States Occupational Safety and Health Administration. Excavations shall be adequately shored, braced, and sheeted so that the earth will not slide or settle, and all existing and new manholes, structures, and pipelines will be fully protected from damage.

3.3.6 If workers enter any trench or other excavation 4 feet or more in depth, it shall be shored, or other safety methods shall be constructed in conformance with the Washington Industrial Safety and Health Act (WISHA) requirements. The Contractor alone shall be responsible for worker safety and the County assumes no responsibility.

3.3.7 The support for excavation shall remain in place until the Work has been completed. During or after backfilling, the shoring, sheeting, and bracing shall be carefully removed so that there will be no caving, lateral movement, or flowing of the subsoils.

3.3.8 The Contractor shall make arrangements for disposing excess material and debris, regardless of the nature and type, in accordance with Section 2.4.

3.3.9 If the Contractor wishes to stockpile excavated material, he/she shall provide adequate facilities for drainage of water from the material, and for handling of storm water drainage from the area. The Contractor shall not stockpile excavated material on the existing asphalt or within the existing public Right-of-Way. The Contractor shall utilize Best Management Practices (e.g., plastic sheeting, silt fence, etc.) in accordance with Section 2.6
to prevent storm water pollution runoff as a result of stockpiling excavated and/or select material.

3.4 QUALITY CONTROL

3.4.1 The Contractor shall be required to furnish test reports and certification from material suppliers and independent, third-party testing laboratories affirming that all materials and workmanship conform to these Specifications. Testing shall be as specified herein or as required by the County.

3.5 TRENCHING

3.5.1 Excavations for pipe shall be to the lines and grades shown on the Approved Drawings.

3.5.2 The length of trench excavated in advance of the pipe laying shall not exceed 150 feet unless otherwise approved by the County.

3.5.3 Trenches shall be of sufficient width to permit proper jointing of the pipe and backfilling of material along the sides of the pipe. Trench width at the surface of the ground shall be kept to the minimum amount necessary to install the pipe in a safe manner and within the Rights-of-Way or easements. If the maximum trench width is exceeded by the Contractor without written authorization by the County, the Contractor may be required to provide pipe of higher strength classification, provide a higher class of bedding, and/or provide additional specified bedding as deemed necessary by the County.

3.5.4 Excavation for manholes and other structures shall be sufficient to provide a minimum of 12 inches between their surfaces and the sides of the excavation.

3.5.5 Unless otherwise indicated on the Approved Drawings, excavations shall extend to a depth which will provide sufficient space for placement of bedding material as described in Section 3.7.

3.5.6 Temporary shoring systems shall be removed during the process of backfilling using methods that will not disturb the pipe, but shall remain in place until the backfill is of sufficient depth so as to stabilize the trench walls. Where utilized, the Contractor shall exercise particular caution when in pulling trench boxes.

3.5.7 Trenches shall be closed at night unless otherwise approved by the County. Trenches that must remain open shall be suitably bridged or covered as required by the County to permit access to homes and businesses. Boring pits shall be covered and/or adequately protected with lighted barricades at night. The Contractor shall cooperate with the fire official having jurisdiction concerning maintenance of access to all areas within the Work zone, and shall notify the fire official of all street restrictions and closures in accordance with Section 1.7.3.

3.6 FOUNDATION MATERIAL AND PLACEMENT

3.6.1 Proper preparation of the foundation, placement of foundation material where required, and placement of bedding material shall precede the installation of all pipe and structures. This shall include removal of unsuitable material, compaction of native material, leveling the bottom of the excavation, placement and compaction of Gravel Backfill for
Foundations as defined herein, and placement and compaction of Bedding Material as described in Section 3.7 to provide a uniformly dense and unyielding support.

3.6.2 Whenever the excavation is carried beyond the lines and grades shown on the Approved Drawings, or when directed by the County, the Contractor shall backfill the over excavation with Gravel Backfill for Foundations as specified herein.

3.6.3 Gravel Backfill for Foundations shall consist of crushed, partially crushed, or naturally occurring granular material. The sources from which the foundation material is to be manufactured shall meet the following test requirements.

- Los Angeles Wear, 500 rev. 40% max.
- Degradation Factor 15 min.

The grading and quality requirements are:

<table>
<thead>
<tr>
<th>GRAIN SIZE</th>
<th>PERCENT PASSING BY WEIGHT</th>
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<tbody>
<tr>
<td>2 ½” square</td>
<td>100</td>
</tr>
<tr>
<td>2” square</td>
<td>65-100</td>
</tr>
<tr>
<td>1” square</td>
<td>50-85</td>
</tr>
<tr>
<td>U.S. No. 4</td>
<td>26-44</td>
</tr>
<tr>
<td>U.S. No. 40</td>
<td>16 max.</td>
</tr>
<tr>
<td>U.S. No. 200</td>
<td>9.0 max.</td>
</tr>
</tbody>
</table>

- Dust Ratio: ¾ max.
- Sand Equivalent: 35 min.

3.6.4 Where required, the Contractor shall place Gravel Backfill for Foundations to a minimum compacted depth of 6 inches under pipe and structures to the lines, grades, and thickness shown on the Approved Drawings. Foundation material shall be placed in maximum 12-inch loose lifts and compacted to 95 percent of maximum dry density as determined by ASTM D1557.

3.6.5 When approved by the County, Controlled Density Fill (CDF) meeting the requirements of Section 3.9 may be used as foundation material.
3.7 BEDDING MATERIAL AND PLACEMENT

3.7.1 Bedding Material for pipes and structures shall be a commercially available pea gravel that is clean, sound, free-draining and granular, and which conforms to the following gradation:

<table>
<thead>
<tr>
<th>GRAIN SIZE</th>
<th>PERCENT PASSING BY WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>½” square</td>
<td>100</td>
</tr>
<tr>
<td>⅜” square</td>
<td>85-100</td>
</tr>
<tr>
<td>U.S. No. 4</td>
<td>10-30</td>
</tr>
<tr>
<td>U.S. No. 8</td>
<td>0-10</td>
</tr>
<tr>
<td>U.S. No. 16</td>
<td>0-5</td>
</tr>
</tbody>
</table>

3.7.2 Prior to placement of Bedding Material, the Contractor shall level the bottom of the excavation, or top of the Foundation Material as the case may be, to the elevations required by the Approved Drawings, or as otherwise directed by the County.

3.7.3 Bedding Material for pipe bedding shall be placed to a minimum compacted depth of 6 inches under the pipe barrel, and along its sides to 12 inches over the top of pipe. Bedding Material shall be placed simultaneously on both sides of the pipe for the full width of the trench in lifts not exceeding 6 inches. To assure uniform support, the material shall be carefully worked under the pipe haunches with a tool capable of preventing the formation of void spaces around the pipe.

3.7.4 The minimum compacted depth of Bedding Material placed under any structure shall be 6 inches, or as otherwise shown on the Approved Drawings, the Standard Plans, or directed by the County.

3.8 BACKFILL MATERIAL AND PLACEMENT

3.8.1 Placement of Backfill Material shall be performed in accordance with these Specifications and as identified in the Standard Plans. Trench backfill shall consist of two stages: (1) Bedding Material as described in Section 3.7, to a level 12 inches above the top of the pipe, and (2) Backfill Material as described herein, from the top of the Bedding Material to the subgrade for roadway or landscape restoration.

3.8.2 Backfill Material shall consist of granular soil and/or aggregate which is free of deleterious material and is non-plastic. Deleterious material includes wood, organic waste, coal, charcoal, or any other extraneous or objectionable material. The material shall be considered non-plastic if the percent by weight passing the U.S. No. 40 sieve cannot be rolled, at any moisture content, into a thread as prescribed in Section 4 of AASHTO T 90.
3.8.3 Unless otherwise shown on the Approved Drawings or Right-of-Way permit, Backfill Material shall meet the requirements of Aggregate for Gravel Base as specified in Section 9-03.10 of the WSDOT Standard Specifications, excepting however that 100 percent of the material shall pass a 4-inch square screen in conformance to the following gradation:

<table>
<thead>
<tr>
<th>GRAIN SIZE</th>
<th>PERCENT PASSING BY WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>4” square</td>
<td>100</td>
</tr>
<tr>
<td>2” square</td>
<td>75 – 100</td>
</tr>
<tr>
<td>U.S. No. 4</td>
<td>22 – 100</td>
</tr>
<tr>
<td>U.S. No. 200</td>
<td>0 – 10</td>
</tr>
</tbody>
</table>

Dust Ratio: \( \frac{2}{3} \) max.
Sand Equivalent: 30 min.

3.8.4 No pipe shall be backfilled above the top of the pipe until the pipe joints, elevations, gradient, and alignment have been checked by the Contractor and the Work has been approved by the County. However, partial backfill to protect the pipe will be permitted immediately after the pipe has been properly laid in accordance with the Approved Drawings and these Specifications.

3.8.5 Excavations for manholes and structures shall be backfilled as soon as the structures have developed sufficient strength to resist backfilling loads and forces. Backfill Material shall not be placed on or against any Portland cement concrete until the strength of the concrete is sufficient to support the imposed loads.

3.8.6 Construction Requirements and Compaction Testing

3.8.6.1 Water settling and jetting of Backfill Material are not acceptable. Mechanical methods shall be utilized for placement and compaction of all Backfill Material unless otherwise approved in writing by the County or governing jurisdiction. The Contractor shall use compacting equipment approved by the County.

3.8.6.2 The Contractor shall retain the services of an independent, third-party soils testing laboratory to conduct compaction testing of the Backfill Material and subgrade to ensure compliance with these Specifications. The testing laboratory shall meet the “Recommended Requirements for Independent Laboratory Qualifications” as published by the American Council of Independent Laboratories (ACIL) and be approved by the County.

3.8.6.3 In-place density shall be determined by nuclear methods in accordance with WSDOT FOP for AASHTO T310, unless otherwise approved by the County. The maximum dry density of the Backfill Material shall be determined in accordance with ASTM D1557, and corrected for oversize in accordance with ASTM D4718. The moisture content of the material shall not vary more than 3 percent above or below optimum as determined in accordance with ASTM D1557.

3.8.6.4 Shallow Trench Zone Restoration (trench depth less than 8 feet)

1. The backfill material shall be placed in maximum 1-foot lifts and compacted to at least 95% maximum dry density, except within easements where no
vehicular traffic is anticipated where the minimum compaction shall be 90% maximum dry density.

2. The minimum allowable compaction testing frequency in the shallow trench zone shall be three tests per 100 lineal feet of trench. The three tests should be distributed uniformly over the full extent (depth) of the trench zone (e.g., 8 feet deep, 4 feet deep, and subgrade).

3.8.6.5 Medium Trench Zone Restoration (trench depth greater than or equal to 8 feet but less than 16 feet)

1. The backfill material shall meet the requirements of Section 3.8.3, with the exception that 100 percent of the material shall pass the 6-inch square sieve. All other requirements in Section 3.8 shall remain in effect.

2. The backfill material shall be placed in maximum 2-foot lifts and compacted to at least 95% maximum dry density, except within easements where no vehicular traffic is anticipated where the minimum compaction shall be 90% maximum dry density.

3. The minimum allowable compaction testing frequency in the medium trench zone shall be one test per 100 lineal feet of trench.

3.8.6.6 Deep Trench Zone Restoration (trench depth greater than or equal to 16 feet)

1. The backfill material shall meet the requirements of Section 3.8.3, with the exception that 100% of the material shall pass the 6-inch square sieve. All other requirements in Section 3.8 shall remain in effect.

2. The backfill material shall be placed in maximum 4-foot lifts and compacted to 95% maximum dry density, except within easements where no vehicular traffic is anticipated where the minimum compaction shall be 90% maximum dry density.

3. The minimum allowable compaction testing frequency in the deep trench zone shall be one test per 100 lineal feet of trench.

3.8.6.7 The Contractor shall provide the County with results of compaction testing within 5 business days of the tests being performed, and prior to placement of surfacing materials and hot mix asphalt, whichever occurs first.

3.8.7 Alternative Trench Backfill Material

3.8.7.1 Backfill Material that does not meet the requirements of Section 3.8.3 may be conditionally accepted as “Alternative Trench Backfill Material”, provided that the following conditions are met:

1. A soils analysis and report must be provided to the County prior to utilizing a material that does not meet the specifications stated above. At a minimum, the report shall provide the following information:
   a. Grain size (sieve) analysis including dust ratio and sand equivalency demonstrating the material is non-plastic. The material shall be considered non-plastic if the percent by weight passing the U.S. NO. 200 sieve does not exceed 15 percent, or if the soil fraction passing the U.S. No. 40 sieve cannot be rolled, at any moisture content, into a thread as prescribed in Section 4 of AASHTO T 90.
   b. Optimum moisture content and proctor (ASTM D1557).
c. Construction requirements that address means for placing and compacting the material, maximum lift thickness, frequency of compaction testing, protecting material from wet weather conditions, etc. In no case shall the requirements stated in the soils report be less restrictive than the requirements stated herein.

2. The soils analysis and report shall be stamped by an engineer who has an expertise in soil mechanics and who is licensed in the State of Washington.

3. An engineer who has an expertise in soil mechanics, and who is licensed in the State of Washington, shall monitor the placement and compaction of the material. The engineer shall be on the site each day during backfilling operations to monitor moisture content and to observe field operations to ensure compliance with the soils report.

4. Random verification sample(s) of the trench backfill material shall be taken during construction at a frequency of 1 sample per 500 lineal feet of trench, and a minimum of 1 sample per Project. The sample shall be taken by the engineer who stamped the original soils report, or their duly appointed representative. The samples shall be analyzed by the engineer. As a minimum, the engineer shall test and report the results for comparison purposes with the requirements for gravel base per Sections 3.8.2 and 3.8.3. If appropriate (more than 15% by weight passing the 200 sieve), the engineer shall report the results of AASHTO T 90.

5. In the event that test results or construction observations verify lack of compliance with the soils report or construction requirements, the material shall be removed, replaced and re-compacted to the satisfaction of the engineer.

6. At the completion of construction, a report that summarizes the observations associated with the trench backfill, results of the soils analysis, and compaction results shall be submitted to the County. Included as an appendage, include copies of the daily Project diaries, soil testing reporting forms, and compaction reports. The licensed engineer described above shall affix their seal, sign and date the end of Project report.

7. A 2-year warranty, from the date of Final Acceptance of the Project, shall be provided to guarantee satisfactory road restoration in the case of settlement or pavement distress. The warranty amount shall be 10% of the total construction costs.

8. As appropriate, the governing jurisdiction or Property Owner shall indemnify and hold the Sewer Utility harmless from loss or damages arising out of the use of alternative trench backfill material. A notarized “Hold Harmless” agreement shall be in force prior to commencing Work.

3.9 CONTROLLED DENSITY FILL (CDF)

3.9.1 CDF is a self-compacting, cementitious, flowable material requiring no subsequent vibration or tamping to achieve consolidation. The Contractor shall provide a mix design in writing to the County, utilizing ACI 229 as a guide to develop the CDF mix design. No CDF shall be placed until the County has reviewed and approved the mix design.
3.9.2 CDF shall be designed to have a minimum 28-day compressive strength of 50 psi and a maximum 28-day compressive strength of 300 psi. The consistency of CDF shall be flowable in accordance with the following applications:

- CDF used as trench dam: 3” ± 1”
- CDF used as trench backfill or foundation material: 10” ± 1”

3.9.3 The water/cement ratio shall be calculated on the total weight of cementitious material. Portland cement, fly ash, ground granulated blast furnace slag, and microsilica fume are considered cementitious materials.

3.9.4 Admixtures used in CDF shall meet the requirements of Section 9-23.6 of the WSDOT Standard Specifications. Foaming agents, if used, shall meet the requirements of ASTM C869. Non-chloride accelerating admixtures may be used to accelerate the hardening of CDF. All admixtures shall be used in accordance with the manufacturer’s recommendations.

3.9.5 CDF shall meet the requirements of Sections 6.2 and 6.3 of these Specifications, and shall be accepted based on a Certificate of Compliance. The producer shall provide a Certificate of Compliance for each truckload of CDF in accordance with Section 6.3.5 of these Specifications.

3.9.6 The Contractor shall provide all required bracing, ballast, or tie-downs required to prevent movement, flotation, and deformation of pipelines during placement of CDF. Trenches shall be dewatered in accordance with Section 3.2 of these Specifications before placing CDF.

3.10 TEMPORARY ROADWAYS

3.10.1 The Contractor shall construct temporary roadways as shown on the Approved Drawings or as required for the Project. Temporary roadways shall be adequately designed, constructed, and maintained to provide access to adjacent public and private property.

3.10.2 The Contractor shall be solely responsible for ensuring that temporary roadways adjacent to or over existing facilities are adequate for all intended uses without causing damage to the existing facilities.

3.10.3 Temporary roadways shall have a smooth and even surface profile, free of bumps and depressions, and shall be conditioned so as to allow safe use by public traffic.

3.10.4 At a minimum, surfacing for temporary roadways shall meet the requirements for Crushed Surfacing Top Course as specified in Section 9-03.9(3) of the WSDOT Standard Specifications, unless otherwise approved by the County or governing jurisdiction.

3.10.5 Failure of the Contractor to prevent dust nuisance in accordance with Section 1.2.1.3 will be just cause for the County to suspend the Contractor’s Work until corrective measures are taken.

3.10.6 All temporary access roads and fills required for the Project shall be removed prior to the completion of the Work.
3.11 FLAGS, SIGNS, AND TRAFFIC CONTROL DEVICES

3.11.1 The Contractor shall be responsible for providing flaggers, spotters, flagging signs, and all other traffic control devices in accordance with an approved Traffic Control Plan for the protection of the Work and the public at all times, regardless of whether or not the flagpersons, barricades, lights, and signs are ordered by the County or governing jurisdiction. The Contractor and the Contractor’s surety shall be liable for injuries and damages to persons and property suffered by reason of the Contractor’s operations or any negligence in connection therewith.

3.11.2 Flagging, signs, and all other traffic control devices and procedures shall conform to the standards established in the latest WSDOT-adopted edition of the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) as published by the United States Department of Transportation, and the Washington State Modifications to the MUTCD. Judgment as to the quality of devices furnished shall be based upon Quality Guidelines for Temporary Traffic Control Devices as published by the American Traffic Safety Services Association.

3.11.3 The Contractor shall submit to the County a copy of the approved Traffic Control Plan and Right-of-Way permit prior to commencement of the Work.

3.12 PUBLIC CONVENIENCE AND SAFETY

3.12.1 The Contractor shall conduct their operations with the least possible obstruction and inconvenience to the public, and shall have under construction no greater length or amount of Work than they can execute properly with due regards to the rights of the public. The Contractor shall not open up sections of the Work and leave them unfinished, but shall instead finish the Work as they go insofar as practicable.

3.12.2 All public traffic shall be permitted to pass through the Work with as little inconvenience and delay as possible. The Contractor shall keep existing roads and streets adjacent to or within the limits of the Project open to and maintained in a good and safe condition for traffic at all times. The Contractor shall remove any deposits or debris, and shall repair all damage resulting from construction operations.

3.12.3 Existing traffic signal and highway lighting systems shall be kept in operation for the benefit of the traveling public during progress of the Work, and the authority having jurisdiction will continue the routine maintenance of such existing systems.

3.12.4 Construction shall be conducted so that as little inconvenience as possible is caused to abutting Property Owners. Convenient access to driveways, houses and buildings along the line of Work shall be maintained at all times. When the abutting Property Owners’ access across the Right-of-Way line is to be eliminated and replaced under the Project by other access, the existing access shall not be closed until the replacement access facility is available. Temporary approaches to crossing or intersecting highways shall be provided and kept in good condition at all times.

3.13 ONE-WAY PILOTED TRAFFIC CONTROL

3.13.1 The construction of treated bases, surface treatments, and pavements sometimes requires permitting traffic to use a portion of the roadway during the progress of the Work using one-way piloted traffic control. If this is the case, the Contractor shall confine their
operations to one-half the roadway, permitting traffic on the other half. If, at the discretion of the County or governing jurisdiction, one-way piloted traffic is necessary, the Contractor will be required to furnish flaggers, pilot car(s), and driver(s).

3.13.2 Insofar as conditions will permit, the Contractor shall, at the end of each day, leave the Work in such condition that it can be traveled without damage to the Work and without danger to traffic. The County shall be the sole judge as to whether or not flagging and piloting can be dispensed with after working hours.

3.14 CONSTRUCTION AND MAINTENANCE OF DETOURS

3.14.1 Plans for detours shall be submitted to the governing jurisdiction for approval. Surfacing and pavement requirements shall be determined by the governing jurisdiction based on traffic loading and other factors.

3.14.2 The Contractor shall construct, maintain in a safe condition, and keep open to traffic all approved detours and detour bridges, to include detour crossings of intersecting highways and temporary approaches, to accommodate traffic diverted from the roadway. A minimum of two-way traffic shall be maintained, unless otherwise approved by the County or governing jurisdiction.

3.14.3 Detours necessitated by the Contractor’s operations or for the convenience of the Contractor shall be constructed, maintained, and removed by the Contractor.

3.14.4 Upon failure of the Contractor to immediately provide, maintain, or remove detours or detour bridges when ordered to do so by the County or the governing jurisdiction, the County or the governing jurisdiction may, without further notice to the Contractor or the Contractor’s Surety, provide, maintain, or remove the detours or detour bridges and request payment against the Contractor’s Surety.

3.15 FILLS AND EMBANKMENTS

3.15.1 Areas upon which embankments will be placed shall be prepared by clearing and grubbing as described in Section 2.2. Debris shall be disposed of in accordance with Section 2.4. After clearing and grubbing is complete, the exposed area shall be compacted to at least 95 percent of maximum dry density as determined by ASTM D1557. The County or governing jurisdiction may order excavation below subgrade to remove soft and uncompactable material. The replacement material shall be free-draining and granular, or other materials as determined by the governing jurisdiction.

3.15.2 When approved by the County, excess native material from sewer pipeline and structure excavation may be used for fills and embankments. The Contractor shall obtain materials in excess of that available on the site and approved by the County from commercial sources, or from other locations approved by the County. Fill material for embankments in which sanitary sewers will be located shall meet the requirements of Section 3.8.

3.15.3 Fill material shall not be placed in water, on frozen ground, or on other surfaces not approved by the County. No fill shall be placed until approved by the County.

3.15.4 The Contractor shall place earth embankments in horizontal layers of uniform grade and cross section, to the dimensions shown on the Approved Drawings or as stated herein.
No layer shall exceed 8 inches in depth before compaction. Fill material for embankments in which sanitary sewers will be located shall be placed to a depth of not less than 3 feet over the crown of the pipe, or as shown on the Approved Drawings. If dimensions are not shown, the embankment shall have a minimum top width equal to the outside diameter of the pipe plus 3 feet, and sides sloped at 1.5 horizontal to 1.0 vertical (1.5 H: 1.0 V).

3.15.5 Each layer shall run full width from the top to the bottom of the embankment, and shall be compacted to 95 percent of the maximum dry density as determined by ASTM D1557 in accordance with Section 3.8.6. Compaction testing shall be performed at a frequency not less than one test per 10,000 square feet of area for each layer. No additional layers shall be placed until the density of each layer in place has been approved by the County. Slopes shall be compacted as part of embankment compaction.

END OF SECTION
SECTION 4

PIPELINE CONSTRUCTION

4.1 GENERAL

4.1.1 This Section includes furnishing and installing all pipe materials for gravity sewers, pressure/force main sewers, side sewers, manhole drop structures, and all other piping appurtenances shown on the Approved Drawings or specified herein. Pipe sizes are nominal inside diameter unless otherwise noted. All sizes and types of pipe shall be as shown on the Approved Drawings and specified herein. All materials and equipment furnished under this Section shall be by the manufacturer specified on the Approved Drawings, as identified in the Standard Plans, and as specified herein.

4.1.2 All pipe and fittings delivered to the job site shall be clearly marked to identify the material, class, and thickness. All material shall be new and free of blemishes. Acceptance of pipe and accessories by the County will be based on load bearing tests, material tests and, inspection of the complete products as specified herein. Acceptance of installed piping will be based on inspection and leakage tests as specified herein.

4.1.3 All pipe, fittings, and accessories shall be of rugged construction, with ample strength for all stresses which may occur during fabrication, transportation, installation, testing, and during continuous or intermittent operation, and shall be designed for the service intended. Pipe, fittings, and accessories shall be adequately stayed, braced and anchored during installation, and shall be installed in a neat and workmanlike manner.

4.1.4 The Contractor shall furnish and install all necessary guides, inserts, anchor and assembly bolts, washers and nuts, supports, gaskets, flanges, and other appurtenant items shown on the Approved Drawings, identified in the Standard Plans, specified herein, or otherwise required for the proper installation and operation of the piping and piping accessories.

4.1.5 Anchor and assembly bolts and nuts shall be of ample size and strength for the purpose intended. Unless otherwise specifically noted, all bolts shall be standard machine bolts with cold-pressed hexagon nuts. Bolts and nuts shall be stainless steel, unless otherwise specified herein. Stainless steel for bolts shall conform to ASTM F593, Alloy Group 2. Stainless steel for nuts shall conform to ASTM F594, Alloy Group 2.

4.1.6 Watertight plugs or caps shall be provided on the ends of sanitary sewer stubs. Thrust blocks may also be required at the discretion of the County.

4.2 PIPE MATERIAL

4.2.1 The pipe and fittings shall be designated by pipe type. All pipe and fittings shall be new and shall conform to the specifications contained herein. Pipe class shall be as shown on the Approved Drawings or as required by test results, whichever is greater. The Contractor shall submit a Manufacturer’s Certificate of Compliance for each type of pipe certifying that the pipe meets or exceeds the specification requirements.
4.2.2 Where pipe types are specifically shown on the Approved Drawings, only those pipe
types shall be installed. Only one type of pipe shall be installed between adjacent manholes
or other pipeline terminus points, unless otherwise noted on the Approved Drawings,
identified in the Standard Plans, or otherwise approved by the County.

4.2.3 Pipe for pressure/force main sewers shall be ductile iron pipe (DIP), pressure
polyvinyl chloride (PVC) pipe, or pressure high-density polyethylene (HDPE) pipe as
specified herein, unless otherwise noted on the Approved Drawings, identified in the
Standard Plans, or approved by the County.

4.2.4 Pipe types shall be appropriate for the depth of cover. Minimum cover over pipe shall
be 5 feet in driving areas and existing or proposed Rights-of-Way, and 3 feet in non-driving
areas. Ductile iron pipe may be used where 5 feet of cover cannot be obtained, but in no
case shall the cover be less than 3 feet. Cover shall be measured from the top of pipe to the
finished grade. The minimum pipe types based on cover shall be per the table below.

<table>
<thead>
<tr>
<th>Pipe Type</th>
<th>Maximum Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC SDR 35</td>
<td>20 ft</td>
</tr>
<tr>
<td>PVC SDR 21</td>
<td>25 ft</td>
</tr>
<tr>
<td>PVC C900/C905</td>
<td>Per Manufacturer’s Recommendations</td>
</tr>
<tr>
<td>DIP CL52</td>
<td>Per Manufacturer’s Recommendations</td>
</tr>
<tr>
<td>HDPE</td>
<td>Per Manufacturer’s Recommendations</td>
</tr>
</tbody>
</table>

4.3 DUCTILE IRON PIPE (DIP)

4.3.1 Gravity DIP shall conform to the requirements of ANSI/AWWA A21.51/C151,
thickness Class 52. Pressure DIP shall conform to the requirements of ANSI/AWWA
A21.15/C115, thickness class as required (Class 52 minimum) for flanged pipe rated for not
less than 250 psi working pressure.

4.3.2 Joints shall be bell and spigot, compression ring, push-on type utilizing a special bell
designed to make a complete watertight joint using a single sewage-resistant synthetic
rubber gasket. Joints, gaskets, and gasket lubricant shall conform to the requirements of
ANSI/AWWA A21.11/C111. All DIP shall be provided with nitrile rubber gaskets.

4.3.3 Fittings shall conform to the requirements of ANSI/AWWA A21.10/C110, except for
the laying length, and shall utilize bell and spigot joints as specified herein. Fittings shall
receive a factory-applied standard bituminous exterior lining, 1 mil minimum thickness.
Fittings for pressure DIP shall be rated for not less than 250 psi working pressure.

4.3.4 Where flanged joints are shown on the Approved Drawings or identified in the
Standard Plans, they shall utilize ductile iron screwed-on flanges, 125-point class with
oversized hub, and shall conform in all other respects to the requirements of ANSI/ASME
B16.42. Flanges shall be refaced before shipment. Gaskets shall be ring-type (not full face),
service sheet Style 60, 1/16 inch thick, as manufactured by Johns Mansville, equivalent
gasket by the Crane Company, or Approved Equal. A non-stick parting agent shall be
applied to both sides of the gasket by the gasket manufacturer. No oil or compound shall be
used in the field for gasket installation.
4.3.5 Bolts and nuts shall be standard machine bolts with square heads and cold-pressed hexagon nuts. Studs with two cold-pressed hexagon nuts shall be used where required. Bolts and nuts shall conform to the requirements of ASTM A307, Grade B and ANSI/ASME B18.2. Stud bolts and nuts shall conform to the requirements of ASTM A193, Grade B7, ASME B16.5, and ANSI/ASME B18.2. Bolts and nuts shall be Type 316 stainless steel.

4.3.6 Watertight plugs shall be U.S. Pipe & Foundry Company No. U-364, the equivalent product from Pacific States Cast Iron Pipe Company, or Approved Equal.

4.3.7 Mechanical joints and fittings, where shown on the Approved Drawings, shall conform to ANSI/AWWA A21.10/C110 and ANSI/AWWA A21.11/C111.

4.3.8 DIP shall receive protective coatings in accordance with Section 10.2.

4.4 GRAVITY POLYVINYL CHLORIDE (PVC) PIPE

4.4.1 Gravity PVC pipe shall be plasticized polyvinyl chloride pipe with integral wall bell and spigot joints. and shall be suitable for use as a gravity conduit for the conveyance of domestic sewage. The material used to produce the pipe and fittings shall be clean, virgin material conforming to the requirements of ASTM D1784, Class 12454.

4.4.2 Pipe and fittings size 4 inch through 15 inch shall conform to the requirements of ASTM D3034, except as modified herein. Pipe and fittings size 16 inch and larger shall conform to the requirements of ASTM F679.

4.4.3 All gravity PVC pipe shall be ASTM D3034, SDR 35 or better. SDR 21 pipe shall meet the requirements of ASTM D2241. Pipe meeting the requirements of AWWA C900 or AWWA C905, DR18 or better, is an acceptable alternative to SDR 21 pipe as approved by the County.

4.4.4 Joints for Pipe and Fittings

4.4.4.1 Sewer Main and Side Sewer Stubs – Joints for pipe and fittings shall conform to ASTM D3212, and shall utilize sewage-resistant synthetic rubber gaskets conforming to the requirements of ASTM F477. The gaskets shall be the sole element depended upon to make the joint flexible and watertight. Provisions for expansion and contraction shall be made at each joint. The assembled joint shall withstand a pressure of 4 psi for a period of 1 hour without leakage in the concentric alignment and in the manufacturer’s recommended maximum deflected position. The assembled joint shall be subject to air testing in accordance with Section 12.2.3.

4.4.4.2 Building Sewers – Joints for building sewers upstream of the side sewer stub may be either gasketed, meeting the requirements of Section 4.4.4.1 above, or solvent-weld. When using solvent-welded joints, the Contractor shall ensure the joint is assembled in accordance with the manufacturer’s written instructions; the use of a compatible primer is required. The assembled joint, whether gasketed or solvent-welded, shall be subject to exfiltration testing in accordance with Section 12.2.4.

4.4.5 All gravity PVC pipe shall be placed within the installation areas at least 24 hours prior to installation to permit temperature equalization. Pipe manufactured greater than 10 months prior to actual installation will not be permitted. Pipe shall be protected from exposure to ultraviolet light according to manufacturer’s recommendations.
4.4.6 Pipe and fittings shall be manufactured by J-M Manufacturing Company, Inc., PW Pipe, or Approved Equal.

4.5 PRESSURE POLYVINYL CHLORIDE (PVC) PIPE

4.5.1 Pressure PVC pipe shall be rigid plasticized polyvinyl chloride pipe suitable for use as a pressure conduit for the conveyance of domestic sewage. The pipe shall be suitable for use at a minimum hydrostatic pressure of 200 psi at 73°F. Pipe shall conform to the requirements of ASTM D2241, except as modified herein. The material used to produce the pipe and fittings shall be clean, virgin material conforming to the requirements of ASTM D1784, Class 12454.

4.5.2 All pressure PVC pipe shall be Class 200 or better. The Contractor shall submit pressure class determination calculations to the County, if so directed.

4.5.3 Joints for Pipe and Fittings

4.5.3.1 Sewer Force Mains – Joints for pipe and fittings size 2-inch and larger shall conform to ASTM D3212, and shall utilize sewage-resistant synthetic rubber gaskets conforming to the requirements of ASTM F477. The gaskets shall be the sole element depended upon to make the joint flexible and watertight. Provisions for expansion and contraction shall be made at each joint. Joints for pipe and fittings less than 2-inch diameter shall be solvent-weld. When using solvent-welded joints, the Contractor shall ensure the joint is assembled in accordance with the manufacturer’s written instructions; the use of a compatible primer is required. The assembled joint, whether gasketed or solvent-welded, shall be subject to pressure testing in accordance with Section 12.3.

4.5.3.2 Pressure Building Sewers – Joints for pressure building sewers may be either gasketed, meeting the requirements of Section 4.5.3.1 above, or solvent-weld. When using solvent-welded joints, the Contractor shall ensure the joint is assembled in accordance with the manufacturer’s written instructions; the use of a compatible primer is required. The assembled joint, whether gasketed or solvent-welded, shall be subject to pressure testing in accordance with Section 12.3.

4.5.4 All pressure PVC pipe shall be placed within the installation areas at least 24 hours prior to installation to permit temperature equalization. Pipe manufactured greater than 10 months prior to actual installation will not be permitted. Pipe shall be protected from exposure to ultraviolet light according to manufacturer’s recommendations.

4.5.5 Pipe and fittings shall be manufactured by J-M Manufacturing Company, Inc., PW Pipe, or Approved Equal.

4.6 GRAVITY HIGH-DENSITY POLYETHYLENE (HDPE) PIPE

4.6.1 Gravity HDPE Pipe Less Than 18-Inch Diameter

4.6.1.1 Materials used for the manufacture of gravity HDPE pipe and fittings less than 18-inch diameter shall be PE 3608 high-density polyethylene meeting cell classification 345464C for black per ASTM D3350. The pipe shall be listed in the Plastic Pipe Institute (PPI) report TR-4 with a standard grade HDB rating of 1,600 psi at 73°F per ASTM D2837.
4.6.1.2 HDPE pipe size 4-inch and larger, IPS and DIPS, shall be manufactured in accordance with ASTM F714 and AWWA C906 (IPS). Each production lot of material or pipe shall be tested for melt index, density and percent-carbon, dimensions, and ring tensile strength. The diameter and DR rating of the pipe shall be as shown on the Approved Drawings (DR17 minimum).

4.6.1.3 Clean rework materials derived from a manufacturer’s own pipe and fitting product may be used by the same manufacturer provided that the cell classification of the rework material complies with the material to which it will be added and the rework material and finished products meet the requirements of these Specifications.

4.6.1.4 HDPE pipe shall be marked with identification markings that will remain legible during normal handling and storage. The markings shall be applied at intervals not exceeding 5 feet along the pipe. Information provided in the markings shall include:

1. Nominal pipe size,
2. Standard material code designation,
3. Dimension ratio,
4. Pressure class,
5. Certification base,
6. Manufacturer’s production code,
7. Name of manufacturer.

4.6.1.5 HDPE pipe shall be designed, installed, bedded, and compacted in accordance with these Specifications and the manufacturer’s recommendations. If conditions at the time of installation vary from the conditions noted herein, the County, Engineer, pipe manufacturer, and Contractor shall determine the corrective measures necessary to prevent the pipe deflection from exceeding 2 percent.

4.6.1.6 Joints between plain end pipes shall be made by butt fusion per PPI TR-33. Joints between the main and saddle branch fittings shall be made using saddle fusion. The butt fusion and saddle fusion procedures used shall be per the manufacturer’s recommendations. Internal beads shall be removed on all butt fused joints. Fusion shall only be done by persons that have been trained using the manufacturer’s recommended procedures. Personnel shall provide current certification indicating they have been trained in accordance with the manufacturer’s requirements. The assembled joint shall be subject to air testing in accordance with Section 12.2.3.

4.6.1.7 Electrofusion couplers shall be designed and manufactured according to ASTM F1055. The couplers shall be produced from a pre-blended virgin resin that has a PPI listing of PE 3608, and shall be tested according to AWWA C906. The pipe ends and coupling shall be cleaned and prepared according to the manufacturer’s recommendations prior to installation. The electrofusion procedures used shall be per the manufacturer’s recommendations. Internal beads shall be removed on all electrofused joints. Fusion shall only be done by persons that have been trained using the manufacturers recommended procedures. Personnel shall provide current certification indicating they have been trained in accordance with the manufacturer’s requirements.
4.6.1.8 The pipe and fittings shall be DriscoPlex® 4600 (IPS) or 4700 (DIPS) as manufactured by Performance Pipe, similar product by JM Eagle (IPS or DIPS), or Approved Equal.

4.6.2 Gravity HDPE Pipe 18-Inch Diameter and Larger

4.6.2.1 Gravity HDPE pipe and fittings size 18-inch and larger shall conform to ASTM F894 for large-diameter, profile wall polyethylene sewer and drain pipe. Materials used for the manufacture of the pipe and fittings shall be high-density polyethylene meeting cell classification of 345444E for white or near-white per ASTM D3350. The pipe resin shall conform to all requirements of ASTM D1248, Type III, Class C, Grade P34, with a Plastic Pipe Institute (PPI) listing of PE 3408. The long-term hydrostatic strength shall be 1,250 psi, and the hydrostatic design stress shall be 650 psi, as determined by ASTM D2837. The Contractor shall submit copies of all test results as required herein when submitting the Manufacturer’s Certificate of Compliance.

4.6.2.2 The minimum Ring Stiffness Constant (RSC) value for the pipe shall be as specified on the Approved Drawings, or 90 percent of the nominal class value when tested in accordance with Section 8.5 of ASTM F894, whichever is greater. There shall be no evidence of splitting, cracking, or breaking when the pipe is flattened to 40 percent of its original diameter in accordance with Section 8.6 of ASTM F894. Sample size for RSC and flattening tests shall be one sample per size and class of pipe. The County shall have free access to the testing and inspection areas of the manufacturer’s plant.

4.6.2.3 The average nominal inside diameter shall be true to the specified pipe size and within the tolerances given in Table 1 of ASTM F894. Except for mandrel breakout lines running in the direction of flow and mold marks, the inner wall of the pipe shall be smooth and have no visible circumferential weld seems so as to provide a typical Manning N factor of 0.010 for clean water. Per ASTM F894, slight lines and mold marks are permissible provided that they do not result in variations of the inside diameter of more than ⅛ inch from that obtained on adjacent unaffected portions of the surface. Ends of closed profile pipe shall be factory sealed to prevent leakage through the profile channel. Standard laying lengths shall be 20 feet.

4.6.2.4 Clean rework materials derived from a manufacturer’s own pipe and fitting product may be used by the same manufacturer provided that the cell classification of the rework material complies with the material to which it will be added and the rework material and finished products meet the requirements of these Specifications.

4.6.2.5 The pipe shall be clearly marked with the ASTM F894 designation, the nominal pipe size, the RSC class, material cell classification, and the manufacturer’s name and production code.

4.6.2.6 Pipe joining shall be effected by compressing a gasket between a bell and a spigot, which are integrally wound onto the pipe wall with no external weld or fusion. The gasket shall be contained in a machine groove on the pipe spigot except for pipe used to connect to HDPE manholes, fittings, and structures. Pipe connecting to HDPE manholes, fittings, and structures shall have a smooth surface suitable for gasket sealing. Gaskets shall be molded rubber or, if approved by the County, produced from an extruded shape approved by the pipe manufacturer and spliced into circular form, and shall conform to the non-pressure requirements of ASTM F477. Lubricant used for joint
assembly shall have no detrimental effect on the gasket or the pipe. Joints shall show no signs of leakage when tested in accordance with ASTM D3212. The assembled joint shall be subject to air testing in accordance with Section 12.2.3.

4.6.2.7 The pipe shall be stored, loaded, unloaded, installed, bedded, compacted, and backfilled in complete accordance with the manufacturer’s recommendations, unless otherwise specifically directed or authorized in writing by the County.

4.6.2.8 A manufacturer’s representative shall be on site during start-up construction to instruct work crews and ensure compliance with installation regulations. The manufacturer’s representative shall remain on site for a minimum of 8 hours for each crew utilized, or until the Contractor has demonstrated competence in the method employed by the Contractor for this type of pipe installation.

4.6.2.9 The pipe shall be Spirolite® pipe manufactured by Industrial Pipe Fittings, or Approved Equal.

4.7 PRESSURE HIGH-DENSITY POLYETHYLENE (HDPE) PIPE

4.7.1 Pressure HDPE pipe used for pressure/force main sewers shall conform to all specifications under Section 4.6.1 of these Specifications (Gravity HDPE Pipe Less Than 18-Inch Diameter) except that the wall thickness shall be DR11 minimum, and pipe sizes 1-¼ inch through 3 inch (IPS) shall be manufactured in accordance with ANSI/AWWA C901 and to the requirements of ASTM D3035, and the assembled joints shall be subject to pressure testing in accordance with Section 12.3.

4.8 PIPING ACCESSORIES

4.8.1 Flexible Couplings. Straight, transition, and long-barrel couplings shall be Romac Industries, Inc. Style 501. Flexible couplings do not provide protection against possible pullout of pipe ends in unrestrained conditions. When required by the Approved Drawings, restrained joints shall be provided in accordance with the manufacturer’s recommendation. Restraints shall be designed for 150 percent of the maximum working pressure of the applicable service. No Fernco-type couplings shall be used.

4.8.2 Flanged Coupling Adapters. Flanged coupling adapters shall be Romac Industries, Inc. Style FCA501. When required by the Approved Drawings, restrained joints shall be provided in accordance with the manufacturer’s recommendation. Restraints shall be designed for 150 percent of the maximum working pressure of the applicable service.

4.8.3 Couplings for threaded pipe shall be extra-heavy recessed, of the same material as the pipe to which attached. Bolted, compression-type couplings shall be provided where shown on the Approved Drawings, as manufactured by Romac Industries, Inc., or Approved Equal. Gaskets shall be suitable for the pressure, fluids, and temperature in the pipeline.

4.8.4 Couplings for joining different pipe types shall be a gasket by gasket type. Couplings shall produce a smooth interior transition between upstream and downstream pipes. Fittings shall be one-piece injection molded or fabricated from a PVC compound meeting ASTM D1748. Solvent-weld bells shall be as defined in ASTM D3034 and ASTM F679. Gasket bells shall conform to ASTM D3212 and ASTM F477. Fittings shall also conform to ASTM F913 and ASTM F1336. Couplings shall be manufactured by Specified Fittings, Inc., or Approved Equal.
4.8.5 Cast iron body coupling systems may be used for coupling pipes outside of vaults and pump stations. Cast iron body coupling systems shall consist of a sewage-resistant synthetic rubber or polyvinyl chloride sleeve, Type 301 or better stainless steel bands, and a tightening mechanism designed to compress the sleeve to form a watertight and airtight seal when the joint is assembled as approved by the County. The coupling shall produce a smooth interior transition between upstream and downstream pipes. Couplings shall be as manufactured by Romac Industries, Inc., or Approved Equal.

4.8.6 Prior to coupling installation, the Contractor shall thoroughly clean oil, scale, rust, and dirt from the pipe to provide a clean seat for the gasket. Gaskets shall be wiped clean before they are installed. If necessary, flexible couplings and flanged coupling adaptor gaskets may be lubricated with soapy water or the manufacturer’s standard lubricant before installation on the pipe ends. Couplings shall be installed in accordance with the manufacturer’s recommendations. Bolts shall be tightened progressively, drawing up bolts on opposite sides a little at a time until all bolts have a uniform tightness. Workmen tightening bolts shall be equipped with torque-limiting wrenches. Joints made using couplings shall be subject to testing in accordance with Section 12 of these Specifications.

4.8.7 Seals for pipe sleeves shall be bolt-up type consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the sleeve. When bolts are tightened, the rubber sealing elements shall expand to result in a watertight seal. Bolts and pressure plate nuts shall be Type 316 stainless steel. Rubber links shall be suitable for use in water, moist environments, normal atmospheric conditions, and temperatures between -40º F and 250º F for standard service. Seals shall be Link-Seal ® modular seals as manufactured by Pipeline Seal and Insulator, Inc., or Approved Equal.

4.8.8 Unions for copper tube, where shown on the Approved Drawings, shall be wrought copper, with solder joints and copper-to-copper seats.

4.8.9 Pipe supports and stands shall be Standon, Model S89, flange support constructed of Type 304 stainless steel, or Approved Equal. Piping between the base plate and flange support shall be fabricated from Type 316 stainless steel. Pipe supports and stands shall be mounted to the floor of the cleanout/valve vaults with ½-inch diameter Type 316 stainless steel anchors, and shall be made to fit exact dimensions between floor and base elbow.

4.8.10 Pipe saddles shall be installed wherever gauges are installed, as indicated on the Approved Drawings. Pipe saddles shall be Romac Industries, Inc. Style 202NS or 202NU, or Approved Equal. All pipe saddles shall be installed prior to testing main piping, and shall be plugged before testing without gauges attached. All pipe saddles shall be centered on the top of pipe.

4.9 VALVES AND ACCESSORIES

4.9.1 General

4.9.1.1 This Section describes valves and accessories as shown on the Approved Drawings, identified in the Standard Plans and these Specifications, and as otherwise required to completely interconnect all equipment with piping for complete and operable systems.
4.9.1.2 All materials and equipment furnished under this Section shall be by the manufacturer specified herein. A single manufacturer shall furnish all valves or accessories of the same style or type.

4.9.1.3 All valves and accessories shall be installed in the manner and location as shown on the Approved Drawings, or as otherwise required for the application, and in accordance with the manufacturer’s instructions. Valve size shall be equal to the piping on which the valve is installed, unless otherwise noted on the Approved Drawings or specified herein. All valves shall be supported where necessary. Supports shall meet the requirements of Section 4.8.9. In case of conflict between these Specifications and a governing code, the more stringent standard shall prevail.

4.9.1.4 Operators for manual valves shall be lever or handwheel, as is standard with the manufacturer, unless another type of operator is specified or required by the manufacturer. Valves shall be installed with the operator positioned for convenient operation. Particular care shall be taken to ensure that adequate space is available for the operation of lever or handwheel operated valves without interference by walls, piping, or equipment. Any valve that is installed in a manner that operation is inconvenient, in the opinion of the Inspector, shall be modified or removed and reinstalled in a manner suitable to the Inspector.

4.9.1.5 Exposed valves and other equipment in below ground structures shall be coated in accordance with Section 10.2 of these Specifications.

4.9.2 Submittals

4.9.2.1 The Contractor shall submit detailed installation drawings and catalog cuts of all piping and connected equipment. The drawings shall include all fittings, pipe support locations and types, and appurtenances. Additionally, the Contractor shall submit pipe fitting and joint fabrication details for all ductile iron pipe and fittings. The submittal shall demonstrate that the pipe, fittings, pipe supports, seismic braces, flexible couplings, flanged adapters, valves, and other appurtenances conform to these Specification requirements. All submittals shall be clean, legible copies with the size, model, and proposed location(s) of use clearly indicated on the submittal.

4.9.2.2 The Contractor shall furnish manufacturer’s installation and operation manuals, bulletins, and spare parts lists for all valves and appurtenances installed.

4.9.2.3 The Contractor shall submit certified test reports as required herein and by the referenced standard specifications.

4.9.3 Materials

4.9.3.1 Gate Valves

1. Type: Size 3-inch to 12-inch, resilient seat per AWWA C509; size 14-inch and larger, resilient wedge per AWWA C515.
3. Opening: Counter-clockwise.
4. Body: Ductile iron, fusion bonded epoxy coating.
5. Ends: Flanged, mechanical joint.
7. Stem Seals: O-ring.
8. Body-Bonnet Connections: Bolted with corrosion-resistant material.
10. Manufacturer: Clow/Kennedy/M&H.

4.9.3.2 Plug Valves

1. Type: Non-lubricated eccentric; ANSI/AWWA C517.
2. Rating: 150 psi W.O.G.
4. Laying Length: Size 12-inch and under, flange face-to-face dimensions equal to standard gate valves.
5. Body: Cast iron with raised seats.
6. Seats: Size 4-inch and larger, welded-in overlay of high nickel content on all surfaces contacting the plug face. Seat end of valve shall be on the side closest to the pump(s).
7. Plugs: Resilient-faced plugs with neoprene facing, suitable for use with sewage, sludge, and scum. Port areas for valves size 20-inch and larger shall be at least 80 percent of the full pipe area.
8. Bearings: Size 20-inch and under shall have permanently lubricated stainless steel bearings in the upper and lower plug stem journals.
10. Packing: Size 4-inch and larger shall be adjustable, capable of being repacked without removing the bonnet.
11. Zinc Plating: All exposed nuts, bolts, springs, and washers.
12. Operator: Plug valves size 6-inch and larger shall be provided with gear operators attached to the valve. Plug valves smaller than 6 inches shall be provided with factory supplied levers.
13. Manufacturer: DeZurik.

4.9.3.3 Shut-Off Valves

1. Type: Ball, 2-piece, full port.
2. Material: Brass body with Type 316 stainless steel ball and stem.
5. Rating: 600 psi W.O.G.
7. Manufacturer: Apollo with mounting pads, or Approved Equal.

4.9.3.4 Check Valves

4.9.3.4.1 Size 3-Inch and Smaller

1. Size: 3-inch and smaller.
2. Type: Swing check, Y pattern.
5. Rating: 200 psi W.O.G.
7. Manufacturer: Red and White, or Approved Equal.

4.9.3.4.2 Larger than 3 Inches

1. Size: Larger than 3-inch.
2. Type: Swing with outside lever.
3. Material: Cast iron, bronze trim.
4. Rating: 200 psi W.O.G.
7. Seat ring: Bronze.
8. Disc plate: Bronze.
9. Manufacturer: Flomatic Model #90LW / 92LW.

4.9.3.5 Air Release and Vacuum Relief Valves

4.9.3.5.1 Air Release Valves

1. Size: 2-inch and smaller.
5. Connection: Threaded.
6. Manufacturer: A.R.I. Model #S021, or Approved Equal

4.9.3.5.2 Vacuum Relief Valves

1. Size: 8-inch and smaller.
2. Material: Type 316 Stainless Steel.
6. Manufacturer: A.R.I. Model #D020, or Approved Equal

4.9.3.6 Pressure Gauges

4.9.3.6.1 Compound Gauge

1. Type: Type 316 stainless steel or bronze Bourdon tube.
2. Size: 4-½ inch dial face.
3. Care: Phenolic turret style.
5. Window: Shatterproof glass, gasketed.
6. Range: Dual in psi and feet, as shown on the Approved Drawings.
7. Diaphragm Seals: Glycerin filled, Type 316 stainless steel flushing connection, use only where shown on the Approved Drawings.
8. Manufacturer: Ashcroft Model #1220, as shown on the Approved Drawings, or Approved Equal.
4.9.3.6.2 Diaphragm Seal

1. Type: Teflon over Type 316 stainless steel.
2. Body: Type 316 stainless steel.
5. Manufacturer: Ashcroft Model #75-101-S-02T-CG-YT-84 with locking devise, or Approved Equal.

4.9.3.6.3 Pulsation Dampeners

1. Type: Changeable orifice with three plungers.
2. Material: Type 316 stainless steel.
3. Manufacturer: Ray Pressure Snubbers, or Approved Equal.

4.9.3.7 Sluice Gate Valves

4.9.3.7.1 Sluice gate valves size 14-inch and smaller shall be manufactured by Waterman Industries Inc., Model #P-32, as shown on the Approved Drawings. Sluice gate valves larger than 14 inches shall be manufactured by Waterman Industries Inc., Model #SC5000, as shown on the Approved Drawings.

4.9.3.7.2 All sluice gate valves shall be non-rising stem. The Contractor will be required to furnish, fabricate, and install a stainless steel extension with handle to the valve stem as indicated on the Approved Drawings.

4.9.3.8 Backflow Preventer

4.9.3.8.1 Backflow Preventer

1. Type: Reduced pressure principle, automatic operation.
2. Design: Two independent spring-loaded check valves together with a spring-loaded, diaphragm-actuated differential pressure relief valve located between the check valves.
3. Accessories:
   a. Isolation ball valves.
   b. Test cocks.
5. Hydrostatic Test Pressure: 350 psi.
6. Approvals: By State and local authorities.
10. Manufacturer: Watts Model #909.

4.9.3.8.2 The backflow preventer shall be housed in an insulated fiberglass enclosure designed specifically for this purpose. The enclosure shall be Lok Box® Model LF021033025 as manufactured by Hubbell Power Systems.

4.9.3.8.3 The Contractor shall install an electrical conduit/circuit from the electrical control panel to the backflow preventer enclosure. The conduit shall be stubbed up through the concrete slab foundation for the backflow preventer enclosure. The
Contractor shall provide a GFI duplex receptacle with waterproof cover in the backflow preventer enclosure, as indicated on the Approved Drawings. Penetrations through the enclosure are unacceptable.

4.9.3.8.4 The Contractor shall provide heat tape around the backflow preventer as recommended by the manufacturer. The heat tape shall be Raychem ® Model 51-12P as manufactured by Tyco Thermal Controls, LLC, or Approved Equal.

4.9.3.8.5 The Contractor shall submit backflow preventer test certification to the County for review.

4.9.3.8.6 Water service connections shall be made in conformance with the local water utility requirements.

4.10 PIPE LAYING

4.10.1 All pipe utilizing bell-and-spigot-type joints shall be laid continuously upgrade with the bell of the pipe forward, unless specifically shown otherwise on the Approved Drawings or as required by the County. Each length of pipe shall be properly bedded and backfilled in accordance with Sections 3.6, 3.7 and 3.8 of these Specifications. Each length of pipe shall have a true bearing for its entire length, except at field joints. A depression in the bedding material no larger than necessary to accommodate the pipe shall be excavated at each joint location. Adjustment to line and grade shall be made by scraping away, filling in, and tamping the bedding material to provide true grade to fit the barrel of the pipe. No wedging or blocking up of pipe shall be permitted, unless otherwise approved by the County. No pipe shall be laid in water or when trench conditions or weather are unsuitable for such Work, except as permitted by the County.

4.10.2 Both bell and spigot shall be clean before the joint is made, and care shall be taken that nothing but the joint material and lubricant enters the joint. Joints shall be made in accordance with the manufacturer’s recommendations. Care shall be exercised to insure that the gasket is fully seated and that the insertion of the spigot end is complete and complies fully with the manufacturer’s recommendations for installation. In no case shall a pipe joint have a gap greater than 1-½ inches between the end of the spigot and the neck of the bell. The neck of the bell in this case is defined as the point where the end of the spigot is fully bottomed out. Particular attention is called to the high coefficient of expansion of PVC and HDPE pipe and the need to carefully observe necessary joint clearances as indicated by pipe markings.

4.10.3 After making the joint, the pipe shall be rigidly secured in place by backfilling to the top of the pipe on each side of the pipe at the center of the section using bedding material or initial backfill material in accordance with the designated bedding condition. Due to the light weight of PVC and HDPE pipe, additional care shall be taken during initial backfilling so as not to disturb, raise, lower, or laterally displace the pipe. Deflection of PVC pipe shall not exceed 5 percent of the inside diameter of the pipe.

4.10.4 Where shown on the Approved Drawings or otherwise required or approved by the County, concrete encasement of pipe shall consist of placing Portland cement concrete around the pipe to the dimensions shown on the Approved Drawings and the Standard Plans. Concrete encasement for pipe shall begin and end at a pipe joint. Portland cement concrete used for concrete encasement shall meet the requirements for Commercial Concrete as specified in Section 6.2.5.
4.10.5 All stubs shall be capped, not plugged, at their terminus. Caps for stubs shall be compatible with the pipe joint, and shall be in accordance with the pipe manufacturer’s recommendations. Blocking of caps shall be provided as required.

4.10.6 When pipe laying is not in progress, the forward end of the pipe shall be kept effectively closed with a temporary plug. Care shall be taken to prevent damage to pipe or pipe ends. Any damaged pipe or pipe ends shall be removed and discarded.

4.10.7 All pipelines shall be laid to the line and grade shown on the Approved Drawings, unless otherwise directed by the County. Variance from established line and grade for gravity sewer lines between manholes shall not exceed ½ inch, provided that such a variation does not result in a level or reverse sloping pipe invert. Variance in the invert elevation between adjoining pipe ends due to non-concentricity of joining and pipe interior surfaces shall not exceed \( \frac{1}{64} \) inch per inch of pipe diameter, or ½ inch maximum, and shall not result in level or reverse sloping pipe invert.

4.10.8 Line and grade shall be surveyed at each manhole as the Work is in progress when the pipe is designed at or near the minimum grades identified in the Criteria for Sewage Works Design published by the Washington State Department of Ecology, and as indicated below:

<table>
<thead>
<tr>
<th>Pipe size (inches)</th>
<th>Minimum Slope (feet per 100 feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>0.40</td>
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<tr>
<td>10</td>
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<td>21</td>
<td>0.10</td>
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<tr>
<td>24</td>
<td>0.08</td>
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4.10.9 Survey line and grade control hubs shall be provided by the Contractor for use in constructing all pipelines to the proper grade and alignment as shown on the Approved Drawings. The Contractor shall transfer line and grade to control the Work. In case the referenced methods are impractical, the Contractor may control line and grade by the use of approved surveying instruments operated by qualified personnel. The Contractor shall constantly check line and grade of the pipe, and in the event they do not meet specified limits the Work shall be immediately stopped and the cause remedied before proceeding.

4.10.10 Trench dams shall be installed where shown on the Approved Drawings, and immediately upstream of every new connection to an existing sanitary sewer system and just downstream of any stream, wetland, drainage ditch, storm pond, or infiltration trench. Trench dams shall be constructed as shown on the Approved Drawings and the Standard Plans, or as otherwise directed by the County. Controlled Density Fill (CDF) used for trench dams shall meet the requirements of Section 3.9 of these Specifications. Trench dams shall be constructed as identified in the Standard Plans.
4.10.11 The Contractor shall provide pipeline location markers for all sewer pipelines installed within easements and within the Rights-of-Way, when the pipeline is located outside of the driving surface and shoulder, or as otherwise directed by the County. The markers shall be installed 4 feet upstream of each manhole location, and in accordance with the manufacturer’s recommendations. The markers shall be green in color with an identifying sticker stating “WARNING SEWER PIPELINE” attached in a vertical fashion to the upper 12 inches of the marker rail. The bottom portion of the identifying sticker shall state “Before digging in this area call: UNDERGROUND UTILITIES LOCATION CENTER AT 1-800-424-5555” printed in a horizontal fashion. The markers shall be Rhino 3-Rail #70457, or Approved Equal.

4.11 PRESSURE SEWER INSTALLATION

4.11.1 Each pipe fitting and accessory shall be carefully inspected before installation. The interior and exterior protective coatings for ductile iron pipe, fittings, and appurtenances, as specified herein, shall be thoroughly inspected, and all damaged areas shall be patched by the Contractor in the field or replaced at the direction of the County.

4.11.2 Pressure sewer pipe shall be laid in accordance with the pipe manufacturer’s requirements and to the lines and grades shown on the Approved Drawings, unless otherwise directed by the County. Mud, silt, gravel, and other foreign material shall be kept out of or removed from the pipe interior prior to installation, and all joints shall be thoroughly cleaned before joining.

4.11.3 All piping shall be backfilled, supported, hung, or braced against movement as shown on the Approved Drawings, required by these Specifications, or otherwise required for proper installation. The internal bead shall be removed on all thermally fused joints. Deflection of PVC pipe shall not exceed 5 percent of the inside diameter of the pipe.

4.11.4 Thrust restraint (e.g., mechanical, concrete thrust blocks, etc.) shall be installed at all force main bends as detailed on the Approved Drawings, identified in the Standard Plans, or as directed by the County.

4.11.5 Pipeline Location Systems

4.11.5.1 The Contractor shall provide locate wire and test stations as shown on the Approved Drawings and the Standard Plans, and as identified below for all pressure/force main sewers.

4.11.5.2 The Contractor shall submit detailed manufacturer’s cut-sheets, together with sufficient data to show that the locating system materials conform to these Specifications.

4.11.5.3 Indicator cable shall be No. 10 HMW-PE Cable, 1-conductor, stranded, plain annealed copper with \(\frac{7}{64}\) -inch thick, black high-molecular weight polyethylene insulation jacket.

4.11.5.4 Epoxy splice kits shall be wire splice kits sized for the wire to be spliced, including epoxy resin, hardeners, and mold.

4.11.5.5 Connectors for terminating copper conductors shall be insulated, solid-barrel, crimp type, with spade tongue plated alloy terminals sized for the conductor.
4.11.5.6 Test stations shall be Testox Model #311 as supplied by Norton Corrosion Limited, LLC (Woodinville, WA). The stainless steel machine screws shall have adequate length to allow for connection by alligator clips on the monitoring equipment. Each test station shall have two leads. All test stations shall be located as shown on the Approved Drawings and as indicated in the Standard Plans.

4.11.5.7 The indicator cable shall be installed at the top of the pipeline and extended to the test stations located inside all force main valve and cleanout vaults, and inside all discharge manholes. The cable shall be attached to the crown of the pipe to ensure the proper position of the cable.

4.11.6 The Contractor shall provide a continuous ribbon of detectable warning tape for all pressure/force main sewers. The tape shall be an inert plastic film that is highly resistant to alkalis, acids, and other destructive chemicals likely to be encountered in soils, and shall have a metalized foil core to enable detection with electronic instruments. The tape shall be a minimum of 2 inches wide, and shall be brightly colored, bearing an imprint to the effect that a sewer pipeline lies below. Warning tape shall be installed 2 feet directly above the entire length of the pipe.

4.11.7 The Contractor shall provide pipeline location markers for all sewer pipelines installed within easements and within the Rights-of-Way, when the pipeline is located outside of the driving surface and shoulder, or as otherwise directed by the County. The markers shall be installed in accordance with the manufacturer’s recommendations 4 feet upstream of each vault and manhole location and at intervals not to exceed 350 feet. The markers shall be green in color with an identifying sticker stating “WARNING SEWER PIPELINE” attached in a vertical fashion to the upper 12 inches of the marker rail. The bottom portion of the identifying sticker shall state “Before digging in this area call: UNDERGROUND UTILITIES LOCATION CENTER AT 1-800-424-5555” printed in a horizontal fashion. The markers shall be Rhino 3-Rail #70457, or Approved Equal.

4.12 GENERAL EXPOSED PIPING INSTALLATION

4.12.1 Unless otherwise shown on the Approved Drawings, piping intended for exposed service shall be installed parallel to building lines, plum and level, and without springing or forcing.

4.12.2 All pipe flanges shall be set level, plumb, and aligned. All flanged fittings shall be true and perpendicular to the axis of the pipe. All bolt holes in flanges shall straddle the vertical centerline of pipes.

4.12.3 Flexible couplings shall be provided for all piping connected to motor-driven equipment and where otherwise shown on the Approved Drawings. The Contractor may install additional flexible couplings to facilitate piping installation, provided that he/she submits complete details describing the location, pipe supports, and hydraulic thrust protection for review and approval by the County. Unions or flexible couplings shall be installed where shown on the Approved Drawings and at all non-motor-driven equipment to facilitate removal of the equipment. At least one union shall be installed on every horizontal and vertical reach of PVC pipe.

4.12.4 Equipment drain connections, where provided, shall be valved, with the discharge pipe carried to the nearest floor drain, drain trench, or sump. Where no receptacle for drain
exists, drain valves shall be piped to within 1 inch above the floor. Drain piping and valve materials shall conform to the requirements of the system served.

4.13 SERVICE FITTINGS AND SIDE SEWERS

4.13.1 Regardless of the locations shown on the Approved Drawings, all service fittings and side sewers shall be installed at the locations directed by the County.

4.13.2 The Contractor shall provide a continuous ribbon of detectable warning tape for all side sewers. The tape shall be an inert plastic film that is highly resistant to alkalis, acids, and other destructive chemicals likely to be encountered in soils, and shall have a metalized foil core to enable detection with electronic instruments. The tape shall be a minimum of 2 inches wide, and shall be brightly colored, bearing an imprint to the effect that a sewer pipeline lies below. Warning tape shall be installed 2 feet directly above the entire length of the pipe.

4.13.3 All side sewers shall be marked with a 2-inch by 4-inch wood stake placed at the end of the side sewer adjacent to the Right-of-Way or easement line. The stake shall be painted white with an oil-based enamel base coat. The word “SEWER” and the depth to invert shall be clearly marked with black enamel paint on the upper portion of the stake.

4.14 TRENCHLESS CONSTRUCTION

4.14.1 The Contractor shall evaluate the conditions at the Project site and shall select a construction method compatible with these conditions. Trenchless construction methods shall not be used unless approved by the County.

4.14.2 The Contractor shall submit shop drawings and details of the methods to be employed to the County for review and approval. The submittal shall include a list of materials and equipment required for the Work. The County’s review of the methods of Work, or the information regarding the materials and equipment proposed for use, shall not relieve the Contractor of his/her responsibility for errors therein and shall not be regarded as an assumption of risk or liability by the County. Before commencing trenchless construction operations, the Contractor shall have all necessary materials and equipment at the Project site.

4.14.3 The Contractor shall make every attempt to probe the Project site to ensure that proper equipment is available for all materials to be encountered. The Contractor may be required to relocate the alignment, if necessary, based on materials and/or obstructions encountered.

4.14.4 All Work performed beneath existing structures, Rights-of-Way, and stream channels shall be performed in accordance with the requirements and regulations of the parties or agencies having jurisdiction over these locations. The Contractor shall contact such parties or agencies prior to starting the Work, and shall meet all requirements of the parties or agencies with regard to insurance, methods of construction, and safety precautions to be taken while performing the Work. The Contractor shall provide the County with written confirmation that all requirements of the governing jurisdiction have been satisfied.
4.14.5 Tunneling

4.14.5.1 Excavation in tunnels made beneath existing structures, across railroad Rights-of-Way, across highway Rights-of-Way, under stream channels, or other locations indicated on the Approved Drawings or as directed by the County shall be of sufficient height, length, and width to permit the installation of the pipe and/or conduits, to permit proper bracing of the tunnel section, and to permit ample room for the Work and safety of the workmen.

4.14.5.2 Design loads for highway and pavement tunnels shall be based upon continuous load carrying structures for the height of cover under HS-20 loading. Design loads for railroad tunnels shall be based on continuous load carrying structures for the height of cover under Cooper E-80 loading.

4.14.5.3 Tunnels shall be lined with full-circle metal liner plates of sufficient strength to meet loading conditions. Liner plates shall be galvanized and bituminous coated. Voids between the ground and the liner plates shall be pressure grouted with a low pressure grout as described in Section 4.15.6.

4.14.6 Jacking and Auguring

4.14.6.1 Jacking and receiving pits or trenches shall be excavated at, and shall not exceed the limits of, the locations shown on the Approved Drawings, unless otherwise approved by the County. Excavations shall be of sufficient size to accommodate the pipe and jacking or auguring machinery.

4.14.6.2 Casing pipe meeting the requirements of Section 4.15 shall be augured or jacked continuously upgrade, unless otherwise shown on the Approved Drawings or approved by the County, and shall be accurate to the line and grade shown on the Approved Drawings.

4.14.6.3 Special care shall be taken during the installation of the casing pipe to ensure that no settlement of adjacent areas occurs. Any damage resulting from such settlement caused by the Contractor’s operations shall be repaired to the satisfaction of the County. In the event that the pipe is damaged during installation and such defects cannot be corrected to the satisfaction of the County, the Contractor shall remove and replace the damaged pipe.

4.14.6.4 The sewer pipe shall be bedded and backfilled in accordance with Sections 3.7 and 3.8. The Contractor shall test the sewer pipe in accordance with Section 12 of these Specifications prior to and after the placement of backfill material.

4.15 CASING PIPE

4.15.1 Casing pipe shall be fabricated from steel conforming to the requirements of ASTM A36. Wall thickness shall be a minimum of ½ inch, or as shown on the Approved Drawings. The pipe shall be of all-welded construction and shall be watertight. Successive lengths of pipe shall be jointed with a continuous weld.

4.15.2 Casing pipe joints shall be welded by operators who have been qualified in accordance with AWWA C206. No less than 3 weeks prior to field welding operations, the Contractor shall submit to the County written welding procedures and evidence of welder
qualification as described in Sections 3.2 and 3.3 of AWWA C206. Upon completion of welding, the Contractor shall furnish the County an Affidavit of Completion as described in Section 1.5 of AWWA C206.

4.15.3 Pipe welds shall conform to AWWA C206. Weld filler material for field welds shall be low-hydrogen type, AWS A5.1, E7018 stick rod or AWS A5.2, E-71T-11 wire-feed type unless otherwise approved by the County. Metal surfaces at welded joints shall be kept dry and the Work area covered with temporary shelters to keep rain, wind, and dew away from the weld area.

4.15.4 The Contractor shall retain the services of an independent, AWS-certified welding inspector to perform all welding inspections, including welds for pipe supports as may be necessary within the casing pipe. The Contractor shall submit a copy of the inspector’s certification to the County prior to field welding. All welds shall be visually inspected in accordance with AWS B1.11 and AWS D1.1. Defective welds shall be chipped out and re-welded.

4.15.5 Once the casing pipe has been installed, the Contractor shall jack the sewer pipe through the casing on pipe supports meeting the requirements of Section 4.15.6. The sewer pipe shall have joints located within one-half the diameter of the casing pipe on each end of the casing.

4.15.6 Pipe Supports

4.15.6.1 Sewer pipe installed in a tunnel or casing pipe shall be supported throughout its entire length as shown on the Approved Drawings or identified in the Standard Plans. Skids, as shown in the Standard Plans, shall be made of thoroughly seasoned Western Red Cedar or Douglas/Hemlock Fir which has been pressure treated with an approved preservative. Skids shall be sized to the dimensions necessary to achieve the pipe grade specified on the Approved Drawings, and shall be fastened to the sewer pipe with steel bands.

4.15.6.2 Alternately, prefabricated steel pipe supports may be used. Prefabricated pipe supports shall consist of a 12-inch wide steel band bolted around the barrel of the sewer pipe and fitted with glass reinforced plastic runners. Steel bands shall be 14 gauge minimum thickness, and shall be coated with heat-fused polyvinyl chloride to a minimum thickness of 10-mils (0.010-inch). Runners shall be of sufficient size to allow for placement of sand or grout as described in Section 4.15.6 under the bell. Prefabricated steel supports shall be placed at the bell and spigot ends and at the midpoint of each section of sewer pipe. Prefabricated steel pipe supports shall be PSI Model C12G as manufactured by the Pipeline Seal and Insulator Company (Burbank, California), or Approved Equal.

4.15.6.3 Alternately, steel rails may be used to support the sewer pipe. If steel rails are used, they are to be embedded in concrete to the invert of the casing pipe, as shown on the Approved Drawings, so as to assure proper grade and alignment of the carrier pipe. The rails shall be positioned so as to allow for placement of sand or grout as described in Section 4.15.6 under the bell, and to prevent this sewer pipe from coming into contact with the casing pipe.

4.15.6.4 Whichever method of supporting the sewer pipe is used, the Contractor shall submit shop drawings to the County for approval prior to installation.
4.15.7 After the sewer pipe has been installed through the casing pipe and the grade has been verified, the annular space surrounding the sewer pipe shall be backfilled with clean, dry sand or concrete grout as specified in Section 4.15.8.

4.15.8 Grouting

4.15.8.1 Grout used to fill voids in and around casing pipes shall be produced using Type I or II Portland cement, fine aggregate (sand), and water which are properly proportioned to produce a 7-day compressive strength of 1,000 psi as determined by AASHTO T 106. The grout shall be a workable mix with a consistency suitable for the intended application. The Contractor shall submit the proposed mix design for approval by the County prior to use.

4.15.8.2 Grouting equipment shall effectively mix and agitate the grout, and force the grout into holes at the specified pressure. Grouting hoses and supply lines shall not be less than 1-½ inches nominal inside diameter. Grouting equipment shall include a flow meter and pressure gauges, and shall provide for continuous grout circulation in the system and allow accurate control of the pressure by operation of a valve on the grout return line. Grouting equipment and lines shall be maintained in good operational condition to provide uninterrupted service during grouting.

4.15.8.3 The Contractor shall provide holes in the casing pipe with connection devices for connecting grouting hoses as may be necessary to fill all voids in and around the casing pipe with grout. The grout shall be injected at a pressure not to exceed 25 psi, or one-half the overburden pressure calculated from the top of the casing pipe to the ground surface, whichever is less. The Contractor shall monitor and control the grouting pressure throughout the grouting operation in order to prevent damage to existing facilities. Grouting shall be performed continuously until completed for each location.

4.15.9 Following backfilling, the ends of the casing pipe shall be sealed. Unless otherwise approved by the County, end seals shall be flexible, waterproof, synthetic rubber seals fastened to both the casing pipe and the sewer pipe with stainless steel bands.

END OF SECTION
SECTION 5

MANHOLE, PUMP STATION, AND CLEANOUT CONSTRUCTION

5.1 GENERAL

5.1.1 This Section includes furnishing and installing all materials required to construct manholes, pump stations, and cleanouts as detailed on the Approved Drawings and as identified in the Standard Plans.

5.2 PRECAST CONCRETE MANHOLE MATERIALS

5.2.1 Precast concrete manholes shall be constructed entirely of precast concrete sections conforming to ASTM C478 and shall be of watertight construction. The minimum inside diameter for manholes shall be as described below and in the Standard Plans.

5.2.2 Steel lifting loops or hooks for precast components shall be removed to a depth of 1 inch below the surface of the concrete and the concrete shall be patched. Lift holes shall be completely filled with dry pack grout.

5.2.3 Precast concrete manhole bases with manhole invert liners as specified herein shall be used for manhole installation on sewer mains size 36-inch or less. For installation of manholes over mains larger than 36 inches, the manhole shall be constructed as shown on the Approved Drawings and as identified in the Standard Plans. Channeling shall be completed as specified herein. Manhole benches shall be sloped to drain into the channels.

5.2.4 Steps shall be installed in precast base sections, riser sections and taper sections of precast concrete manholes in accordance with Section 11.4.1 of these Specifications.

5.2.5 The exterior of all precast concrete manholes shall receive protective coatings as described in Section 10.3.10. Where indicated on the Approved Drawings, manhole interiors shall receive protective coatings as described in Section 10.3.11.

5.2.6 Precast Riser Sections

5.2.6.1 Precast riser sections shall consist of circular sections in standard nominal inside diameters of 48, 54, 60, 72, and 96 inches. Reinforcement shall be in accordance with ASTM C478. The minimum height of a riser section shall be 1 foot, and only one 1-foot high riser section will be allowed on each manhole. If used, the 1-foot high riser section shall be set in contact with the taper (cone) section when assembling the manhole.

5.2.6.2 Heights of riser and base sections shall be arranged so no pipes pass through the joining surfaces. The Kor-n-Seal ® Pipe to Manhole Connector as manufactured by NPC, Inc. shall be utilized for all pipe connections to precast riser sections at the locations shown on the Approved Drawings. The connector shall be installed in the riser wall to the correct line, grade, and size as indicated on the Approved Drawings. Connectors shall meet or exceed all material and performance requirements of ASTM C923, and shall produce a positive watertight connection.
5.2.6.3 The taper (cone) section shall be eccentric, tapering from 48 or 54 inches inside diameter to 24 inches inside diameter, and shall be between 18 and 36 inches high. Joining to the riser sections shall be similar to joining between riser sections, but the top surface shall be flat and at least 5 inches wide, radially, to receive grade rings.

5.2.6.4 Reductions from 72 or 96 inches inside diameter to 48 inches inside diameter shall be made by means of a precast, reinforced concrete flat slab reducing section as shown on the Approved Drawings and the Standard Plans. The section shall be a minimum of 8 inches thick for 72-inch manholes and 12 inches thick for 96-inch manholes, and shall conform to the outer dimensions of the section on which it will be placed. The 48-inch opening shall be located as shown on the Approved Drawings or as directed by the County. Reinforcing shall be as shown on the Approved Drawings or in accordance with the manufacturer’s requirements.

5.2.7 Precast Base Sections

5.2.7.1 Precast base sections shall conform to the requirements for precast riser sections except that a reinforced base slab shall be cast monolithically with the walls or otherwise constructed to achieve a watertight structure. Base slab thickness shall be a minimum of 6 inches.

5.2.7.2 Base slabs shall be reinforced with No. 4 steel bars on 12-inch centers, placed in the middle third of the slab thickness and extending into the wall section of the base. The walls of the base section shall be reinforced in accordance with ASTM C478. Manhole base diameters shall be sized as shown on the Approved Drawings and the Standard Plans, unless otherwise directed or approved by the County.

5.2.7.3 All precast base sections shall be provided with a fiberglass reinforced polymer (FRP) or polypropylene (PP) liner. The base liner shall be utilized for all pipe connections, unless otherwise shown on the Approved Drawings or approved by the County, and shall be complete with: (1) full-flow channels with side walls extending to the crown of the pipe; and (2) gasketed, flexible, watertight bell-type connections to suit the pipe type(s), size(s), and grade alignment(s) shown on the Approved Drawings. Installation of the liner to the precast base section shall be in accordance with the liner manufacturer’s requirements and these Specifications. Base liners shall be manufactured by Predl Systems North America Inc. (f.k.a. GU International; f.k.a. Sealcon Liner Systems, Ltd.).

5.2.7.4 Stubs shall be provided in the locations shown on the Approved Drawings. Positioning of the stubs shall accommodate the pipe size, invert elevations, and alignment of future sewer extensions as indicated on the Approved Drawings.

5.2.8 Grade rings shall be precast, reinforced concrete meeting the requirements of ASTM C478. Individual grade rings above the taper sections shall be 24 inches inside diameter, and shall be between 4 and 6 inches high. The overall height of grade ring(s) shall be a minimum of 4 inches, and shall be no greater than 12 inches (two 6-inch rings). A maximum of two grade rings are allowed on new manholes.

5.2.9 Precast concrete manholes shall have a manhole joint sealing system utilizing flexible sewage-resistant synthetic rubber gaskets conforming to the requirements of ASTM C443. Gasket joint details shall be subject to approval by the County. A pre-formed joint sealant shall also be used for all manhole section joints. This sealant shall be in rope form.
conforming to the requirements of Federal Specification SS-S-210. Pre-formed joint sealant shall be Kent Seal™ as manufactured by Hamilton Kent, Ram-Nek XT as manufactured by the Henry Company, or Approved Equal.

5.3 HIGH-DENSITY POLYETHYLENE (HDPE) MANHOLES AND PUMP STATION WET WELL MATERIALS

5.3.1 HDPE manholes and pump station wet wells shall be constructed entirely of high-density polyethylene meeting the material strength and modulus of elasticity requirements of cell classification PE 335444E for white or near-white per ASTM D3350. Rubber gaskets, where used, shall comply in all respects with the physical requirements specified in the non-pressure requirements of ASTM F477.

5.3.2 HDPE manholes and pump station wet wells shall be designed, fabricated, shipped, installed, and tested in accordance with ASTM F1759, unless otherwise stated or shown in the Approved Drawings. The manhole and pump station wet well risers shall be constructed from solid wall profile pipe. The minimum Ring Stiffness Constant (RSC) value for the pipe shall be as specified on the Approved Drawings, or 90 percent of the nominal class value when tested in accordance with Section 8.5 of ASTM F894, whichever is greater. There shall be no evidence of splitting, cracking, or breaking when the pipe is flattened to 40 percent of its original diameter in accordance with Section 8.6 of ASTM F894. Sample size for RSC and flattening tests shall be one sample per size and class of pipe. The County shall have free access to the testing and inspection areas of the manufacturer’s plant.

5.3.3 HDPE manholes shall be provided with stubs fabricated of HDPE pipe meeting the requirements of Section 4.6. Stubs shall be located as shown on the Approved Drawings, and the Contractor shall coordinate with the manhole manufacturer to ensure that the inside diameter of the stubs are sized such that the downstream pipe has an inside diameter that is equal to or greater than the upstream pipe diameter.

5.3.4 Benches for HDPE manholes shall have a 1:10 slope toward the main channel. All channels shall be full-flow with side walls extending to the crown of the pipe as shown on the Approved Drawings and on the Standard Plans.

5.3.5 Ladders shall be installed in HDPE manholes and pump station wet wells in accordance with Sections 11.4.2 and 11.4.3.

5.3.6 Complete shop drawings of each HDPE manhole and pump station wet well to be installed shall be submitted to the County for review and approval prior to fabrication.

5.3.7 All HDPE manholes and pump station wet wells shall be manufactured by Industrial Pipe Fittings, or Approved Equal.

5.4 PRECAST CONCRETE VAULT MATERIALS

5.4.1 Precast concrete valve and force main cleanout vaults shall be constructed entirely of concrete sections conforming to the requirements of ASTM C913 and ASTM C858. Portland cement used in the manufacturing of the precast sections shall conform to the requirements of ASTM C150. All vaults shall be constructed to withstand HS-20 loading.

5.4.2 All vaults shall be adequately sized to accommodate the minimum horizontal and vertical clearances shown on the Approved Drawings and on the Standard Plans. Vault
floors shall be sloped to the sump as shown on the Standard Plans, unless otherwise approved by the County.

5.4.3 The interior and exterior of all precast concrete valve and cleanout vaults shall receive protective coatings as described in Sections 10.3.10 and 10.3.11.

5.4.4 Ladders shall be installed in precast concrete valve and cleanout vaults in accordance with Section 11.4.4.

5.4.5 Vaults shall be manufactured by Hanson Pipe & Precast, Inc. (Tacoma, WA), or Approved Equal.

5.5 MANHOLE FRAMES AND COVERS

5.5.1 Manhole frames and covers shall be made from superior quality gray iron meeting the requirements of ASTM A48, Class 30B. The castings shall be free of adhering sand, scale, cracks, and hot tears or other defects as determined by visual examination. They shall be smooth and well cleaned, and continuously machined to prevent rocking and rattling. No repairing by plugging or welding of any type shall be permitted.

5.5.2 The frames shall weigh a minimum of 215 pounds and the covers shall weigh a minimum of 150 pounds. The covers shall be easily removed and shall be interchangeable.

5.5.3 Manhole frames and covers shall be as identified in the Standard Plans. The covers shall be marked “Pierce County Sewer” for public systems and “Private Sewer” for private systems. The manufacturer’s name shall be cast into, not stamped on, an exposed surface. All covers shall have the statement “Confined Space Permit Required” cast on the lid as identified in the Standard Plans.

5.5.4 A bituminous coating shall be applied to all surfaces. The finished coating shall be continuous, smooth, neither brittle when cold nor sticky when exposed to the sun, and shall strongly adhere to the casting. The County shall have the right to require inspection and approval of all castings prior to coating.

5.5.5 Watertight manhole frames and covers shall be provided on all manholes located in unpaved areas, in localized low-lying areas within the roadway surface, in roadways designated as an arterial, or as otherwise indicated on the Approved Drawings or directed by the County. Watertight manhole frames and covers shall be as identified in the Standard Plans. The recessed gasket shall be \( \frac{3}{8} \) inch by \( \frac{5}{16} \) inch neoprene, 60-durometer hardness, or Approved Equal.

5.6 TEMPORARY CLEANOUTS

5.6.1 Temporary cleanouts shall consist of a manhole frame and cover meeting the requirements of Section 5.5, cast into a Portland cement concrete base and collar as shown in the Standard Plans. The concrete base and collar shall be a Class 3000 mix meeting the requirements of Sections 6.2 and 6.3. The formwork for all temporary cleanouts shall be approved by the County prior to pouring the concrete base.
5.7 GROUT

5.7.1 This Section covers the use of prepackaged, cementitious, non-metallic, non-shrink grout to fill the annular space where ductile iron pipe and fittings penetrate precast concrete manhole and vault walls, and for the installation of grade rings and manhole frames and covers.

5.7.2 The Contractor shall submit manufacturer’s catalog cuts and recommended application procedures for review and approval by the County prior to use.

5.7.3 Grout shall be suitable for the intended purpose, and for bonding dissimilar materials (ductile iron and concrete), either vertically or horizontally, at the temperature and surface moisture of the application.

5.7.4 Surfaces to be grouted shall be prepared in accordance with the grout manufacturer’s recommendations.

5.7.5 Grout shall be proportioned, mixed, and applied in accordance with the manufacturer’s recommendations. The Contractor shall pay particular attention to the manufacturer’s safety recommendations, and temperature and surface moisture limitations.

5.7.6 Grout shall be Speed Crete ® Red Line as manufactured by The Euclid Chemical Company, or Approved Equal.

5.8 PRECAST CONCRETE MANHOLE AND TEMPORARY CLEANOUT INSTALLATION

5.8.1 Precast concrete manhole and temporary cleanout installation shall be as shown on the Approved Drawings and as identified in the Standard Plans. Precast sections with damaged joint surfaces or with cracks or damage that would permit infiltration shall not be installed.

5.8.2 Precast base sections shall be set level and perpendicular at the design elevation on a pre-leveled, 8-inch thick bed of pea gravel meeting the requirements of Section 3.7. The pea gravel shall provide full bearing for the entire base slab. Leveling the base section by wedging is not allowed.

5.8.3 Precast riser and taper (cone) sections shall be set using the specified joint sealant and gasket as described in Section 5.2.9. Priming and preparation of surfaces and installation of jointing material shall be in strict accordance with the jointing material manufacturer’s instructions. Manhole grade rings shall be set in a full bed of cement grout meeting the requirements of Section 5.7.

5.8.4 Manhole frames and covers shall meet the requirements of Section 5.5, and shall be set to the established surface grade in a full bed of cement grout meeting the requirements of Section 5.7. The manhole rim elevation shall be set flush with the existing pavement or grade in paved and improved areas. In unpaved areas, manhole rim elevations shall be set a minimum of 2 inches above grade. Concrete collars for manhole frames shall be constructed as shown on the Approved Drawings and the Standard Plans.

5.8.5 Concrete channels, where approved by the County, shall conform accurately to the sewer grade and shall provide smooth, well-rounded intersections of flow lines. Concrete benches shall be given a light broom finish, or equivalent, and shall be sloped to drain into...
the channels. Terminal manholes shall be channeled straight through to the opposite side of the manhole or in the direction and elevation of designated stubs and/or knockouts.

5.8.6 Manholes are subject to tests for water tightness as described in Section 12.4 of these Specifications. Testing shall occur prior to the application of interior protective coatings as described in Section 10.3.11, when such coatings are required.

5.9 HDPE MANHOLE AND PUMP STATION WET WELL INSTALLATION

5.9.1 HDPE manhole and pump station wet well installation shall be as shown on the Approved Drawings, as identified in the Standard Plans, and as prescribed by the manufacturer.

5.9.2 HDPE manholes and pump station wet wells shall be set level and perpendicular at the design elevation on a pre-leveled, 12-inch thick bed of pea gravel meeting the requirements of Section 3.7. The pea gravel shall provide full bearing for the entire surface of the manhole and/or pump station wet well base. Leveling the manhole and/or pump station wet well by wedging is not allowed.

5.9.3 Precast concrete manhole caps and pump station wet well top slabs shall be constructed of Class 4000 mix Portland cement concrete meeting the requirements of Sections 6.2 and 6.3. Caps and slabs shall be capable of withstanding HS-20 loading, and shall be constructed in accordance with the Approved Drawings and as identified in the Standard Plans. Manhole caps and pump station wet well top slabs shall be set on a pre-leveled base compacted to 95 percent maximum dry density as determined by ASTM D1557. A gap of 1 inch minimum to 2 inches maximum shall exist between the cap/top slab and the manhole/pump station wet well. Foam shall be placed in the gap to prevent the soil around the manhole or pump station wet well from entering into the gap.

5.9.4 A maximum of one grade ring may be installed above the precast manhole cap on new HDPE manholes. Grade rings shall meet the requirements of Section 5.2.8, and shall be set in a full bed of cement grout conforming to Section 5.7.

5.9.5 Manhole frames and covers shall meet the requirements of Section 5.5, and shall be set to the established surface grade in a full bed of cement grout meeting the requirements of Section 5.7. The manhole rim elevation shall be set flush with the existing pavement or grade in paved and improved areas. In unpaved areas, manhole rim elevations shall be set a minimum of 2 inches above grade. Concrete collars for manhole frames shall be constructed as shown on the Approved Drawings and the Standard Plans.

5.9.6 Manholes are subject to tests for water tightness as described in Section 12.4.

5.9.7 Access doors meeting the requirements of Section 11.9 shall be integrally cast into the precast concrete pump station wet well top slab as shown on the Approved Drawings and the Standard Plans.

5.9.8 Antiflotation anchors and slabs for HDPE manholes and pump station wet wells shall be constructed in accordance with the Approved Drawings and Standard Plans of Class 3000 mix Portland cement concrete meeting the requirements of Sections 6.2 and 6.3.
5.10 PRECAST CONCRETE VAULT INSTALLATION

5.10.1 Precast concrete valve and cleanout vault installation shall be as shown on the Approved Drawings and the Standard Plans, and in accordance with the vault manufacturer’s recommendations. Precast sections with damaged joint surfaces or with cracks or damage that would permit infiltration shall not be installed.

5.10.2 Precast base sections shall be set level and perpendicular at the design elevation on a pre-leveled bed of pea gravel meeting the requirements of Section 3.7. The pea gravel bedding shall be placed to a minimum depth of 4 inches and a maximum depth of 8 inches, and shall provide full bearing for the entire vault base. Leveling the vault by wedging is not allowed.

5.10.3 Precast riser sections shall be set using the specified joint sealant and gasket as described in Section 5.2.9. Priming and preparation of surfaces and installation of jointing material shall be in strict accordance with the jointing material manufacturer’s instructions. Grade rings, where used, shall conform to Section 5.2.8, and shall be set in a full bed of cement grout meeting the requirements of Section 5.7.

5.10.4 Manhole frames and covers shall meet the requirements of Section 5.5, and shall be set to the established surface grade in a full bed of cement grout conforming to Section 5.7. The vault rim elevation shall be set flush with the existing pavement or grade in paved and improved areas. In unpaved areas, vault rim elevations shall be set a minimum of 2 inches above grade. Concrete collars for manhole frames shall be constructed as shown on the Approved Drawings and the Standard Plans.

5.10.5 Where indicated on the Approved Drawings, access doors meeting the requirements of Section 11.9 shall be integrally cast into the precast concrete valve and force main cleanout vault top slab as shown on the Approved Drawings and the Standard Plans.

5.10.6 All piping shall maintain the clearances shown on the Approved Drawings and the Standard Plans, as measured from the outer wall of the piping to the vault surfaces. All valves and piping shall be installed in accordance with Section 4 of these Specifications.

5.10.7 All piping penetrations through the vault wall shall utilize Link-Seal® watertight pipe-to-concrete wall couplers as manufactured by Pipeline Seal and Insulator, Inc., or Approved Equal. The Contractor shall fill the annular space between the pipe fittings and vault wall with non-shrink grout meeting the requirements of Section 5.7.

5.10.8 Vaults are subject to tests for water tightness as described in Section 12.4 of these Specifications. Testing shall occur prior to the application of interior protective coatings.

5.11 CONNECTIONS TO EXISTING PRECAST CONCRETE MANHOLES

5.11.1 The Contractor shall excavate completely around the existing manhole to ensure against unbalanced loading on the manhole structure, and shall notify the County of any obvious damage and/or defects in the existing manhole prior to commencing with the Work. This notice shall be given sufficiently in advance of the Work so as to provide the County adequate time to inspect and verify the reported damage and/or defects. Absent any such notice, the Contractor shall repair all damage and/or defects in the existing manhole prior to Final Acceptance of the Work. The Contractor shall repair all damage to existing manholes resulting from his/her own operations.
5.11.2 The Contractor shall keep the manhole in operation at all times, and shall take necessary precautions to prevent any debris or other materials from entering the existing sanitary sewer system. The Contractor may be required to install a tight-line bypass through the existing channel. Flushing water used to clean bypass piping upon completion of the Work shall not be allowed to enter the existing sanitary sewer system, but shall be pumped from the existing manhole and disposed of in accordance with Section 2.4.

5.11.3 The Contractor shall verify the existing manhole invert elevations prior to connection. A concrete coring machine shall be utilized for connection to any existing concrete manhole; no exceptions. Laterals shall be brought into the existing manhole so that the crowns of the incoming and outgoing pipes are at the same elevation, unless otherwise shown on the Approved Drawings or approved by the County. The new channel shall be formed so as to provide smooth flow transition into the existing channel. Existing manholes with base liners as specified in Section 5.2.7.3 shall be repaired in accordance with the liner manufacturer’s instructions.

5.11.4 The Contractor shall provide a watertight seal between the pipe and the manhole using a Kor-n-Seal® pipe-to-manhole connector as manufactured by NPC, Inc., or Approved Equal. The annular space between the pipe and the interior wall of the manhole shall be filled with non-shrink grout meeting the requirements of Section 5.7. Existing interior coatings, where applicable, shall be repaired in accordance with the coating manufacturer’s instructions, unless otherwise directed by the County.

5.12 INSIDE GRAVITY DROP MANHOLES

5.12.1 Inside gravity drop manholes shall utilize the GU 370 Inside Drop Structure as manufactured by GU International (f.k.a. Sealcon Liner Systems, Ltd.). Drop structures shall be installed where shown on the Approved Drawings and as identified in the Standard Plans, and shall be constructed in accordance with the manufacturer’s specifications. All anchor bolts, straps, and appurtenances associated with the drop structure shall be Type 316 stainless steel.

5.12.2 Manholes to receive inside drop structures shall have a minimum nominal inside diameter of 48 inches. Manholes where two or more inside drop structures will be installed shall have a minimum nominal inside diameter of 54 inches, unless otherwise approved by the County. Inside drops for manholes larger than 54 inches and up to 120 inches shall utilize an adapter gasket available from the drop structure manufacturer.

5.12.3 A concrete coring machine shall be utilized for all sewer pipe penetrations through the wall of precast concrete manholes. The Contractor shall provide a watertight seal between the pipe and the manhole using a Kor-n-Seal® pipe-to-manhole connector as manufactured by NPC, Inc., or Approved Equal. The annular space between the pipe and the interior wall of the manhole shall be filled with non-shrink grout meeting the requirements of Section 5.7.

5.12.4 Penetrations through the wall of HDPE manholes shall utilize an HDPE sleeve attached to the manhole wall with a full penetration weld all around as shown on the Standard Plans. Material for sleeves shall meet the requirements of Section 4.6.1. The Contractor shall provide a watertight seal between the pipe and the sleeve using a Link-Seal® wall coupler as manufactured by Pipeline Seal and Insulator, Inc., or Approved Equal.
Seals shall be installed in accordance with the manufacturer’s instructions, and oriented so that the tightening bolts are accessible from inside the manhole.

5.12.5 Ductile iron pipe meeting the requirements of Section 4.3 shall be used for the first length of pipe out of the manhole or until reaching undisturbed soil, whichever is greater, as shown in the Standard Plans.

5.12.6 Each drop structure shall be accessible by a set of manhole steps meeting the requirements of Section 11.4.1 or 11.4.2, as applicable. The steps shall be installed in accordance with these Specifications and as shown on the Standard Plans, and shall be located within 1 foot horizontally from each drop structure and extend from within 18 inches of the manhole bench to at least 12 inches above the drop invert.

5.12.7 Existing inside drop structures constructed using ductile iron pipe shall be removed and replaced with GU inside drops as specified herein when the Project includes installation of a new drop structure within the same manhole.

END OF SECTION
SECTION 6

CONSTRUCTION OF CONCRETE STRUCTURES

6.1 GENERAL

6.1.1 This Section includes the construction of all structures (and their parts) made of Portland cement concrete, with or without reinforcement, in accordance with the Approved Drawings, the Standard Plans, and these Specifications.

6.2 MATERIALS AND MIXING

6.2.1 Materials shall conform to the following sections of the WSDOT Standard Specifications, or the relative sections of these Specifications as indicated:

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<th>Material</th>
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<tr>
<td>Portland Cement</td>
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<td>Aggregate for Portland Cement Concrete</td>
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<td>Gravel Backfill for Foundations</td>
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<td>Joint and Crack Sealing Material</td>
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<td>Epoxy-coated Reinforcing Steel</td>
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6.2.2 The class of concrete to be used shall be as noted on the Approved Drawings, the Standard Plans, and these Specifications. The numerical class of concrete defines the specified minimum compressive strength at 28 days in accordance with WSDOT FOP for AASHTO T 22. The Contractor may request, in writing, permission to use a different class of concrete with either the same or a higher compressive strength than specified. The County will evaluate the substitute concrete for acceptance based on the specified class of concrete, and will respond in writing.

6.2.3 Proportioning Materials

6.2.3.1 The total water soluble chloride ion content of the mixed concrete shall not exceed 0.06 percent by weight of cementitious material for prestressed concrete, nor 0.10 percent by weight of cementitious material for reinforced concrete. An initial evaluation may be obtained by testing individual concrete ingredients for total chloride ion content per AASHTO T 260 and totaling these to determine the total water soluble chloride ion in accordance with ASTM C1218.

6.2.3.2 Unless otherwise specified, the Contractor shall use Type I or Type II Portland cement in all concrete, as defined in Section 9-01.2(1) of the WSDOT Standard Specifications.
6.2.3.3 The use of fly ash and ground granulated blast furnace slag is optional for all classes of concrete. Fly ash, if used, shall not exceed 35 percent by weight of the total cementitious material and shall conform to Section 9-23.9 of the WSDOT Standard Specifications. Ground granulated blast furnace slag, if used, shall not exceed 25 percent by weight of the total cementitious material and shall conform to Section 9-23.10 of the WSDOT Standard Specifications. When both fly ash and ground granulated blast furnace slag are used in the concrete mix, the total weight of both materials shall be limited to 35 percent by weight of the total cementitious material.

6.2.3.4 The water/cement ratio shall be calculated on the total weight of cementitious material. The following are considered cementitious materials: Portland cement; fly ash; ground granulated blast furnace slag; and microsilica fume.

6.2.3.5 As an alternative to the use of fly ash, ground granulated blast furnace slag and cement as separate components, a blended hydraulic cement that meets the requirements of Section 9-01.2(4) of the WSDOT Standard Specifications may be used.

6.2.4 Contractor Mix Design

6.2.4.1 The Contractor shall provide a mix design in writing to the County for all classes of concrete specified on the Approved Drawings, except for those accepted based on a Certificate of Compliance. No concrete shall be placed until the County has reviewed the mix design. The required average 28-day compressive strength shall be selected per Section 5.3.2 of ACI 318. ACI 211.1 and ACI 318 shall be used to determine proportions. All concrete mix designs, except those for lean concrete and commercial concrete, shall have a minimum cementitious material content of 564 pounds per cubic yard of concrete.

6.2.4.2 The Contractor’s submittal of a mix design shall be on WSDOT Form 350-040, or some other form with similar information, and shall provide a unique identification for each mix design, the mix proportions per cubic yard, the proposed sources, the average 28-day compressive strength for which the mix is designed, the fineness modulus, and the water/cement ratio. Concrete placeability, workability, and strength shall be the responsibility of the Contractor. The Contractor shall notify the County in writing of any mix design modifications.

6.2.4.3 Fine aggregate shall conform to Section 9-03.1(2) of the WSDOT Standard Specifications, Class 1 or Class 2.

6.2.4.4 Coarse aggregate shall conform to Section 9-03 of the WSDOT Standard Specifications. An alternate combined aggregate gradation conforming to Section 9-03.1(5) of the WSDOT Standard Specifications may also be used.

6.2.4.5 Nominal maximum size for concrete aggregate is defined as the smallest standard sieve opening through which the entire amount of the aggregate is permitted to pass.

6.2.4.6 Water reducing and retarding admixtures are optional for all concrete classes. A high-range water reducer (superplasticizer) may be used in all mix designs. Microsilica fume may be used in all mix designs. The use of a high-range water reducer or microsilica fume shall be submitted as part of the Contractor’s concrete mix design.
6.2.4.7 Air content shall be a minimum of 4-½ percent and a maximum of 7-½ percent for all concrete placed above the finished ground line.

6.2.5 Commercial Concrete

6.2.5.1 Commercial concrete shall have a minimum compressive strength at 28 days of 3,000 psi in accordance with WSDOT FOP for AASHTO T 22. Commercial concrete placed above the finished ground line shall be air entrained and have an air content from 4-½ percent to 7-½ percent per WAQTC FOP for AASHTO T 152. Commercial concrete does not require plant approval, mix design, or source approvals for cement, aggregate, and other admixtures.

6.2.5.2 Where concrete Class 3000 is specified for non-structural items such as luminaire bases, pedestals, cabinet bases, sign post foundations, fence posts, sidewalks, curbs, and gutters, the Contractor may use commercial concrete. If commercial concrete is used for sidewalks and curbs, it shall have a minimum cementitious material content of 564 pounds per cubic yard of concrete, shall be air entrained, and the tolerances of Section 6-02.3(5)C of the WSDOT Standard Specifications shall apply. Commercial concrete shall not be used for structural items such as wet wells and vaults. The County may approve the use of commercial concrete for other applications not listed above.

6.2.6 Admixtures

6.2.6.1 Concrete admixtures shall be added to the concrete mix at the time of batching the concrete in accordance with the manufacturer’s written procedure and as approved by the County. A copy of the manufacturer’s written procedure shall be furnished to the County prior to the use of any admixture. Any deviations from the manufacturer’s written procedures shall be submitted to the County for approval. Admixtures shall not be added to the concrete with the modified procedures until the County has approved them in writing.

6.2.6.2 When the Contractor is proposing to use admixtures from different admixture manufacturers, they shall provide evidence to the County that the admixtures will be compatible and not adversely affect the air void system of the hardened concrete. Test results complying with ASTM C457 shall be provided as the evidence to satisfy this requirement. Admixture combinations which have been previously tested and which are in compliance with ASTM C457 shall be listed in the Qualified Products List (QPL). Proposed combinations not found in the QPL shall meet this requirement.

6.2.6.3 Accelerators shall not be used.

6.2.6.4 Air-entrained cement shall not be used to air entrain concrete.

6.2.7 All concrete, except commercial concrete, shall be batched in a pre-qualified or automatic plant as described in Section 6.2.8 of these Specifications. The County is not responsible for any delays experienced by the Contractor due to problems in getting the plant certified.
6.2.8 Qualification of Concrete Supplier

6.2.8.1 Batch Plant Pre-qualification may be obtained through one of the following methods:

1. Certification by the National Ready Mix Concrete Association (NRMCA). Information concerning NRMCA certification may be obtained from the NRMCA at 900 Spring Street, Silver Springs, MD 20910, or online at www.nrmca.org. The NRMCA certification shall be good for a 2-year period. When this method of certification is used, the following documentation shall be submitted to the County:
   a. A copy of the current NRMCA Certificate of Conformance.
   b. The concrete mix design(s) (WSDOT Form 350-040).
   c. Copies of the truck list, batch plant scale certification, admixture dispensing certification, and volumetric water batching devices (including water meters) verification.

2. Independent evaluation certified by a Professional Engineer using the NRMCA Plant Certification checklist. The Professional Engineer shall be licensed under Title 18 RCW, State of Washington, qualified in civil engineering. The independent certification using the NRMCA checklist shall be good for a 2-year period. When this method of certification is used, the following documentation shall be submitted to the County:
   a. A copy of the Professional Engineer’s stamped and sealed NRMCA Verification of Inspection and Application for Certificate page from the NRMCA checklist.
   b. The concrete mix design(s) (WSDOT Form 350-040).
   c. Copies of the truck list, batch plant scale certification, admixture dispensing certification, and volumetric water batching devices (including water meters) verification.

3. Inspection conducted by the Plant Manager, defined as the person directly responsible for the daily plant operation, using the NRMCA Plant Certification checklist. The Plant Manager certification shall be done prior to the start of a Project, and every 6 months throughout the life of the Project, and shall meet the following requirements:
   a. The Agreement to Regularly Check Scales and Volumetric Batching Dispensers page in the NRMCA Plant Certification checklist shall be signed by the Plant Manager and notarized.
   b. The signed and notarized Agreement to Regularly Check Scales and Volumetric Batching Dispensers page and a copy of the NRMCA Plant Certification checklist cover page showing the plant designation, address and Company operating the plant shall be submitted to the County with the concrete mix design (WSDOT Form 350-040), along with copies of the truck list, batch plant scale certification, admixture dispensing certification, and volumetric water batching devices (including water meters) verification.
   c. The NRMCA Plant Certification checklists shall be maintained by the Plant Manager and are subject to review at any time by the County.
   d. Volumetric water batching devices (including water meters) shall be verified every 90 days.
6.2.8.2 All concrete production facilities shall be subject to verification inspections at the discretion of the County. Verification inspections are a check for: (1) current scale certifications, (2) accuracy of water metering devices, (3) accuracy of the batching process, and (4) verification of coarse aggregate quality. If the concrete producer fails to pass the verification inspection, the following actions will be taken:

1. For the first violation, a written warning will be provided.
2. For the second violation, the County will give written notification and will assess a price reduction equal to 15 percent of the invoice cost of the concrete that is supplied from the time of the infraction until the deficient condition is corrected.
3. For the third violation, the concrete supplier will be suspended from providing concrete until all such deficiencies causing the violation have been satisfactorily corrected, and the plant and equipment have been re-inspected and meet all the prequalification requirements.
4. For the fourth violation, the concrete supplier will be disqualified from supplying concrete for 1 year from the date of disqualification. At the end of the suspension period, the concrete supplier may request that the facilities be inspected for prequalification.

6.2.9 Mixing Concrete

6.2.9.1 For central-mixed concrete, the mixer shall be equipped with a timer that prevents the batch from discharging until the batch has been mixed for the prescribed mixing time. A mixing time of 1 minute will be required after all materials and water have been introduced into the drum. Shorter mixing time may be allowed if the mixer performance is tested in accordance with AASHTO M 157 Annex A1 (Concrete Uniformity Requirements). Tests shall be conducted by an independent testing lab or by a commercial concrete producer's lab. If the tests are performed by a producer's lab, a representative of the County shall witness all testing.

6.2.9.2 For shrink-mixed concrete, the mixing time in the stationary mixer shall not be less than 30 seconds or until the ingredients have been thoroughly blended.

6.2.9.3 For transit-mixed or shrink-mixed concrete, the mixing time in the transit mixer shall be a minimum of 70 revolutions at the mixing speed designated by the manufacturer of the mixer. Following mixing, the concrete in the transit mixer may be agitated at the manufacturer's designated mixing speed for a maximum of 320 revolutions (total of mixing and agitation) prior to discharge.

6.2.9.4 All transit mixers shall be equipped with an operational revolution counter and a functional device for measurement of water added. All mixing drums shall be free of concrete buildup and the mixing blades shall meet the minimum specifications of the drum manufacturer. A copy of the manufacturer's blade dimensions and configuration shall be on file at the concrete producer's office. A clearly visible metal plate (or plates) attached to each mixer and agitator shall display: (1) the maximum concrete capacity of the drum or container for mixing and agitating, and (2) the rotation speed of the drum or blades for both the agitation and mixing speeds. Mixers and agitators shall always be operated within the capacity and speed-of-rotation limits set by the manufacturer. Any mixer, when fully loaded, shall keep the concrete uniformly mixed. All mixers and agitators shall be capable of discharging the concrete at a steady rate. Only those transit
mixers which meet the above requirements will be allowed to deliver concrete to the Project.

6.2.9.5 In transit-mixing, mixing shall begin within 30 seconds after the cement is added to the aggregates.

6.2.9.6 Central-mixed concrete, transported by truck mixer/agitator, shall not undergo more than 250 revolutions of the drum or blades before beginning discharging. To remain below this limit, the supplier may agitate the concrete intermittently within the prescribed time limit. When water or admixtures are added after the load is initially mixed, an additional 30 revolutions will be required at the recommended mixing speed, but in no case shall the total number of revolutions exceed the maximum limit prescribed above.

6.2.9.7 For small quantities of concrete, the Contractor may mix concrete on the jobsite provided the Contractor has requested in writing and received written permission from the County. The Contractor’s written request shall include a mix design, batching and mixing procedures, and a list of the equipment performing the jobsite mixing. All jobsite-mixed concrete shall be mixed in a mechanical mixer.

6.2.9.8 If the County permits, hand mixing of concrete will be permitted for pipe collars, fence posts, or other items approved by the County, provided the hand mixing is done on a watertight platform in a way that distributes materials evenly throughout the mass. Mixing shall continue long enough to produce a uniform mixture. No hand-mixed batch shall exceed ½ cubic yard.

6.2.9.9 Concrete mixed at the jobsite is never permitted for placement in water.

6.2.10 Consistency

6.2.10.1 The maximum slump for concrete shall be:

1. 3-½ inches for vibrated concrete placed in all slabs,
2. 4-½ inches for all other vibrated concrete, or
3. 5-½ inches for all concrete placed in curbs and sidewalks.

6.2.10.2 When a high-range water reducer is used, the maximum slumps listed above may be increased an additional 2 inches.

6.2.11 Temperature and Time for Placement

6.2.11.1 Concrete temperatures shall remain between 55º F and 90º F while it is being placed. Precast concrete that is heat cured per Section 6-02.3(25)D of the WSDOT Standard Specifications shall remain between 50º F and 90º F while being placed.

6.2.11.2 The batch of concrete shall be discharged at the Project site no more than 1-½ hours after the cement is added to the concrete mixture. The time to discharge may be extended to 1-¾ hours if the temperature of the concrete being placed is less than 75º F. With the approval of the County, and as long as the temperature of the concrete being placed is below 75º F, the maximum time to discharge may be extended to 2 hours.
6.2.11.3 When conditions are such that the concrete may experience an accelerated initial set, the County may require a shorter time to discharge. The time to discharge may be extended upon written request from the Contractor. This time extension will be considered on a case-by-case basis and requires the use of specific retardation admixtures and the approval of the County.

6.3 ACCEPTANCE OF CONCRETE

6.3.1 General

6.3.1.1 Commercial concrete will be accepted based on a Certificate of Compliance to be provided by the supplier, as described in Section 6.3.2 of these Specifications.

6.3.1.2 For all other concrete, the Contractor shall retain the services of an independent, third-party testing laboratory approved by the County to perform all testing of concrete as prescribed herein, and shall be responsible for all costs associated with acceptance sampling and testing. The concrete will be accepted based on conformance to the requirement for temperature, slump, air content for concrete placed above finished ground line, and the specified compressive strength at 28 days for sublots as tested and determined by the independent testing laboratory, unless otherwise directed by the County.

6.3.1.3 A “sublot” is defined as the material represented by an individual strength test. An individual strength test is the average compressive strength of cylinders from the same sample of material.

6.3.1.4 Each sublot will be deemed to have met the specified compressive strength requirement when both of the following conditions are met:

1. Individual strength tests do not fall below the specified strength by more than 12-\(\frac{1}{2}\) percent or 500 psi, whichever is least.
2. An individual strength test averaged with the two preceding individual strength tests meets or exceeds the specified strength (for the same class and exact Mix I.D. of concrete on the same Project).

6.3.1.5 When compressive strengths fail to satisfy one or both of the above requirements, the Contractor may:

1. Request acceptance based on the supplier’s strength test data for cylinders made from the same truckload of concrete as tested by the Contractor’s independent testing laboratory, provided:
   a. The supplier’s test results are obtained from testing cylinders fabricated, handled, and stored for 28 days in accordance with AASHTO T 22. The test cylinders shall be the same size cylinders as those cast by the Contractor’s independent testing laboratory.
   b. The technician fabricating the cylinders is qualified by either ACI, Grade 1, or WAQTC to perform this Work.
   c. The supplier performing the tests per AASHTO T 22 has an evaluation process per AASHTO R 18.
   d. Both the Contractor’s independent testing laboratory and the supplier have at least fifteen test results from the same mix to compare. The supplier’s results could be used if the computed average of all their test results is within 1
standard deviation of the independent testing laboratory’s average test result. The computed standard deviation of the supplier’s results must also be within plus or minus 200 psi of the independent testing laboratory’s standard deviation.

2. Request acceptance of in-place concrete strength based on core results. This method will not be used if the County determines coring would be harmful to the integrity of the structure. Cores, if allowed, shall be obtained by the tester in accordance with AASHTO T 24 and tested in accordance with AASHTO T 22. If the concrete in the structure will be dry under service conditions, the core shall be air-dried at a temperature between 60º F and 80º F and at a relative humidity of less than 60 percent for 7 days before testing, and shall be tested air-dry.

6.3.1.6 Acceptance for each sublot by the core method requires that the average compressive strength of three cores be at least 85 percent of the specified strength with no single core less than 75 percent of the specified strength. When the Contractor requests strength analysis by coring, the results obtained will be accepted by both parties as conclusive and supersede all other strength data for the concrete sublot.

6.3.1.7 If the Contractor elects to core, cores shall be obtained no later than 50 days after initial concrete placement. The County will concur in the locations to be cored. Repair of cored areas shall be the responsibility of the Contractor. The cost incurred in coring and testing these cores, including repair of core locations, shall be borne by the Contractor.

6.3.2 Certification of Compliance

6.3.2.1 The concrete producer shall provide a Certificate of Compliance for each truckload of concrete delivered to the jobsite. The Certificate of Compliance will be used by the County to verify that the concrete is in compliance with the approved mix design and shall include:

1. Manufacturer plant (batching facility)
2. County Permit number (SWLE #)
3. Date
4. Time batched
5. Truck No.
6. Initial revolution counter reading
7. Quantity (quantity batched this load)
8. Type of concrete by class and producer design mix number
9. Cement producer, type, and Mill Certification No. (The mill test number as required by Section 9-01.3 of the WSDOT Standard Specifications shall be the basis for acceptance of cement)
10. Fly ash (if used) brand and type
11. Approved aggregate gradation designation
12. Mix design weight per cubic yard and actual batched weights for:
   a. Cement
   b. Fly ash (if used)
   c. Coarse concrete aggregate and moisture content (each size)
   d. Fine concrete aggregate and moisture content
   e. Water (including free moisture in aggregates)
   f. Admixtures brand and total quantity batched
i. Air-entraining admixture
ii. Water-reducing admixture
iii. Other admixture(s)

6.3.2.2 For concretes that use combined aggregate gradation, the Certificate of Compliance shall include the aggregate components and moisture contents for each size in lieu of the aggregate information described above.

6.3.2.3 The Certificate of Compliance shall be signed by a responsible representative of the concrete producer affirming the accuracy of the information provided.

6.3.2.4 For commercial concrete, the Certificate of Compliance shall include, as a minimum, the batching facility, date, and quantity batched per load.

6.3.3 Conformance to Mix Design

6.3.3.1 Cement, coarse and fine aggregate weights shall be within the following tolerances of the mix design:

| Batch Volumes less than or equal to 4 cubic yards |
|-----------------|-----------------|-----------------|
| Cement          | +5%             | -1%             |
| Aggregate       | +10%            | -2%             |

| Batch Volumes more than 4 cubic yards |
|-----------------|-----------------|-----------------|
| Cement          | +5%             | -1%             |
| Aggregate       | +2%             | -2%             |

6.3.3.1 If the total cementitious material weight is made up of different components, these component weights shall be within the following tolerances:

1. Portland cement weight plus 5 percent or minus 1 percent of that specified in the mix design.
2. Fly ash and ground granulated blast furnace slag weight plus or minus 5 percent of that specified in the mix design.
3. Microsilica weight plus or minus 10 percent of that specified in the mix design.

6.3.3.2 Water shall not exceed the maximum water specified in the mix design.

6.3.4 Concrete Testing

6.3.4.1 All concrete used for structural applications, or when otherwise required by the County, shall be tested for acceptance in accordance with the WSDOT Materials Manual. All costs in connection with concrete testing shall be included in the unit Contract prices for the various Bid items of Work involved.

6.3.4.2 The Contractor shall retain the services of an independent, third-party testing laboratory approved by the County to perform all concrete testing as specified herein. The testing laboratory’s equipment shall be calibrated within 1 year prior to testing and testers shall be either ACI certified or qualified in accordance with AASHTO R 18. The Contractor shall notify the Inspector of the time, date, and location of all testing to be performed so that a representative of the County may be present during testing. The
Contractor shall furnish the Inspector with all test results, proof of equipment calibration, and tester's certification within 7 calendar days of the tests being performed.

6.3.4.3 The test methods to be used with these Specifications are:

- WSDOT FOP for AASHTO T 22 Compressive Strength of Cylindrical Concrete Specimens
- WSDOT FOP for AASHTO T 23 Making and Curing Concrete Test Specimens in the Field
- WSDOT FOP for AASHTO T 119 Slump of Hydraulic Cement Concrete
- WSDOT FOP for WAQTC TM 2 Sampling of Freshly Mixed Concrete
- WSDOT FOP for WAQTC/ AASHTO T 152 Air Content of Freshly Mixed Concrete by the Pressure Method
- WSDOT FOP for AASHTO T 231 Capping Cylindrical Concrete Specimens
- WSDOT FOP for AASHTO T 309 Temperature of Freshly Mixed Portland Cement Concrete

6.3.4.4 Point of Acceptance

6.3.4.4.1 Determination of concrete properties for acceptance shall be made based on samples taken at the discharge of the placement system or the truck discharge, as applicable.

6.3.4.4.2 It shall be the Contractor's responsibility to provide adequate and representative samples of the fresh concrete to his/her independent testing laboratory for the testing of concrete properties and making of cylinder specimens. Once the Contractor has turned over the concrete for acceptance testing, no more mix adjustment will be allowed. The concrete will either be accepted or rejected.

6.3.4.5 Water/Cement Ratio Conformance

6.3.4.5.1 The actual water/cement ratio shall be determined from the certified proportions of the mix, adjusting for in-transit and jobsite additions. No water may be added after acceptance testing or after placement has begun.

6.3.4.6 Sampling and Testing Frequency for Temperature, Consistency, and Air Content

6.3.4.6.1 Concrete properties shall be determined from concrete as delivered to the Project and as accepted by the Contractor for placement. The Contractor's independent testing laboratory shall test for acceptance of concrete for slump, temperature, and air content, if applicable.

6.3.4.6.2 Sampling and testing shall be performed before concrete placement from the first truck load. Concrete shall not be placed until tests for slump, temperature, and entrained air (if applicable) have been completed by the Contractor’s independent testing laboratory, and the results indicate that the concrete is within acceptable limits. Except for the first load of concrete, up to ½ cubic yard may be placed prior to testing for acceptance. Sampling and testing shall continue for each load until two successive loads meet all applicable acceptance test requirements,
after which the sampling and testing frequency may decrease to one test for every five truck loads. Loads to be sampled shall then be selected in accordance with the random selection process as outlined in WAQTC FOP for TM 2.

6.3.4.6.3 When the results for any subsequent acceptance test indicates that the concrete as delivered and approved by the Contractor for placement does not conform to the specified limits, the sampling and testing frequency will be resumed for each truck load. Whenever two successive subsequent tests indicate that the concrete is within the specified limits, the random sampling and testing frequency of one test for every five truck loads may resume.

6.3.4.6.4 Sampling and testing for placement of one class of concrete consisting of 50 cubic yards or less shall be as described above, except that: (1) sampling and testing will continue until one load meets all of the applicable acceptance requirements, and (2) after one set of tests indicate that the concrete is within the specified limits, the remaining concrete to be placed may be accepted by visual inspection.

6.3.4.7 Sampling and Testing for Compressive Strength and Initial Curing

6.3.4.7.1 Acceptance testing for compressive strength shall be conducted at the same frequency as the acceptance tests for temperature, consistency, and air content.

6.3.4.7.2 The Contractor shall provide and maintain cure boxes for curing concrete cylinders. The Contractor shall also provide, maintain, and operate all necessary power sources and connections needed to operate the curing box. Concrete cylinders shall be molded and cured in a cure box in accordance with WSDOT FOP for AASHTO T 23. The cure boxes shall maintain a temperature between 60º F and 80º F for concrete with specified strengths less than 6,000 psi and between 68º F and 78º F for concrete with specified strengths of 6,000 psi and higher. A minimum/maximum thermometer shall be installed to measure the internal temperature of the cure box. The thermometer shall be readable from outside of the box and be capable of recording the high and low temperatures during a 24-hour period. The cure boxes shall create an environment that prevents moisture loss from the concrete specimens. The top shall have a working lock and the interior shall be rustproof. A moisture-proof seal shall be provided between the lid and the box. The cure box shall be the appropriate size to accommodate the number of concrete acceptance cylinders necessary or the Contractor shall provide additional cure boxes. Once concrete cylinders are placed in the cure box, the cure box shall not be moved until the cylinders have been cured in accordance with these Specifications. When concrete is placed at more than one location simultaneously, multiple cure boxes shall be provided.

6.3.4.7.3 The Contractor shall protect concrete cylinders in cure boxes from excessive vibration and shock waves during the curing period in accordance with Section 6.8.3 of these Specifications.

6.3.4.7.4 At the end of the curing period, the concrete cylinders shall be tested for compressive strength in accordance with AASHTO T 22.
6.3.4.8 Early Concrete Test Cylinder Breaks

6.3.4.8.1 The fabrication, curing, and testing of early cylinders shall be the responsibility of the Contractor. Early cylinders are defined as all cylinders tested in advance of the design age of 28 days whose purpose is to determine the in-place strength of concrete in a structure prior to applying loads or stresses. The Contractor’s independent testing laboratory shall perform early test cylinder breaks.

6.3.4.8.2 The concrete cylinders shall be molded in accordance with WSDOT FOP for AASHTO T 23 from concrete last placed in the forms and representative of the quality of concrete placed in that pour.

6.3.4.8.3 The cylinders shall be cured in cure boxes in accordance with WSDOT FOP for AASHTO T 23 and as described in Section 6.3.4.7.2 of these Specifications.

6.3.4.8.4 At the end of the curing period, the concrete cylinders shall be tested for compressive strength in accordance with AASHTO T 22. The number of early cylinder breaks shall be in accordance with the Contractor’s need and as approved by the County.

6.3.4.8.5 The Contractor shall furnish the County with all test results, proof of equipment calibration and tester’s certification. The test results will be reviewed and approved before any forms are removed. The Contractor shall not remove forms without the approval of the County.

6.3.5 Rejecting Concrete

6.3.5.1 Rejection Without Testing – The County, prior to sampling, may reject any batch or load of concrete that appears defective in composition; such as cement content or aggregate proportions. Rejected material shall not be incorporated in the Work.

6.3.6 Concrete with Non-Conforming Strength

6.3.6.1 Concrete with cylinder compressive strengths (fc) that fail to meet acceptance level requirements will be evaluated by the County for structural adequacy. If the material is found to be inadequate, the concrete represented by the sample shall be removed and disposed of in accordance with Section 2.4 of these Specifications, and replaced by the Contractor.

6.3.6.2 Concrete that fails to meet minimum acceptance levels using the coring method will be evaluated by the County for structural adequacy. If the material is found to be inadequate, the concrete represented by the sample shall be removed and disposed of in accordance with Section 2.4 of these Specifications, and replaced by the Contractor.

6.4 PLACING CONCRETE

6.4.1 The Contractor shall not place concrete:

1. On frozen or ice-coated ground or subgrade;
2. Against or on ice-coated forms, reinforcing steel, structural steel, conduits, precast members or construction joints;
3. Under rainy conditions (placing of concrete shall be stopped before the quantity of surface water is sufficient to affect or damage surface mortar quality, cause a flow or wash the concrete surface);
4. In any foundation until the County has approved its depth and character;
5. In any form until the County has approved it and the placement of any reinforcing in it; or
6. In any area when vibrations from nearby Work may harm the concrete’s initial set or strength.

6.4.2 When a foundation excavation contains water, the Contractor shall pump it dry, as specified in Section 3.2 of these Specifications, before placing concrete. If this is not possible, an underwater concrete seal shall be placed that complies with Section 6.4.11 of these Specifications. This seal shall be thick enough to resist any uplift.

6.4.3 All foundations and forms shall be moistened with water just before the concrete is placed. Any standing water on the foundation or in the form shall be removed.

6.4.4 The Contractor shall place concrete in the forms as soon as possible after mixing. The concrete shall always be plastic and workable. For this reason, the County may reduce the time to discharge even further. Concrete placement shall be continuous, with no interruption longer than 30 minutes between adjoining layers, unless otherwise approved by the County. Each layer shall be placed and consolidated before the preceding layer takes initial set. After initial set, the forms shall not be jarred, and projecting ends of reinforcing bars shall not be disturbed.

6.4.5 In walls, concrete shall be placed in continuous, horizontal layers between 1½ feet and 2½ feet deep. Compaction shall leave no line of separation between layers. In each part of a form, the concrete shall be deposited as near to its final position as possible.

6.4.6 Any method for placing and consolidating shall not segregate aggregates or displace reinforcing steel. Any method shall leave a compact, dense and impervious concrete with smooth faces on all exposed surfaces. Plastering is not permitted. Any section of defective concrete shall be removed at the Contractor’s expense.

6.4.7 To prevent aggregates from separating, the length of any conveyor belt used to transport concrete shall not exceed 300 feet. If the mix needs protection from sun or rain, the Contractor shall cover the belt. When concrete pumps are used for placement, a Contractor’s representative shall, prior to use on the first placement of each day, visually inspect the pumps water chamber for water leakage. No pump shall be used that allows free water to flow past the piston.

6.4.8 If a concrete pump is used as the placing system, the pump priming slurry shall be discarded before placement. Initial acceptance testing may be delayed until the pump priming slurry has been eliminated from the concrete being pumped. Eliminating the priming slurry from the concrete may require that several cubic yards of concrete are discharged through the pumping system and discarded. Use of a concrete pump requires a reserve pump (or other backup equipment) at the site.

6.4.9 If the concrete will drop more than 5 feet, it shall be deposited through a sheet metal (or other approved) conduit. If the form slopes, the concrete shall be lowered through approved conduit to keep it from sliding down one side of the form. No aluminum conduits or tremies shall be used to pump or place concrete.
6.4.10 Concrete shall be placed in a continuous operation between expansion or construction joints in slabs and in walls.

6.4.11 Placing Concrete in Foundation Seals

6.4.11.1 If the Approved Drawings require a concrete seal, the Contractor shall place the concrete underwater inside a watertight cofferdam, tube, or caisson.

6.4.11.2 Seal concrete shall be placed in a compact mass in still water. It shall remain undisturbed and in still water until fully set. While seal concrete is being deposited, the water elevation inside and outside the cofferdam shall remain equal to prevent any flow through the seal in either direction. The cofferdam shall be vented at the vent elevation shown in the Approved Drawings. The thickness of the seal is based upon this vent elevation.

6.4.11.3 The seal shall be at least 18 inches thick, unless the Approved Drawings specify otherwise. The County may change the seal thickness during construction, which may require redesign of the structure.

6.4.11.4 To place seal concrete underwater, the Contractor shall use a concrete pump or tremie. The tremie shall have a hopper at the top that empties into a watertight tube at least 10 inches in diameter. The discharge end of the tube is first filled with concrete. Tube supports shall permit the discharge end to move freely across the entire Work area and to drop rapidly to slow or stop the flow. One tremie may be used to concrete an area up to 18 feet per side. Each additional area of this size requires an additional tremie.

6.4.11.5 Throughout the underwater concrete placement operation, the discharge end of the tube shall remain submerged in the concrete and the tube shall always contain enough concrete to prevent water from entering. The concrete placement shall be continuous until the Work is completed, resulting in a seamless, uniform seal. If the concreting operation is interrupted, the County may require the Contractor to prove by core drilling, or other tests, that the seal contains no voids or horizontal joints. If testing reveals voids or horizontal joints, the Contractor shall repair them or replace the seal at no expense to the County.

6.4.11.6 Concrete Class 4000 shall be used for seals. The maximum slump for non-vibrated concrete shall be 7 inches. When a high-range water reducer is used, the maximum slump may be increased an additional 2 inches.

6.4.12 Dewatering Concrete Seals and Foundations

6.4.12.1 After a concrete seal is constructed, the Contractor shall pump the water out of the cofferdam and place the rest of the concrete in the dry. This pumping shall not begin until the seal has set enough to withstand the hydrostatic pressure (3 days for gravity seals and 10 days for seals containing piling or shafts). The County may extend these waiting periods to ensure structural safety or to meet a condition of the operating permit.

6.4.12.2 If weighted cribs are used to resist hydrostatic pressure at the bottom of the seal, the Contractor shall anchor them to the foundation seal. Any method used (such as dowels or keys) shall transfer the entire weight of the crib to the seal.
6.4.12.3 No pumping shall be done during the 24 hours after concrete placement unless done from a suitable sump separated from the concrete Work by a watertight wall. Pumping shall be done in a way that eliminates any chance of concrete being carried away.

6.4.13 Vibration of Concrete

6.4.13.1 The Contractor shall supply enough vibrators as may be required to consolidate the concrete (except that placed underwater) according to the requirements of this Section. Each vibrator must:

1. Be designed to operate while submerged in the concrete;
2. Vibrate at a rate of at least 7,000 pulses per minute; and
3. Receive the County’s approval of the type and method of use.

6.4.13.2 Immediately after concrete is placed, vibration shall be applied in the fresh batch at the point of deposit. In doing so, the Contractor shall:

1. Space the vibrators evenly, no farther apart than twice the radius of the visible effects of the vibration;
2. Ensure that vibration intensity is great enough to visibly affect a weight of 1 inch slump of concrete across a radius of at least 18 inches;
3. Insert the vibrators slowly to a depth that will effectively vibrate the full depth of each layer, penetrating into the previous layer on multilayer pours;
4. Protect partially hardened concrete (i.e. non-plastic, which prevents vibrator penetration when only its own weight is applied) by preventing the vibrator from penetrating it or making direct contact with steel that extends into it;
5. Not allow vibration to continue long enough to form pools of grout;
6. Withdraw the vibrators slowly when the process is complete; and
7. Not use vibrators to move concrete from one point to another within the forms.

6.4.13.3 When vibrating and finishing top surfaces that will be exposed to weather or wear, the Contractor shall not draw water or laitance to the surface. In high lifts, the top layer shall be shallow and made up of a concrete mix as stiff as can be effectively vibrated and finished.

6.4.13.4 The Contractor shall hand tamp the outside surfaces of concrete to produce a smooth, dense finish.

6.5 CONSTRUCTION AND EXPANSION JOINTS

6.5.1 Construction Joints

6.5.1.1 Construction joints shall be placed at the locations shown, and be of the type specified on the Approved Drawings, unless otherwise approved by the County.

6.5.1.2 If the County approves, the Contractor may add, delete, or relocate construction joints. Any request for such changes shall be in writing, accompanied by a drawing that depicts them. The Contractor will bear any added costs resulting from such changes.
6.5.1.3 All construction joints shall be formed neatly with grade strips or other approved methods. The County will not accept irregular or wavy pour lines. Wire mesh forming material shall not be used. All joints shall be horizontal, vertical, or perpendicular to the main reinforcement. The Contractor shall not use an edger on any construction joint, and shall remove any lip or edging before making the adjacent pour.

6.5.1.4 If the Approved Drawings require a roughened surface on the joint, the Contractor shall strike it off to leave grooves at right angles to the length of the member. The grooves shall be between ½ inch and 1 inch wide, and between ¼ inch and ½ inch deep, and shall be spaced equally at twice the width of the groove. If the first strike-off does not produce the required roughness, the Contractor shall repeat the process before the concrete reaches initial set. The final surface shall be clean and without laitance or loose material.

6.5.1.5 If the Approved Drawings do not require a roughened surface, the Contractor shall include shear keys at all construction joints. These keys shall provide a positive, mechanical bond. Shear keys shall be formed depressions and the forms shall not be removed until the concrete has been in place at least 12 hours. Forms shall be slightly beveled to ensure ready removal. Raised shear keys are not allowed.

6.5.1.6 Unless the Approved Drawings show otherwise, shear keys shall equal approximately ⅓ of the joint area and shall be approximately 1-½ inches deep.

6.5.1.7 Before placing new concrete against cured concrete, the Contractor shall thoroughly clean and roughen the cured face and wet it with water. Before placing the reinforcing mat for footings on seals, the Contractor shall: (1) remove all scum, laitance and loose gravel, and sediment; (2) clean the construction joint at the top of the seals; and (3) chip off any high spots on the seals that would prevent the footing steel from being placed in the position required by the Approved Drawings.

6.5.2 Expansion Joints

6.5.2.1 This section outlines the requirements of specific expansion joints as shown on the Approved Drawings. The Approved Drawings may require other types of joints, seals, or materials than those described herein.

6.5.2.2 Joints made of vulcanized, elastomeric compound (with neoprene as the only polymer) shall be installed with an approved lubricant adhesive as recommended by the manufacturer. The length of the seal shall match that required in the Approved Drawings without splicing or stretching.

6.5.2.3 Open joints shall be formed with a template made of wood, metal, or other suitable material. Insertion and removal of the template shall be done without chipping or breaking the edges, or otherwise damaging the concrete.

6.5.2.4 Any part of an expansion joint running parallel to the direction of expansion shall provide a clearance of at least ½ inch (produced by inserting and removing a spacer strip) between the two surfaces. The Contractor shall ensure that the surfaces are precisely parallel to prevent any wedging from expansion and contraction.

6.5.2.5 All poured rubber joint sealer (and any required primer) shall conform with Section 9-04.2(2) of the WSDOT Standard Specifications.
6.6 FINISHING CONCRETE SURFACES

6.6.1 All concrete shall show a smooth, dense, uniform surface after the forms are removed. If it is porous, the Contractor shall bear the cost of repairing it. The Contractor shall clean and refinish any stained or discolored surfaces that may have resulted from their Work or from construction delays.

6.6.2 The Contractor shall tool to a \( \frac{3}{8} \)-inch radius all exposed edges of slabs, machine bases, and tops of walls that do not have cast-in-place chamfers. Tooling shall be repeated with each floating or troweling operation.

6.6.3 Control joints shall be cut 1 inch deep in all paving slabs where indicated on the Approved Drawings, but not more than 12 feet apart in each direction. The Contractor shall use a tool that cuts a narrow, 1 inch deep groove (such as Goldblatt No. 06215 M7). Tooling shall be repeated with each floating or troweling operation.

6.6.4 The Contractor shall run decorative feature grooves with a shallow tool before the final troweling.

6.6.5 Class 1 Surface Finish

6.6.5.1 The Contractor shall apply a Class 1 finish to all surfaces of concrete members to the limits designated on the Approved Drawings.

6.6.5.2 To create a Class 1 surface, the Contractor shall:

1. Remove all bolts, and all lips and edgings, where form members have met;
2. Fill all holes greater than \( \frac{1}{4} \) inch with 1:2 mortar floated to an even, uniform finish;
3. Thoroughly wash the surface of the concrete with water;
4. Brush on a 1:1 mortar, working it well into the small air holes and other crevices in the face of the concrete;
5. Brush on no more mortar than can be finished in 1 day;
6. Rub the mortar off with burlap or a piece of carpet as soon as it takes initial set (before it reaches final set);
7. Fog-spray water over the finish as soon as the mortar paint has reached final set; and
8. Keep the surface damp for at least 2 days.

6.6.5.3 If the mortar becomes too hard to rub off as described in Step 6 above, the Contractor shall remove it with a Carborundum stone and water. Random grinding is not permitted.

6.6.5.4 When steel forms have been used, and when the surface of filled holes matches the texture and color of the area around them, the Contractor may omit Steps 3 through 8.

6.6.6 Class 2 Surface Finish

6.6.6.1 The Contractor shall apply a Class 2 finish to all below-ground, formed surfaces not exposed to view, unless otherwise indicated on the Approved Drawings.
6.6.6.2 To produce a Class 2 finish, the Contractor shall remove all bolts and all lips and edgings where form members have met, and shall fill all form tie holes.

6.6.7 Surfaces covered with fill do not require a surface finish.

6.7 CURING CONCRETE

6.7.1 After placement, concrete surfaces shall be cured as follows:

1. Slabs – Two coats curing compound covered by white, reflective-type sheeting, or continuous wet curing. Curing by either method shall be for at least 10 days.
2. All other concrete surfaces – Continuous moisture for at least 3 days. When continuous moisture or wet curing is required, the Contractor shall keep the concrete surfaces wet with water during curing.

6.7.2 The Contractor may provide continuous moisture by watering a covering of heavy quilted blankets, by keeping concrete surfaces wet with water continuously and covering with white reflective-type sheeting, or by wetting the outside surfaces of wood forms. Runoff water shall be collected and disposed of in accordance with all applicable regulations. In no case shall runoff water be allowed to enter any lakes, streams, or other surface waters.

6.7.3 When curing slabs, two coats of white pigmented curing compound (Type 2) that complies with Section 9-23.2 of the WSDOT Standard Specifications shall be applied immediately (not to exceed 15 minutes) after finishing. Application of the second coat shall run at right angles to that of the first. The two coats shall total at least 1 gallon per 150 square feet and shall obscure the original color of the concrete. The Contractor shall agitate the curing compound thoroughly just before and during application. If any curing compound spills on construction joints or reinforcing steel, the Contractor shall clean it off before the next concrete placement. If other materials are to be bonded to the surface, the Contractor shall remove the curing compound by sandblasting or acceptable high-pressure water washing.

6.7.4 For continuous wet curing, the surface shall be covered with presoaked, heavy-quilted blankets or burlap as soon as the concrete has set enough to allow covering without damaging the finish. Soaker hoses are required and shall be placed on top of the blankets or burlap, and shall be charged with water frequently to keep the entire slab covering wet throughout the course of curing.

6.7.5 The Contractor shall have on the site, back-up spray equipment, enough workers and a bridge from which they will apply the curing compound. The County may require the Contractor to demonstrate (at least 1 day before the scheduled concrete placement) that the crew and equipment can apply the compound in an acceptable manner.

6.7.6 White, reflective-type sheeting shall be kept in place by taping or weighting the edges where they overlap.
6.8 PROTECTION OF CONCRETE DURING AND AFTER PLACEMENT

6.8.1 Hot Weather Protection

6.8.1.1 The Contractor shall provide concrete within the specified temperature limits by:

1. Shading or cooling aggregate piles. If sprinkling of the coarse aggregates is to be used, the piles moisture content shall be monitored and the mixing water adjusted for the free water in the aggregate. In addition, when removing the coarse aggregate, it shall be removed from at least 1 foot above the bottom of the pile. Sprinkling of fine aggregate piles is not allowed.
2. Refrigerating mixing water; or replacing all or part of the mixing water with crushed ice, provided the ice is completely melted prior to placing.

6.8.1.2 If the concrete would probably exceed 90º F, the County may require approved temperature-reduction measures be taken before concrete placement begins.

6.8.1.3 If the air temperature exceeds 90º F, the Contractor shall use water spray or other approved methods to cool all concrete-contact surfaces to less than 90º F. These surfaces include forms, reinforcing steel, steel beam flanges and any others that touch the mix. The Contractor shall reduce the time between mixing and placing to a minimum and shall not permit mixer trucks to remain in the sun while waiting to discharge concrete. Chutes, conveyors and pump lines shall be shaded.

6.8.1.4 If slabs are placed while the air temperature exceeds 90º F, the Contractor shall:

1. Cover the top layer of reinforcing steel with clean, wet burlap immediately before concrete placement;
2. Sprinkle cool water on the forms and reinforcing steel just before concrete placement, if required by the County;
3. Finish the concrete slab without delay; and
4. Provide at the site water-fogging equipment to be used, if needed, after finishing to prevent plastic cracks.

6.8.1.5 If the evaporation rate at the concreting site is 0.10 pounds per square foot of surface per hour or more (determined from Table 6-02.3(6) of the WSDOT Standard Specifications), the Contractor shall surround the fresh concrete with an enclosure. This enclosure shall protect the concrete from wind blowing across its surface until the curing compound is applied. If casting deck concrete that is 80º F or hotter, the Contractor shall install approved equipment at the site to show relative humidity and wind velocity.

6.8.2 Cold Weather Protection

6.8.2.1 This Specification applies when the weather forecast predicts air temperatures below 35º F at any time during the 7 days following concrete placement. The weather forecast is based on predictions from the Western Region Headquarters of the National Weather Service. This forecast can be found at http://www.wrh.noaa.gov/.
Surface Evaporation from Concrete
WSDOT Table 6-02.3(6)
6.8.2.2 To achieve adequate curing, the temperature of the concrete shall be maintained above 50º F during the entire curing period, or 7 days, whichever is greater. The concrete temperature shall not be allowed to fall below 35º F during this time. Prior to placing concrete in cold weather, the Contractor shall provide a written procedure for cold weather concreting to the County. The procedure shall detail how the Contractor will adequately cure the concrete and prevent the concrete temperature from falling below 35º F. Extra protection shall be provided for areas especially vulnerable to freezing; such as exposed top surfaces, corners and edges, thin sections, and concrete placed into steel forms. Concrete placement will only be allowed if the Contractor’s cold weather protection plan has been approved by the County.

6.8.2.3 The Contractor shall neither mix nor place concrete while the air temperature is below 35º F, unless the water or aggregates (or both) are heated to at least 70º F. The aggregate shall not exceed 150º F. If the water is heated to more than 150º F, it shall be mixed with aggregates before the cement is added. Any equipment and methods used shall heat the materials evenly. Concrete placed in shafts and piles is exempt from such preheating requirements.

6.8.2.4 The Contractor may warm stockpiled aggregates with dry-heat or steam, but not by applying flame directly or under sheet metal. If the aggregates are in bins, steam or water coils, or other heating methods, may be used if aggregate quality is not affected. Live steam heating is not permitted on or through aggregate bins. If using dry-heat, the Contractor shall increase mixing time enough to permit the super-dry aggregates to absorb moisture.

6.8.2.5 The Contractor shall provide and maintain a maturity meter sensor in the concrete at a location specified by the County, which continuously records the time and temperature during the curing period, for each concrete placement. The Contractor shall also provide recording thermometers or other approved devices to monitor the surface temperature of the concrete. During curing, data from the maturity meter and recording thermometer shall be readily available to the County. The Contractor shall record time and temperature data on hourly intervals. Data shall be provided to the County upon request.

6.8.2.6 Starting immediately after placement, the concrete temperatures measured by the maturity meter and recording thermometer shall be maintained at or above 50º F and the relative humidity shall be maintained above 80 percent. These conditions shall be maintained for a minimum of 7 days, or for the cure period required by Section 6.7 of these Specifications, whichever is longer. If the temperature falls below 50º F on the maturity meter or recording thermometer during this time, no curing time is awarded for that day. Should the Contractor fail to adequately protect the concrete and the temperature of the concrete falls below 35º F during curing, the County may reject it.

6.8.2.7 The Contractor is solely responsible for protecting concrete from inclement weather during the entire curing period. Permission given by the County to place concrete during cold weather will in no way ensure acceptance of the Work by the County. Should the concrete placed under such conditions prove unsatisfactory in any way, the County shall still have the right to reject the Work, although the plan and the Work were carried out with the County’s permission.
6.8.3 Protection Against Vibration

6.8.3.1 Freshly placed concrete shall not be subjected to excessive vibration and shock waves during the curing period until it has reached a compressive strength of 2000 psi minimum for concrete strength classes Class 4000 and lower. For higher strength classes of concrete, the minimum compressive strength for ending the vibration restriction shall be the concrete Class designation (specified in psi) divided by two.

6.8.3.2 After the first 5 hours from the time the concrete has been placed and consolidated, the Contractor shall keep all vibration producing operations at a safe horizontal distance from the freshly placed concrete by following either the prescriptive safe distance method or the monitoring safe distance method, as described herein. These requirements for the protection of freshly placed concrete against vibration shall not apply for plant cast concrete or soldier pile shaft installation operations, nor shall they apply to the vibrations caused by the traveling public. See Section 6-16 of the WSDOT Standard Specifications for soldier pile shaft installation operations.

6.8.3.3 Prescriptive Safe Distance Method. After the concrete has been placed and consolidated, the Contractor shall keep all vibration producing operations at a safe horizontal distance from the freshly placed concrete as follows:

<table>
<thead>
<tr>
<th>MINIMUM COMPR. STRENGTH, (f'_c)</th>
<th>SAFE HORIZONTAL DISTANCE (1) q</th>
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<tbody>
<tr>
<td></td>
<td>EQUIP. CLASS L(2)</td>
</tr>
<tr>
<td>&lt; 1,000 psi</td>
<td>75 feet</td>
</tr>
<tr>
<td>1,000 psi to &lt; 1,400 psi</td>
<td>30 feet</td>
</tr>
<tr>
<td>1,400 psi to 2,000 psi</td>
<td>15 feet</td>
</tr>
</tbody>
</table>

(1) The safe horizontal distance shall be reduced to 10 feet for small rubber tire construction equipment like backhoes under 50,000 pounds, concrete placing equipment and legal Highway vehicles if such equipment travels at speeds of:
- \(\leq 5\) mph on relatively smooth Roadway surfaces or
- \(\leq 3\) mph on rough Roadway surfaces (i.e. with potholes)

(2) Equipment Class L (Low Vibration) shall include tracked dozers under 85,000 pounds, track vehicles, trucks (unless excluded above), hand operated jack hammers, cranes, auger drill rig, caisson drilling, and vibratory roller compactors under 30,000 pounds.

(3) Equipment Class H (High Vibration) shall include pile drivers, machine operated impact tools, pavement breakers and other large pieces of equipment.

6.8.3.4 Monitoring Safe Distance Method. The Contractor may monitor the vibration producing operations in order to decrease the safe horizontal distance requirements of the prescriptive safe distance method. If this method is chosen, all construction operations that produce vibration or shock waves in the vicinity of freshly placed concrete shall be monitored by the Contractor with monitoring equipment sensitive enough to detect a minimum peak particle velocity (PPV) of 0.10 inches per second. Monitoring devices shall be placed on or adjacent to the freshly placed concrete when the measurements are taken. During the time subsequent to the concrete placement, the
Contractor shall cease all vibration or shock producing operations in the vicinity of the newly placed concrete when the monitoring equipment detects excessive vibration and shock waves defined as exceeding the following PPV’s:

<table>
<thead>
<tr>
<th>MINIMUM COMpressive STRENGTH, $f'_c$</th>
<th>MAXIMUM PPV</th>
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<tr>
<td>&lt; 1,000 psi</td>
<td>0.10 in/sec</td>
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<tr>
<td>1,000 psi to &lt; 1,400 psi</td>
<td>1.0 in/sec</td>
</tr>
<tr>
<td>1,400 psi to 2,000 psi</td>
<td>2.0 in/sec</td>
</tr>
</tbody>
</table>

6.8.3.5 After the concrete has reached a minimum compressive strength specified above, the safe horizontal distance restrictions would no longer apply.

6.9 FORMWORK AND FALSEWORK

6.9.1 Formwork and falsework are both structural systems. Formwork contains the lateral pressure exerted by concrete placed in the forms. Falsework supports the vertical and/or the horizontal loads of the formwork, reinforcing steel, concrete and live loads during construction.

6.9.2 All concrete shall be formed unless otherwise shown on the Drawings or approved by the County. In general, formwork and falsework shall consist of timber/lumber, plywood, steel members, accessories and connection devices of such sizes and properties to ensure a completed Work within the allowable tolerances specified herein. Adequacy of the formwork and falsework shall be the sole responsibility of the Contractor.

6.9.3 Concrete forms shall be mortar tight and true to the dimensions, lines, and grades of the structure. Concrete formwork and falsework shall be of sufficient strength and stiffness to prevent overstress and excess deflection. Deflection resulting from dead load and concrete pressure for exposed, visible surfaces shall not exceed $\frac{1}{360}$ the length of the span. Deflection resulting from dead load and concrete pressure for unexposed, non-visible surfaces shall not exceed $\frac{1}{270}$ the length of the span. All forms shall be properly braced, shored, tied and supported to ensure stability against pressure from any source, without failure of any component part, and to maintain the desired position and shape during and after placing concrete.

6.9.4 If the new structure is near or part of an existing one, the Contractor shall not use the existing structure to suspend or support falsework unless otherwise stated on the Approved Drawings.

6.9.5 All exposed outside corners, including the top edges of all walls, machinery bases and curbs, shall be chamfered $\frac{3}{4}$ inch, or as shown on the Approved Drawings. All chamfer strips shall be mill run, surfaced on all sides. Chamfer all equipment bases, at all vertical corners, and around top of base. The top edges of sidewalks and walkways shall be rounded rather than chamfered.

6.9.6 Form joints of an exposed surface shall be in a horizontal or vertical plane. Joints parallel to studs or joists shall be backed by a stud or joist. Joints at right angles to studs or joists shall be backed by a stud or other backing. Perpendicular backing is not required if
studs or joists are spaced: (1) 9 inches or less on center and covered with ¼-inch plywood; or (2) 12 inches or less on center and covered with ¾-inch plywood.

6.9.7 Forms for concrete surfaces which will be exposed shall be treated with a parting compound consisting of a chemical release agent. This compound shall permit the forms to separate cleanly from the concrete. The compound shall not penetrate or stain the surface and shall not attract dirt or other foreign matter. Form oil or other oils shall not be used. The parting compound shall be applied before the reinforcing steel is placed. The forms shall be thoroughly wetted on both sides in advance of placing the concrete. After the forms are removed, the concrete surface shall be dust-free and have a uniform appearance. The Contractor shall apply the compound at the manufacturer’s recommended rate to produce a surface free of dusting action and yet provide easy removal of the forms.

6.9.8 If an exposed concrete surface will be sealed, the release agent shall not contain silicone resin. Before applying the agent, the Contractor shall provide the County a written statement from the manufacturer stating whether the resin in the base material is silicone or non-silicone.

6.9.9 Bolts and rods used for internal ties shall be arranged so that, when the forms are removed, all metal will be: (1) not less than 1-½ inches from the surface for concrete exposed to weathering, in contact with earth and for watertight concrete; and (2) not less than 1 inch from the surface for unexposed concrete. The Contractor shall provide a cone at each end of the ties, and a waterstop washer at the wall centerline. Both cones and waterstop washers shall be approximately 1 inch in diameter.

6.9.10 Bolts or rod-type form ties which are withdrawn when the forms are removed shall not be used. For pours 12 inches thick or less and 10 feet or less in height, “snap ties” with plastic cones and with either 1-inch diameter rubber waterstop washers or 1-inch diameter plastic washer shall be tightly fitted to the rod at wall centerline. Any other wire ties shall not be used. One row of ties shall be placed within 6 inches of each construction joint. The Contractor shall submit data on form ties for review by the County.

6.9.11 Tie rods shall not be removed until the concrete has hardened sufficiently to permit the tie rods to be withdrawn, broken off or otherwise removed without damaging the concrete. Care shall be exercised in removing the form ties so as not to spall or damage the concrete surface.

6.9.12 The Contractor shall be responsible for placement of all equipment, bolts, anchors, sleeves, inserts, structural steel members and angles, and similar items which require embedment in the concrete.

6.9.13 All ferrous metal sleeves, inserts, anchors and other embedded ferrous items shall be hot-dipped galvanized or epoxy coated wherever shown or called for on the Approved Drawings. Anchor bolts for equipment shall be set to templates, shall be plumbed carefully and checked for location and elevation with an instrument, and shall be held in position rigidly by double nutting to the template to prevent displacement while concrete is being poured.

6.9.14 Reinforcing bars may be moved as necessary to avoid interference with other reinforcing steel, conduits or embedded items, but not so as to impair design strengths of the member. If bars are moved more than two bar diameters, the resulting arrangement of bars shall be submitted to the County for review.
6.9.15 Installation of all embedded items and reinforcing shall be accomplished under the continuous inspection of the County.

6.9.16 Allowable Variations for Formwork and Falsework. The following are allowable variations for formwork and falsework:

1. Variation from the plumb or the specified batter in the lines and surfaces of walls – Exposed, in 10 feet, ½ inch; backfilled in 10 feet, 1 inch.
2. Variation in cross-sectional dimensions of slabs, walls, etc. from dimensions shown on the Approved Drawings – minus ¼ inch to plus ½ inch.
3. Variation in thickness of slabs or walls shown on the Approved Drawings – minus ⅛ inch to plus ¼ inch.
4. Misplacement of eccentricity – 2 percent of the footing width in the direction of misplacement, but not more than 1 inch.
5. Variation of vertical dimensions from specified position on the Approved Drawings shall be the overall structural dimensions, plus or minus ¼ inch.
6. Variation from the level or from slopes specified for floors, ceilings and conspicuous lines shall be as follows:
   a. For overall length of line or surface:
      i. For 10 feet or less ______________________________ plus or minus ⅛ inch
      ii. Up to 20 feet ______________________________ plus or minus ⅛ inch
   b. For any two successive intermediate points on the line or surface separated by:
      i. For 10 feet ______________________________ plus or minus ⅛ inch
      ii. For 20 feet or more __________________________ plus or minus ⅛ inch
7. Variation in the size and location of slab and wall openings – ¼ inch

6.9.17 Removal of Falsework and Forms

6.9.17.1 Forms shall be removed without damage to the concrete in a manner to ensure complete safety of the structure. Forms shall not be removed until the concrete has hardened sufficiently to permit their removal with safety, and the members have attained sufficient strength to safely support the imposed loads.

6.9.17.2 Immediately after carefully removing forms, all concrete surfaces shall be inspected by the County. Any defective Work, such as concrete out of line, level or plumb, cracks, poor joints, rock pockets, honeycomb, voids, spalls and exposed reinforcing, together with tie bolt holes, shall be patched at once before the concrete is thoroughly cured.

6.9.17.3 Minor areas to be patched shall be cleaned thoroughly. Curing compound shall not be applied to these areas prior to patching. Minor honeycombed or otherwise defective areas shall be cut out to solid concrete, but to a depth of not less than 1 inch. The edges of the cut shall be slightly more than perpendicular to the surface of the concrete, so as to form a key.

6.9.17.4 Major defects of large areas involving voids or rock pockets extending through the section may be cause for rejection of the Work. If, in the opinion of the County, repairs can be made without adversely affecting the structural integrity of the Work, the section shall be cut out and shall be either dry-packed, or re-formed and re-poured, to match the adjacent concrete.
6.9.17.5 Under no circumstances shall the reinforcing be cut in the repair, and keyways shall be cut into the adjacent sound concrete to securely fasten the patch to the original Work. All surfaces shall be coated with epoxy adhesive compound immediately prior to patching. The concrete patch shall be placed before the epoxy adhesive compound has set. The epoxy adhesive compound shall be mixed and used in accordance with the manufacturer’s recommendations.

6.9.17.6 The County will decide, on the basis of post-placement curing conditions, the exact number of days that shall elapse before formwork or falsework may be removed. If the County does not specify otherwise, the Contractor may request to remove forms based on the criteria listed in Section 6-02.3(17)N of the WSDOT Standard Specifications. In no case shall the Contractor remove formwork or falsework without the County’s approval.

6.9.17.7 The Contractor shall set and maintain concrete forms to ensure that, after removal of the forms and prior to patching and finishing, no portion of the concrete Work will exceed any of the tolerances noted in Section 6.9.16 of these Specifications. The tolerances specified shall not be exceeded by any portion of any concrete surface; the specified variation for one element of the structure will not be applicable when it will permit another element of the structure to exceed its allowable variation.

6.10 ANCHOR BOLTS

6.10.1 Placing Anchor Bolts. The Contractor shall comply with the following requirements in setting anchor bolts in concrete:

1. If set in the wet concrete, the bolts shall be accurately placed before the concrete is placed.
2. If the bolts are set in drilled holes, hole diameter shall exceed bolt diameter by at least 1 inch. Grouting shall comply with Section 6-02.3(20) of the WSDOT Standard Specifications.
3. If the bolts are set in pipe, grouting shall comply with Section 6-02.3(20) of the WSDOT Standard Specifications.
4. If freezing weather occurs before bolts can be grouted into sleeves or holes, they shall be filled with an approved, non-evaporating antifreeze solution.

6.10.2 Grout for Anchor Bolts. Grout shall be prepackaged grout, mixed, placed and cured as recommended by the manufacturer, or the grout shall be produced using Type I or Type II Portland cement, fine aggregate Class 1 or Class 2, and water, in accordance with these Specifications.

6.10.2.1 Grout shall have a minimum compressive strength at 7 days of 4,000 psi in accordance with AASHTO T 106, unless shown otherwise on the Approved Drawings.

6.10.2.2 Grout shall be a workable mix with flowability suitable for the intended application.

6.10.2.3 If the Contractor elects to use a prepackaged grout, a material sample and laboratory test data from an Independent Testing Laboratory shall be submitted to the County for approval with the request for approval of material sources.
6.10.2.4 If the Contractor elects to use a grout consisting of Type I or Type II Portland cement, fine aggregate Class 1, admixture and water, the mix proportions and laboratory test data from an Independent Testing Laboratory shall be submitted to the County for approval with the request for approval of material sources.

6.10.2.5 The Contractor shall receive approval from the County before using the grout.

6.10.2.6 Field grout cubes shall be made in accordance with WSDOT Test Method 813 for either prepackaged grout or a Contractor provided mix when requested by the County, but not less than one per structure or one per day.

6.10.2.7 Before placing grout, the concrete on which it is to be placed shall be thoroughly cleaned, roughened and wetted with water to ensure proper bonding. The grout shall be cured as recommended by the manufacturer, or kept continuously wet with water for 3 days. The grout may be loaded when a minimum compressive strength of 4,000 psi is attained.

6.10.2.8 Before placing grout into anchor bolt sleeves or holes, the cavity shall be thoroughly cleaned and wetted to ensure proper bonding.

6.10.2.9 To grout bearing masonry plates, the Contractor shall:

1. Build a form approximately 4 inches high with sides 4 inches outside the base of each masonry plate;
2. Fill each form to the top with grout;
3. Work grout under all parts of each masonry plate;
4. Remove each form after the grout has hardened;
5. Remove the grout outside each masonry plate to the base of the masonry plate;
6. Bevel off the grout neatly to the top of the masonry plate; and
7. Place no additional load on the masonry plate until the grout has set at least 72 hours.

6.10.2.10 After all grout under the masonry plate and in the anchor bolt cavities has attained a minimum strength of 4,000 psi, the anchor bolt nuts shall be tightened to snug-tight. “Snug-tight” means either the tightness reached by: (1) a few blows from an impact wrench, or (2) the full effort of a person using a spud wrench. Once the nut is snug-tight, the anchor bolt threads shall be burred just enough to prevent loosening of the nut.

6.11 STEEL REINFORCEMENT

6.11.1 If the Approved Drawings call for field-bending of steel reinforcing bars, the Contractor shall bend them in keeping with the structure configuration. Bending steel reinforcing bars partly embedded in concrete shall be done as specified herein.

6.11.2 Field-bending shall not be done:

1. On bars size No. 14 or No. 18;
2. When the air temperature is lower than 45º F;
3. By means of hammer blows or pipe sleeves; or
4. While the bar temperature is in the range of 400º F to 700º F.
6.11.3 In field-bending of steel reinforcing bars, the Contractor shall:

1. Make the bend gradually;
2. Apply heat as described in Tables 2 and 3 on the following page for bending bar sizes No. 6 through No. 11, and for bending bar sizes No. 5 and smaller when the bars have been previously bent. Previously unbent bars of sizes No. 5 and smaller may be bent without heating;
3. Use a bending tool equipped with a bending diameter as listed in Table 1 below;
4. Limit any bend to these maximums – 135 degrees for bars smaller than size No. 9, and 90 degrees for bars size No. 9 and No. 11;
5. Straighten by moving a hickey bar (if used) progressively around the bend.

6.11.4 In applying heat for field-bending of steel reinforcing bars, the Contractor shall:

1. Use a method that will avoid damages to the concrete;
2. Insulate any concrete within 6 inches of the heated bar area;
3. Ensure, by using temperature-indicating crayons or other suitable means, that steel temperature never exceeds the maximum temperatures shown in Table 2 on the following page;
4. Maintain the steel temperature during the entire bending process within the required range shown in Table 2 on the following page;
5. Apply two heat tips simultaneously at opposite sides of bars larger than size No. 6 to assure a uniform temperature throughout the thickness of the bar. For size No. 6 and smaller bars, apply two heat tips, if necessary;
6. Apply the heat for a long enough time that, within the bend area, the entire thickness of the bar (including its center) reaches the required temperature;
7. Bend immediately after the required temperature has been reached;
8. Heat at least as much of the bar as shown in Table 3 on the following page;
9. Locate the heated section of the bar to include the entire bending length; and
10. Never cool bars artificially with water, forced air or other means.

6.11.5 The minimum cold bending diameters for stirrups and ties for No. 4 and No. 5 bars shall be 2 inches and 2-½ inches, respectively.

| Table 1 |
|------------------|------------------|
| **Bending Diameters for Field-Bending Reinforcing Bars** |
| **Bar Size** | **Bend Diameter/Bar Diameter Ratio** |
| | **Heat Not Applied** | **Heat Applied** |
| No. 4, No. 5 | 8 | 8 |
| No. 6 through No. 9 | Not Permitted | 8 |
| No. 10, No. 11 | Not Permitted | 10 |
### Table 2
Preheating Temperatures for Field-Bending Reinforcing Bars

<table>
<thead>
<tr>
<th>Bar Size</th>
<th>Temperature (F)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum</td>
<td>Maximum</td>
<td></td>
</tr>
<tr>
<td>No. 4</td>
<td>1,200</td>
<td>1,250</td>
<td></td>
</tr>
<tr>
<td>No. 5, No. 6</td>
<td>1,350</td>
<td>1,400</td>
<td></td>
</tr>
<tr>
<td>No. 7 through No. 9</td>
<td>1,400</td>
<td>1,450</td>
<td></td>
</tr>
<tr>
<td>No. 10, No. 11</td>
<td>1,450</td>
<td>1,500</td>
<td></td>
</tr>
</tbody>
</table>

### Table 3
Minimum Bar Length to be Heated (\(d = \) nominal diameter of bar)

<table>
<thead>
<tr>
<th>Bar Size</th>
<th>Bend Angle</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>45°</td>
<td>90°</td>
<td>135°</td>
</tr>
<tr>
<td>No. 4 through No. 8</td>
<td>8d</td>
<td>12d</td>
<td>15d</td>
</tr>
<tr>
<td>No. 9</td>
<td>8d</td>
<td>12d</td>
<td>Not Permitted</td>
</tr>
<tr>
<td>No. 10, No. 11</td>
<td>9d</td>
<td>14d</td>
<td>Not Permitted</td>
</tr>
</tbody>
</table>

6.11.6 Protection of Materials

6.11.6.1 The Contractor shall protect reinforcing steel from all damage. When placed into the structure, the steel shall be free from dirt, loose rust or mill scale, paint, oil and other foreign matter.

6.11.6.2 When transporting, storing or constructing in close proximity to bodies of salt water, plain and epoxy-coated steel reinforcing bar shall be kept in enclosures that provide protection from the elements.

6.11.6.3 If plain or epoxy-coated steel reinforcing bar is exposed to mist, spray or fog that may contain salt, it shall be flushed with fresh water prior to concrete placement.

6.11.6.4 When the County requires protection for reinforcing steel that will remain exposed for a length of time, the Contractor shall either: (1) clean and apply a coat of paint, Formula No. A-9-73, over all exposed surfaces of steel; or (2) clean and apply a coat of paint, Formula No. A-9-73, on the first 6-inches of the steel bars protruding from the concrete and cover the bars with polyethylene sleeves. The paint shall have a minimum dry film thickness of 1 mil.

6.11.7 Placing and Fastening

6.11.7.1 The Contractor shall position reinforcing steel as shown on the Approved Drawings, and shall ensure that the steel does not move as the concrete is placed.

6.11.7.2 When spacing between bars is 1 foot or more, they shall be tied at all intersections. When spacing is less than 1 foot, every other intersection shall be tied. If bundled bars are specified on the Approved Drawings, they shall be tied together with...
wires at least every 6 feet. All epoxy-coated bars shall also be tied at all intersections, but shall be tied at alternate intersections when spacing is less than 1 foot in each direction. Wire used for tying epoxy-coated reinforcing steel shall be plastic coated. Tack welding is not permitted on reinforcing steel.

6.11.7.3 Abrupt bends in the steel are permitted only when one steel member bends around another. Vertical stirrups shall pass around main reinforcement or be firmly attached to it. For slip-formed concrete, the reinforcing steel bars shall be tied at all intersections and cross-braced to keep the cage from moving during concrete placement. Cross-bracing shall be with additional reinforcing steel. Cross-bracing shall be placed both longitudinally and transversely.

6.11.7.4 Mortar blocks, or other approved devices, shall be used to maintain the concrete coverage required by the Approved Drawings. The mortar blocks shall: (1) have a bearing surface measuring not greater than 2 inches in either dimension; and (2) have a compressive strength equal to that of the concrete in which they are embedded.

6.11.7.5 In slabs, each mortar cube shall have either: (1) a grooved top that will hold the reinforcing bar in place; or (2) an embedded wire that protrudes and is tied to the reinforcing steel. If this wire is used around epoxy-coated bars, it shall be coated with plastic.

6.11.7.6 Mortar blocks may be accepted on a Manufacturer’s Certificate of Compliance, which shall include test results on two, 2-inch square specimens per AASHTO T 106. Each pair of specimens shall represent 2,500 or fewer mortar blocks and shall be made of the same mortar as the blocks and cured under the same conditions.

6.11.7.7 In lieu of mortar blocks, the Contractor may use metal or plastic chair supports to hold uncoated bars. Any surface of metal chair support that will not be covered by at least ½ inch of concrete shall be one of the following:

1. Hot-dip galvanized after fabrication in keeping with AASHTO M 232, Class D;  
2. Coated with plastic firmly bonded to the metal. This plastic shall be at least \( \frac{3}{32} \) inch thick where it touches the form and shall not react chemically with the concrete when tested in the State Materials Laboratory. The plastic shall not shatter or crack at or above -5º F and shall not deform enough to expose the metal at or below 200º F; or  
3. Stainless steel that meets the requirements of ASTM A493, Type 302. Stainless steel chair supports are not required to be galvanized or plastic coated.

6.11.7.8 In lieu of mortar blocks, epoxy-coated reinforcing bars may be supported by one of the following:

1. Metal chair supports coated entirely with a dielectric material, such as epoxy or plastic;  
2. Other epoxy-coated reinforcing bars; or  

6.11.7.9 Plastic chair supports shall be lightweight, non-porous and chemically inert in concrete. Plastic chair supports shall have rounded seatings, shall not deform under load during normal temperatures and shall not shatter or crack under impact loading in cold weather. Plastic chair supports shall be placed at spacings greater than 1-foot along
the bar and shall have at least 25 percent of their gross place area perforated to compensate for the difference in the coefficient of thermal expansion between plastic and concrete. The shape and configuration of plastic supports shall permit complete concrete consolidation in and around the support.

6.11.7.10 In slabs, the Contractor shall place reinforcing steel mats carefully to provide the required concrete cover. A “mat” consists of two layers of steel. Top and bottom mats shall be supported enough to hold both in their proper positions. If No. 4 bars make up the lower layer of steel in a mat, it shall be blocked at not more than 3 foot intervals (or 4 foot intervals for bars No. 5 and larger). To provide a rigid mat, the Contractor shall add other supports and tie wires to the top mat as needed.

6.11.7.11 If a bar will interfere with a drain or blockout, it shall be bent in the field to bypass the opening.

6.11.7.12 Minimum clearances for steel reinforcing bars shall be as follows:

- 4 inches between: ........... Main bars and the top of any concrete masonry exposed to the action of salt or alkaline water.
- 3 inches between: ........... Main bars and the top of any concrete deposited against earth without intervening forms.
- 2 inches between: ........... Adjacent layers. Main bars and the surface of concrete exposed to earth or weather. Reinforcing bars and the faces of forms for exposed aggregate finish.
- 1-½ inches between: ...... Main bars and the surface of concrete not exposed to earth or weather. Slab bars and the top of the slab. Barrier and curb bars and the surface of the concrete. Stirrups and ties and the surface of the concrete exposed to earth or weather.

6.11.7.13 Reinforcing steel bars shall not vary more than the following tolerances from their positions as shown on the Approved Drawings:

- Members 10 inches or less in thickness ............ ±¼ inch
- Members more than 10 inches in thickness........ ±¾ inch

When reinforcing steel bars are to be placed at equal spacing within a plane:

- Stirrups and ties .............................................±1 inch
- All other reinforcement ............................... ±1 bar diameter

6.11.7.14 Before placing any concrete, the Contractor shall: (1) clean all mortar from reinforcement; and (2) obtain the County’s permission to place concrete after the County has inspected the placement of the reinforcing steel. Any concrete placed without the County’s permission shall be rejected and removed.

6.11.8 Splicing. The Contractor shall supply steel reinforcing bars in the full lengths in accordance with the Approved Drawings. Unless the County approves in writing, the Contractor shall not change the number, type, or location of splices. The County may permit
the Contractor to use thermal or mechanical splices in lieu of the method shown on the Approved Drawings if they are of an approved design.

6.11.9 Welding of Reinforcing Steel

6.11.9.1 Welding of steel reinforcing bars shall conform to the requirements of AWS D1.4, Structural Welding Code – Reinforcing Steel, latest edition, except where superseded by the Approved Drawings.

6.11.9.2 Before any welding begins, the Contractor shall obtain the County’s approval of a written welding procedure for each type of welded splice to be used, including the weld procedure specifications and joint details. The weld procedure specifications shall be written on a form taken from AWS D1.4, Annex A, or equivalent. Test results of tensile strength, macroetch and visual examination shall be included. The form shall be signed and dated.

6.11.9.3 Welders shall be qualified in accordance with AWS D1.4. The Contractor shall be responsible for the testing and qualification of welders, and shall submit welder qualification and retention records to the County for approval. The weld joint and welding position a welder is qualified in shall be in accordance with AWS D1.4. The welder qualifications shall remain in effect indefinitely, unless: (1) the welder is not engaged in a given process of welding for which the welder is qualified for a period exceeding 6 months; or (2) there is some specific reason to question a welder’s ability.

6.11.9.4 Filler metals used for welding reinforcing bars shall be in accordance with AWS D1.4, Table 5.1. All filler metals shall be low-hydrogen and handled in compliance with low-hydrogen practices as specified in the AWS code.

6.11.9.5 All welding shall be protected from air currents, drafts and precipitation to prevent loss of heat or loss of arc shielding. Short circuiting transfer with gas metal arc welding will not be allowed. Slugging of welds will not be allowed.

6.11.9.6 The minimum preheat and interpass temperature for welding shall be in accordance with AWS D1.4, Table 5.2, and mill certification of carbon equivalence, per lot of reinforcing. Preheating shall be applied to the reinforcing bars and other splice members within 6-inches of the weld, unless limited by the available lengths of the bars or splice members.

6.11.9.7 Generally, post heating of welded splices is only required for direct butt welded splices of AASHTO M 31/ASTM A615 Grade 60 bars size No. 9 or larger, and shall be done immediately after welding before the splice has cooled to 700°F. Post heating shall not be less than 800°F, nor more than 1,000°F, and held at this temperature for not less than 10 minutes before allowing the splice to cool naturally to ambient temperature.

6.11.9.8 For the purpose of compatibility with AWS D1.4, welded lap splices for spiral or hoop reinforcing shall be considered Flare-V groove welds, indirect butt joints.

6.11.9.9 The Contractor is responsible for using a welding sequence that will limit the alignment distortion of the bars due to the effects of welding. The maximum out-of-line permitted will be ¼ inch from a 3-½ foot straight-edge, centered on the weld and in line with the bar.
6.11.9.10 The following procedure for welding steel reinforcing bars is recommended:
Sheared bar ends shall be burned or sawed off a minimum of ¼ inch to completely
remove the ruptured portion of the steel shear area prior to welding butt splices.
Surfaces to be welded shall be smooth, uniform and free from fins, tears, cracks and
other defects. Surfaces to be welded and surfaces adjacent to a weld shall also be free
from loose or thick scale, slag, rust, moisture, grease, paint, epoxy covering or other
foreign materials. All tack welds shall be within the area of the final weld. No other tack
weld will be permitted. Double bevel groove welds require chipping, grinding or gouging
to sound metal at the root of the weld before welding the other side. Progression of
vertical welding shall be upward. The ground wire from the welding machine shall be
clamped to the bar being welded. Should the Contractor elect to use a procedure which
differs in any way from the procedure recommended, the Contractor shall submit the
changes, in writing, to the County for approval. Approved weld procedures shall be
strictly followed.

6.11.10 Mechanical Splices

6.11.10.1 The Contractor shall form mechanical splices with a County-approved
system using sleeve filler metal, threaded coupling or another method that complies with
this section. If necessary to maintain required clearances after the splices are in place,
the Contractor shall adjust, relocate or add stirrups, ties and bars.

6.11.10.2 Before splicing, the Contractor shall provide the County with the following
information for each shipment of splice material:

1. The type or series identification (and heat treatment lot number for threaded
   sleeve splices);
2. The grade and size of bars to be spliced;
3. A manufacturer’s catalog with complete data on material and procedures;
4. A written statement from the manufacturer that the material is identical to that
   used earlier by the County in testing and approving the system design; and
5. A written statement from the Contractor that the system and materials will be
   used according to the manufacturer’s instructions and all requirements of this
   section.

6.11.10.3 All splices shall meet the following criteria:

1. Tension splices shall develop at least 130 percent of the yield tensile strength
   specified for the un-spliced bar. The ultimate tensile strength of the sleeve shall
   exceed that of the other parts of the completed splice.
2. AASHTO M 31 bars within a splice sleeve shall not slip more than 0.03 inch for
   Grade 40 bars, nor more than 0.045 inch for Grade 60 bars. This slippage shall
   be measured between gage points clear of the splice sleeve. Measurements
   shall be taken at an initial load of 3,000 psi and again after loading to 90 percent
   of the minimum specified yield strength for the un-spliced bar and then relaxed to
   3,000 psi.
3. Maximum allowable bar size shall be as follows:
   Mechanical butt splice ............................. No. 14
   Mechanical lap splice ............................. No. 6
6.11.10.4 The County will visually inspect the splices and accept all that appear to conform to the test samples. For sleeve-filler splices, the County will allow voids within the limits on file in the design approval. If the County considers any splice defective, it shall be removed and replaced at the Contractor’s expense.

6.11.10.5 In preparing sleeve-filler metal splices, the Contractor shall:

1. Clean the bar surfaces by:
   a. oxyacetylene torch followed by power wire brushing, or
   b. abrasive blasting
2. Remove all slag, mill scale, rust and other foreign matter from all surfaces within and 2 inches beyond the sleeve;
3. Grind down any projection on the bar that would prevent placing the sleeve;
4. Prepare the ends of the bars as the splice manufacturer recommends and as the approved procedure requires; and
5. Preheat, just before adding the filler, the entire sleeve and bar ends to 300° F, plus or minus 50° F. If a gas torch is used, the flame shall not be directed onto the sleeve.

6.11.10.6 When a metallic, sleeve-filler splice is used, or any other system requiring special equipment, both the system and the operator shall qualify in the following way under the supervision of the State Materials and Fabrication Inspector. The operator shall prepare six test splices (3 vertical and 3 horizontal) using bars having the same AASHTO Designation and size (maximum) as those to be used in the Work. Each test sample shall be 42 inches long, made up of two, 21-inch long bars joined end-to-end by the splice. The bar alignment shall not deviate more than \( \frac{3}{8} \) inch from a straight line over the whole length of the sample. All six samples must meet the tensile strength and slip criteria specified herein.

6.11.10.7 The Contractor shall bear the expense for providing the labor, materials and equipment for making these test samples and testing the samples.

6.11.11 Job Control Tests. As the Work progresses, the County may require the Contractor to provide a sample splice (thermal or mechanical) to be used in a job control test. The operator shall create this sample on the job site, and in the presence of the County, using bars of the same size as those being spliced in the Work. The sample shall comply with all requirements specified herein, and is in addition to all other sample splices required for qualification. The County will require no more than two samples on any Project with fewer than 200 splices, and no more than one sample per 100 splices on any Project with more than 200 splices.

6.11.12 Epoxy-coated Steel Reinforcing Bar

6.11.12.1 This Section includes furnishing, fabricating, coating and placing epoxy-coated steel reinforcing bars in accordance with the Approved Drawings.

6.11.12.2 Coating material shall be applied electrostatically, by spraying or by the fluidized-bed method. Fabrication may occur before or after coating. All epoxy-coated bars shall be coated in accordance with AASHTO M 284, with the following modifications.

1. The list of steel reinforcing bars acceptable for coating shall include ASTM A 706.
2. The Contractor shall furnish a written certification that properly identifies the material, the number of each batch of coating material used, quantity represented, date of manufacture, name and address of manufacture, and a statement that the supplied coating material meets the requirements of AASHTO M 284.

3. Prior to coating the bars, the Contractor shall submit to the County for review, the coating material manufacturer’s recommendation on the proper use and application requirements of the coating material.

4. A certification stating that all bars have been coated in accordance with the coating material manufacturer’s recommendations and these Specifications shall be furnished with each shipment. This certification shall include for each bar size and preheat temperatures, cure times, thickness checks, holidays detected, and test results. Two copies of these certifications shall be furnished to the County.

5. Upon request, the Contractor shall give advance notice to the County of the coating schedule in the coating plant so that the County may be present during coating.

6. The patching material, compatible with the coating material and inert in concrete, shall be supplied with each shipment.

7. The thickness of epoxy coating shall be 10 mils, plus or minus 2 mils.

6.11.12.3 The Contractor shall protect epoxy-coated bars from damage using padded or nonmetallic slings and straps that are free from dirt or grit. To prevent abrasion from bending or sagging, the Contractor shall lift bundled bars with a strong-back, multiple supports or a platform bridge. Bundled bars shall not be dropped or dragged. During shop or field storage, bars shall rest on wooden or padded cribbing. The Contractor may substitute other methods for protecting the bars, as approved by the County. Coated bars will be rejected if the County believes they have been badly damaged.

6.11.12.4 Metal chairs and supports shall be coated with epoxy, or another inert coating as approved by the County. The Contractor may use other support devices, as approved by the County. Plastic coated tie wires, as approved by the County, shall be used to protect the coated bars from being damaged during placement.

6.11.12.5 The bars shall be placed in accordance with the Approved Drawings and held firmly in place during placing and setting of the concrete. All bars shall be placed and fastened as specified herein.

6.11.12.6 In the interval between installing coated bars and placing concrete, the Contractor shall protect the coating from damage that might result from other construction operations.

6.11.12.7 The County will inspect the coated bars after they are placed and before concrete is poured. The Contractor shall patch any areas that show significant damage. “Significant damage” means any opening in the coating that exposes the steel in an area that exceeds:

1. 0.05 square inch (approximately ¼ inch square or ¼ inch in diameter, or the equivalent);
2. 0.012 square inches (approximately ¼ inch square or ¼ inch in diameter) when the opening is within ¼ inch of another opening or equal or larger size;
3. 6 inches long, any width; or
4. 0.50-square inch aggregate area in any 1-foot length of bar.

6.11.12.8 The Contractor shall patch significantly damaged areas with County-approved patching material obtained from the epoxy resin manufacturer. This material shall be compatible with the coating and inert in concrete. Areas to be patched shall be clean and free of surface contaminants. Patching shall be done before oxidation occurs and according to the resin manufacturer’s instructions.

6.12 PRECAST CONCRETE STRUCTURES

6.12.1 The Contractor shall perform quality control inspection. The manufacturing plant for precast concrete units shall be certified by the Precast/Prestressed Concrete Institute’s Plant Certification Program for the type of precast member to be produced, or the National Precast Concrete Association’s Plant Certification Program, or be an International Congress Building Officials or International Code Council Evaluation Services recognized fabricator of structural precast concrete products, and shall be approved by WSDOT as a Certified Precast Concrete Fabricator prior to the start of production. WSDOT Certification will be granted at, and renewed during, the annual precast plant review and approval process.

6.12.2 Prior to the start of production of the precast concrete units, the Contractor shall advise the County of the production schedule. The Contractor shall give the Inspector safe and free access to the Work. If the Inspector observes any non-specification Work or unacceptable quality control practices, the Inspector will advise the plant manager. If the corrected action is not acceptable to the County, the unit(s) will be rejected.

6.12.3 Forms may be steel or plywood faced, providing they impart the required finish to the concrete.

6.12.4 All concrete mixes to be used shall be pre-approved in the WSDOT plant certification process and must meet the requirements of Section 9-19.1 of the WSDOT Standard Specifications. The temperature of the concrete when placed shall be between 50º F and 90º F.

6.12.5 Slump shall not exceed 4 inches for normal concrete, nor 7 inches with the use of a high-range water reducing admixture, nor 9 inches when both a high-range water reducing admixture is used and the water/cement ratio is less than or equal to 0.35. The high-range water reducer shall meet the requirements of Section 9-23.6 of the WSDOT Standard Specifications.

6.12.6 Precast units shall not be removed from forms until the concrete has attained a minimum compressive strength of 70 percent of the specified design strength as verified by rebound number determined in accordance with WSDOT FOP for ASTM C805.

6.12.7 Precast units shall not be shipped until the concrete has reached the specified design strength as determined by testing cylinders made from the same concrete as the precast units.

6.12.8 The County may perform Quality Assurance Inspection. By its inspection, the County intends only to facilitate the Work and verify the quality of that Work. This inspection shall not relieve the Contractor of any responsibility for identifying and replacing defective material and workmanship.
6.12.9 Shop Drawings for Precast Units. Before casting precast concrete units, the Contractor and the Inspector shall have possession of a set of shop drawings prepared by a Professional Engineer, licensed under Title 18 RCW, State of Washington, in the branch of Civil or Structural Engineering. The County will not review the shop drawing, and the Contractor shall be responsible for accuracy of the drawings and conformity to the Approved Drawings.

6.12.10 Curing

6.12.10.1 Concrete in the precast units shall be cured by either moist or accelerated curing methods. The methods to be used shall be pre-approved in the WSDOT plant certification process.

6.12.10.2 For moist curing, the surface of the concrete shall be kept covered or moist until such time as the compressive strength of the concrete reaches the strength specified for stripping. Exposed surfaces shall be kept continually moist by fogging, spraying or covering with moist burlap or cotton mats. Moist curing shall commence as soon as possible following completion of surface finishing.

6.12.10.3 For accelerated curing, heat shall be applied at a controlled rate following the initial set of concrete in combination with an effective method of supplying or retaining moisture. Moisture may be applied by a cover of moist burlap, cotton matting or other effective means. Moisture may be retained by covering the unit with an impermeable sheet.

6.12.10.4 Heat may be radiant, convection, conducted steam or hot air. Heat the concrete to no more than 100°F during the first 2 hours after pouring the concrete, and then increase no more than 25°F per hour to a maximum of 175°F. After curing is complete, cool the concrete no more than 25°F per hour to 100°F. Maintain the concrete temperature above 60°F until the unit reaches stripping strength.

6.12.10.5 Concrete temperature shall be monitored by means of a thermocouple embedded in the concrete, linked with a thermometer accurate to plus or minus 5°F. The recording sensor, accurate to plus or minus 5°F, shall be arranged and calibrated to continuously record, date and identify concrete temperature throughout the heating cycle. This temperature record shall be made available to the County for inspection and become a part of the documentation required.

6.12.10.6 The Contractor shall never allow dry heat to directly touch exposed unit surfaces at any point.

6.12.11 Contractor’s Control Strength

6.12.11.1 The concrete strength at stripping and the verification of design strength shall be determined by testing cylinders made from the same concrete as the precast units. The cylinders shall be made, handled and stored in accordance with WSDOT FOP for AASHTO T 23 and compression tested in accordance with AASHTO T 22 and AASHTO T 231.

6.12.11.2 For accelerated cured units, concrete strength shall be measured on test cylinders cast for the same concrete as that in the unit. These cylinders shall be cured under time-temperature relationships and conditions that simulate those of the unit. If the
forms are heated by steam or hot air, test cylinders will remain in the coolest zone throughout curing. If forms are heated by any other means, the Contractor shall provide a record of the curing time-temperature relationship for the cylinders for each unit to the County. When two or more units are cast in a continuous line and in a continuous pour, a single set of test cylinders may represent all units provided the Contractor demonstrates uniformity of casting and curing to the satisfaction of County.

6.12.11.3 The Contractor shall mold, cure and test enough of these cylinders to satisfy the specification requirements for measuring concrete strength. The Contractor may use 4-inch by 8-inch, or 6-inch by 12-inch cylinders. The Contractor shall let cylinders cool for at least ½-hour before testing for release strength.

6.12.11.4 Test cylinders may be cured in a moist room or water tank in accordance with WSDOT FOP for AASHTO T 23 after the unit concrete has obtained the required release strength. If, however, the Contractor intends to ship the unit prior to conducting the standard 28 day strength test, the design strength for shipping shall be determined from cylinders placed with the unit and cured under the same conditions as the unit. These cylinders may be placed in a non-insulated, moisture-proof envelope.

6.12.11.5 To measure concrete strength in the precast unit, the Contractor shall randomly select two test cylinders and average their compressive strengths. The compressive strength in either cylinder shall not fall more than 5 percent below the specified strength. If these two cylinders do not pass the test, two additional cylinders shall be selected and tested.

6.12.12 Finishing. The Contractor shall provide a finish on all relevant concrete surfaces as defined in Section 6.6 of these Specifications, unless otherwise specified on the Approved Drawings.

6.12.13 Tolerances. The units shall be fabricated as shown on the shop drawings or Approved Drawings, or as indicated in the Standard Plans, and shall meet the dimensional tolerances listed in the latest edition of PCI-MNL-166, unless otherwise required by the Approved Drawings.

6.12.14 Handling and Storage. The Contractor shall lift all units only by adequate devices at locations designated on the shop drawings. Precast units shall be stored off the ground on foundations suitable to prevent differential settlement or twisting of the units. Stacked units shall be separated and supported by dunnage of uniform thickness capable of supporting the units. Dunnage shall be arranged in vertical planes. The upper units of a stacked tier shall not be used as storage areas for shorter units unless substantiated by engineering analysis and approved by the County.

6.12.15 Shipping. Precast units shall not be shipped until the concrete has reached the specified design strength. The units shall be supported in such a manner that they will not be damaged by anticipated impact on their dead load. Sufficient padding material shall be provided between tie chains and cables to prevent chipping or spalling of the concrete.

6.12.16 Erection. When the units arrive on the Project site, the County will inspect the precast units for shipping and handling damage. The Contractor shall lift all units by suitable devices at location designated on the shop drawings. Temporary shoring or bracing shall be provided, if necessary. Units shall be properly aligned and leveled as required by the
Approved Drawings. Variations between adjacent units shall be leveled out by a method approved by the County.

END OF SECTION
SECTION 7

MECHANICAL EQUIPMENT FOR SUBMERSIBLE PUMP STATIONS

7.1 GENERAL

7.1.1 This Section describes the general requirements for all of the equipment and mechanical Work in the scope of a submersible pump station Project and wherever specifically required in these Specifications. All materials and equipment furnished under this Section shall be by the manufacturer specified on the Approved Drawings, as identified in the Standard Plans, or as specified herein.

7.1.2 The Contractor shall direct the attention of all Subcontractors and suppliers of equipment and related appurtenances for the Work to the applicable provisions in the Approved Drawings, the Standard Plans, and these Specifications, wherever they may occur.

7.1.3 Standards of Work

7.1.3.1 Complete Systems. Pipe, fittings, wiring, and supports shall be provided to produce complete, operable systems with all elements properly interconnected as shown in schematic diagrams or to provide specified operations. If a specific dimensioned location is not shown for interconnections or for smaller system elements, the Contractor shall select appropriate locations and show them on shop drawing submittals for review.

7.1.3.2 Equipment and materials shall be new and without imperfections, and shall be erected in a neat and workmanlike manner; aligned, leveled, cleaned, and adjusted for satisfactory operation. They installed in accordance with the recommendations of the manufacturers and the best standard practices for this type of Work so that connecting and disconnecting of piping and accessories can be readily made and so that all parts are easily accessible for inspection, operation, maintenance, and repair. Oil and lubrication fittings shall be located clear of and away from guards, bases, and equipment, and shall be within reach from the operating floor. In order to meet these requirements with equipment as furnished, minor deviation from the Approved Drawings may be made as approved by the County.

7.1.3.3 Manufacturer’s Instructions. The recommendations and instructions of the manufacturers of products used in the Work are hereby made part of these Specifications, except as they may be superseded by other requirements of these Specifications.

7.1.4 Submittals

7.1.4.1 Shop Drawings. Shop drawings shall be submitted for review and approval by the County prior to fabrication, construction, or delivery to the Project site in accordance with these Specifications. Shop drawings shall show the sizes and arrangement of equipment, foundations and anchor bolts required, performance characteristics, fan and pump curves, control and wiring diagrams, motor data sheets, methods of assembly, pipe hanging details, ductwork layouts, and connections to other Work. Shop drawings
shall be dated and signed by the County as certified for use in construction of the Project. The arrangement of mechanical equipment and appurtenant piping shown on the Approved Drawings may be varied as necessary to fit the approved certified manufacturer’s installation drawings. However, the manufacturer’s drawings shall not deviate from the Approved Drawings and these Specifications as to location, size, type, and design of equipment.

7.1.4.2 All equipment submittals shall be accompanied by the following information:

1. Overall dimensions.
2. Mounting arrangement and dimensions.
3. Description of materials.
4. Connection sizes and orientation.
5. Capacity and location of lifting eyes.
6. Motor arrangement showing location of electrical connections.
7. Rating data – Mechanical and Electrical, as applicable.
8. Detailed electrical wiring diagrams, showing component designation and rating.
10. List of special tools and/or spare parts required and to be furnished, if any.

7.1.4.3 Each piece of equipment for which certified, witnessed or non-witnessed performance tests are required shall be accompanied by the following information:

1. Owner’s name and location of Project.
2. Contractor’s name and Subcontractor, if applicable.
3. Name of item being submitted.
4. Specification reference by section, paragraph and page.
5. Data on item (manufacturer, general descriptive data, dimensions, size of connections, speeds, performance curves and serial number).
6. Motor data, type, voltage, frequency, phase, full load amperes, starting method, frame size, enclosure insulation type (NEMA Code letter), dimensions, service factor and serial number.
7. Date and signature of person certifying the performance.

7.1.4.4 All motor connections shall be located as shown on the Approved Drawings and as indicated in the Standard Plans.

7.1.4.5 Operation and Maintenance (O&M) Instruction Manuals

7.1.4.5.1 The Contractor shall prepare and submit manufacturers’ instructional manuals and pump build data with part numbers in 3-ring binders, as well as in electronic files in searchable PDF format on CD-ROM, which covers all equipment and machinery specified.

7.1.4.5.2 Two copies of complete O&M Manuals shall be provided in both electronic format (PDF) and hard copy when the pump station is 90 percent complete.
7.1.4.5.3 The subject matter to be included in O&M Manuals shall include, but not be limited to, the following:

1. Start-up.
3. Alternative Specified Operating Modes.
6. Long Term Shut Down (Mothballing).
7. Operator Safety.
8. Lubrication.
10. Parts Identification and a complete parts breakdown for all equipment.
11. Test Results.
12. List of Spare Parts Provided.

7.1.4.5.4 The Contractor shall complete and submit a Pierce County Standard Summary Equipment Form, as provided by the County, for each equipment unit provided. The summary sheets shall include, as a minimum, the following information:

1. Equipment Item.
2. Manufacturer.
3. Serial Number.
5. Manufacturer’s Local Representative (address and telephone number).

7.1.4.5.5 O&M Manuals shall include all equipment provided for the Project, and shall be indexed and include a Table of Contents.

7.1.4.6 Manufacturers’ Affidavits

7.1.4.6.1 Equipment manufacturers or their authorized representatives shall each submit a notarized written report with respect to their equipment certifying that:

1. the equipment has been properly installed and lubricated;
2. the equipment is in accurate alignment;
3. the manufacturer was present when the equipment was placed in operation;
4. the manufacturer has checked, inspected and adjusted the equipment as necessary;
5. the equipment is free from any undue stress imposed by connecting piping or anchor bolts;
6. the equipment is not imposing any undue stress on any connecting members;
7. the equipment has been operated satisfactorily under full load conditions;
8. the manufacturer has inspected their equipment during the operational demonstrations and system validation tests to the extent specified; and
9. the equipment is fully covered under the terms of the guarantee.
7.1.4.6.2 Equipment for which Affidavits shall be provided include the following:

1. Emergency Generator.
2. Pumps.
3. Control Panels.

7.2 RESPONSIBILITY AND CARE OF EQUIPMENT

7.2.1 The Contractor shall be responsible for the equipment included in the Project until it has been finally inspected, tested and accepted in accordance with the requirements of these Specifications.

7.2.2 The Contractor shall make their own provisions for properly storing and protecting all material and equipment against theft, injury or damage from any and all causes. Damaged material and equipment shall not be used in the Work.

7.3 FACTORY TESTS

7.3.1 Factory tests shall be performed for each piece of equipment where specifically called for in the section specifying that equipment. Note that factory tests are inherent in many reference standards. The requirement for a factory test in a referenced standard shall make that requirement a part of these Specifications. Factory tests shall be conducted at the same speeds at which the equipment will operate in the field, except where noted otherwise.

7.3.2 Where specifically noted, performance tests may be witnessed by the County. The Contractor shall inform the County of all such performance test scheduling in sufficient time to allow arrangements for a representative of the County to witness of such tests. When non-witnessed tests are performed, the Contractor shall submit certified test results to the County.

7.3.3 Factory testing of pumps shall be done in accordance with the requirements and standards of the Hydraulic Institute. Tests of other equipment shall conform to the requirements set forth in these Specifications.

7.4 EQUIPMENT MATERIALS AND STANDARD REQUIREMENTS

7.4.1 All equipment shall be designed for the service intended, capable of withstanding all stresses which may occur during fabrication, transportation, erection and during continuous or intermittent operation, shall be adequately stayed, braced and anchored, and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details. Materials of construction shall be cathodically compatible.

7.4.2 All equipment and systems shall be designed, fabricated, and assembled with new materials and in accordance with acceptable current engineering and shop practices. Individual parts shall be manufactured to standard sizes and gauges so that repair parts can be installed in the field. Like parts of duplicate units shall be interchangeable. No equipment shall be placed in service at any time prior to delivery, except as required for factory or shop tests.
7.4.3 Unless otherwise specified, equipment or material of the same type or classification used for the same purpose shall be the product of the same manufacturer and shall be the same model.

7.4.4 Equipment and materials provided shall be suitable for the specified service conditions, and shall meet the standard requirements of ANSI, ASME, AWWA, ASTM, NEMB, IBC, UPC, UL, and OSHA.

7.4.5 All equipment weighing over 100 pounds shall be supplied with lifting eyes. Parts of equipment assemblies which are normally serviced separately, such as motors, shall have lifting eyes of their own.

7.4.6 Pressure Vessels

7.4.6.1 All pressure vessels shall be designed, constructed, and tested in compliance with the applicable codes of the ASME. Pressure vessels shall bear the nameplate of the ASME Code and shall be stamped with the Code and symbol by an ASME inspector.

7.4.6.2 A data sheet shall be filled out on ASME Form U-1 by the manufacturer and shall be signed by the manufacturer and the inspector for each pressure vessel marked with the Code U-symbol. All completed data sheets shall be turned over to the County, including X-ray inspections.

7.4.7 Manufacturer’s Nameplate

7.4.7.1 Each piece of equipment and its driver shall be furnished with a corrosion-resistant metal nameplate, fastened to the item in an accessible location. This nameplate shall contain the manufacturer’s name, equipment rating, capacity, size, model, serial number and speed. Data for motors shall be NEMA standard.

7.4.7.2 All information written or printed shall be in English. Each item of equipment shall bear a different serial number. Measurement units shall be given for ratings and capacity.

7.4.7.3 Nameplates for tanks and pressure vessels shall give working pressure, test pressure, vessel plate thickness and ASME Code data.

7.4.8 Each piece of rotating equipment shall have a direction of rotation arrow.

7.4.9 Units of measure shall be shown on the indicating and totalizing dials of all meters, gauges and other measuring devices.

7.4.10 Where dissimilar metals are used in conjunction with each other, suitable insulation shall be provided between adjacent surfaces so as to eliminate direct contact and any resultant electrolysis. The insulation shall be bituminous impregnated felt, heavy bituminous coatings, non-metallic separators or washers, or other approved material. Connections of dissimilar piping materials shall utilize dielectric unions, flanges, couplings or bushings.

7.4.11 For interlock or failure indicating contacts specified to be supplied as part of equipment, the Contractor shall provide SPDT switches rated for 120 volts AC, 60 Hz at 5 amperes resistive or 3 amperes inductive loading, and terminated at screw-type barrier strips in a NEMA 4 enclosure, unless otherwise shown on the Approved Drawings.
7.4.12 Paints and protective coatings for all equipment shall conform to the applicable requirements of Section 10 of these Specifications.

7.4.13 Noise and Vibration

7.4.13.1 Mechanical and electrical equipment shall not create sound levels that are in excess of that permitted by WISHA for 8 hours per worker-day exposure unless otherwise noted on the Approved Drawings for the specific piece of equipment involved. If the equipment in its designated environment cannot meet the required sound level, sound attenuating enclosures shall be provided.

7.4.13.2 Sound attenuating enclosures shall have necessary ventilation to prevent equipment from overheating and shall be constructed so as to allow easy removal for maintenance purposes. Devices necessary for day-to-day operation shall pierce the enclosure or otherwise be accessible without need to remove the enclosure.

7.5 INSTALLATION

7.5.1 The Contractor shall inspect each item of equipment for damage, defects, completeness, and correct operation before installation, and shall inspect previously installed, related Work to verify it is ready for installation of the new equipment.

7.5.2 Prior to installing equipment, the Contractor shall ensure that the installation areas are clean and that concrete and masonry operations are completed. Installation areas shall be maintained in a broom-clean condition during installation operations. Equipment shall be cleaned, conditioned, and serviced in accordance with the approved O&M Manuals and specific requirements included in the applicable sections of these Specifications.

7.5.3 Equipment Bases and Bedplates

7.5.3.1 Equipment assemblies shall be mounted on a single, heavy, cast iron or welded steel bedplate on a grout or concrete base, unless otherwise shown or specified on the Approved Drawings.

7.5.3.2 Bases and bedplates shall be provided with machined support pads, tapered dowels for alignment or mating of adjacent items, adequate openings to facilitate grouting, and openings for electrical conduits. Corners shall be rounded or chamfered and ground smooth. Seams and contact edges between steel plates and shapes shall be welded with a continuous weld, and welds shall be ground smooth. No machinery or piping shall be supported on bedplates other than that which is factory installed. Jacking screws shall be provided in equipment bases and bedplates to aid in leveling prior to grouting.

7.5.3.3 Grout shall not be placed until initial fitting and alignment of connected piping is completed. The Contractor shall level and align equipment on the concrete foundations, then entirely fill the space under base or bedplates with grout. Exposed grout shall be beveled at a 45-degree angle, except around exposed grout at horizontal surfaces for drainage, and shall be troweled to a smooth, dense finish and damp cured with burlap for 3 days. When grout is fully hardened, jacking screws shall be removed and nuts on anchor bolts shall be tightened. The Contractor shall check the installation for alignment and level, and perform approved corrective Work as required to conform to the tolerances given in the applicable O&M Manual.
7.5.3.4 The Contractor shall make an allowance for at least 1-½ inches of grout under the equipment bases, whether or not shown on the Approved Drawings. Shims used to level and adjust the bases shall be steel. Shims may be left embedded in the grout, in which case they shall be installed neatly and so as to be as inconspicuous as possible in the completed Work. Unless otherwise approved, all grout shall be an approved non-shrink, non-metallic grout as described in Section 6.10.2 of these Specifications.

7.5.3.5 Wherever practical, grout shall be placed through grout holes in the equipment base and worked outward and under the edges of the base and across the rough top of the concrete foundation to a peripheral form so constructed as to provide a suitable chamfer around the top edge of the finished foundation.

7.5.4 Anchors and Fasteners

7.5.4.1 Each equipment manufacturer shall furnish the required anchor bolts, nuts and washers of adequate design for securing bases and bedplates to concrete bases. Provide anchor bolts of sufficient length to allow for 1-½ inch of grout under base plates and adequate anchorage into structural concrete, unless otherwise shown or specified on the Approved Drawings.

7.5.4.2 Anchor and assembly bolts and nuts shall be of ample size and strength for the purpose intended. All bolts shall be standard machine bolts, with cold-pressed hexagon nuts. Unless otherwise specified or noted on the Approved Drawings, materials shall be as follows: (1) Bolts in below-ground locations or submerged and embedded in concrete or buried in earth shall be Type 316 stainless steel. (2) Bolts for supports or equipment in above ground locations shall be Type 316 stainless steel with oversized nuts. Provide suitable degauling compounds for bronze and stainless steel threaded components. Any space wholly or partially underground, or having a wall or ceiling forming part of a water channel, is classified as a wet location.

7.5.4.3 Other bolting materials shall be used where specifically called for in these Specifications or on the Approved Drawings.

7.5.4.4 Anchor all non-motor-driven equipment with cast-in-place anchor bolts or drilled-in anchors set with epoxy adhesive except that, where specifically allowed by note on the Approved Drawings, expansion type anchors may be used.

7.5.4.5 Deliver all anchor bolts with templates or setting drawings and verify that bolts are correctly located in accordance with Section 6.10 of these Specifications prior to placing structural concrete.

7.5.5 Safety Guards

7.5.5.1 Safety guards shall be installed where specified herein, or as shown on the Approved Drawings, and shall comply with the requirements of these Specifications, WISHA Standards and “The Principles and Techniques of Mechanical Guarding” (OSHA 2057, 1973), whichever is more stringent.

7.5.5.2 Cover belt or chain drives, fan blades, couplings, exposed shafts, and other moving or rotating parts on all sides with safety guards conforming to all federal, state, and local codes and regulations.
7.5.5.3 All pipes, manifolds, heaters, and other surfaces which have a surface temperature sufficient to burn human tissue shall be covered with a thermal insulating material or otherwise guarded against contact.

7.5.5.4 Guards shall be designed for easy installation and removal, complete with necessary supports, accessories, and fasteners. All supports, accessories, and fasteners shall be hot-dip galvanized. Guards in outdoor locations shall be designed to prevent entrance of rain and dripping water. A tachometer test opening shall be provided in line with ends of shafts. Typically, guards shall be expanded metal on a structural steel frame, except that outdoor guards may be of solid material. Spring-loaded, hinged doors with latch shall be provided for service and lubrication access.

7.5.6 Structural fabrications shall conform to the AISC Code and Specification referenced in Article “Structural Steel Fabrications,” and as shown on the Approved Drawings and these Specifications.

7.5.7 Equipment shall conform to the approved shop drawings and O&M Manuals. The Contractor shall employ skilled craftsmen experienced in the installation of the types of equipment specified. Specialized tools and equipment, such as precision machinist levels, dial indicators, gauges and micrometers, shall be used as applicable. Installations shall be free of vibration or other defects.

7.6 EQUIPMENT START-UP AND ADJUSTMENT

7.6.1 Manufacturer affidavits shall be provided in accordance with Section 7.1.4.6 prior to equipment start-up and adjustment.

7.6.2 The Contractor shall arrange for an authorized, factory-trained representative of the company or companies supplying the various items of equipment to check the installation and adjust and test the equipment furnished before Final Acceptance of the Project. Said representative shall be experienced and knowledgeable of the equipment being tested. Furthermore, the representative shall assist and instruct the County’s operating staff in adjusting and operating the equipment during the initial start-up period.

7.6.3 Field Testing

7.6.3.1 All equipment shall be tested and demonstrated to the County’s representative that proper operation and capacity have been fully complied with. For pumps, this shall include measurement of discharge pressure at the valve box and measurement of pumping rate by volumetric means, or through a suitably calibrated meter for two points on the performance curve. For two-speed pumps, such tests shall be conducted at both speeds. Any test equipment or measuring devices required which are not part of the permanent installation shall be furnished by the Contractor.

7.6.3.2 The Work shall be demonstrated to be in full operating order prior to acceptance. Should any equipment or part thereof fail to operate as intended, it shall be immediately removed and replaced.

7.6.3.3 Sound Level Testing. The Contractor shall measure the sound level developed by all mechanical and electrical equipment provided for the Project. Testing shall be performed in all rooms and spaces containing such equipment during the final operation test program with all equipment operating. OSHA approved instruments shall be used to
record the highest sound level developed in each room and space when measured in accordance with OSHA standards. The Contractor shall provide a certified copy of the test results to the County.

7.7 NON-CLOG SUBMERSIBLE SEWAGE PUMPS

7.7.1 The Contractor shall furnish and install the quantity and model of pumps as shown on the Approved Drawings. The pumps shall be manufactured by Fairbanks Morse, unless otherwise shown on the Approved Drawings or approved by the County, and shall be UL listed for explosion proof Class I, Division 1, Group C and D explosion proof locations as defined by the NEC. The pumps shall be capable of handling raw, unscreened sewage, and the pumps, with all appurtenances and cable, shall be capable of continuous submergence underwater to a depth of 65 feet without loss of watertight integrity.

7.7.2 The pumps shall be capable of providing the hydraulic conditions specified on the Approved Drawings and in the design report.

7.7.3 Submittals

7.7.3.1 Shop Drawings. The Contractor shall submit shop drawings of the pumps for approval by the County. Sufficient data shall be included to show that the equipment conforms to the requirements of the Approved Drawings, the design report, and these Specifications, and shall show that the pumps, along with driver supports and anchorage, will resist seismic forces. In addition to the shop drawings for each pump, the Contractor shall submit information on the moment of inertia of the rotating elements, in units of pounds-feet squared, and radius of gyration.

7.7.3.2 Factory Testing. Factory performance tests shall be performed for each pump in accordance with the standards of the Hydraulic Institute. Certified factory performance test results shall be submitted to the County. In addition to the performance testing, the following items shall be conducted and submitted to the County for review:

7.7.3.2.1 The pump manufacturer shall perform the following inspections and operational tests on each pump before shipment from the factory:

1. Impeller motor rating and electrical connections shall first be checked for compliance to the customer’s purchase order.
2. A motor and cable insulation test for moisture content or insulation defects shall be conducted.
3. Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.
4. The pump shall be run submerged in water to a minimum depth of 6 feet.
5. After operational test No. 4, the insulation test (No. 2) shall be performed again.

7.7.3.2.2 A written report stating the foregoing inspections and operational tests have been conducted shall be supplied with each pump at the time of shipment.

7.7.3.2.3 Upon receipt of the County’s approval, the pumps may be shipped to the job site. The pump manufacturer shall notify the County of testing dates as the County may wish to witness pump tests.
7.7.3.3 The Contractor shall furnish detailed O&M manuals and parts list, complete with manufacturer’s part numbers, for each pump in accordance with Section 7.1.4.5 of these Specifications.

7.7.3.4 The Contractor shall furnish affidavits from the manufacturer’s representative in accordance with Section 7.1.4.6 of these Specifications, stating that the equipment has been properly installed and tested and is ready for full-time operation.

7.7.3.5 The manufacturer shall warranty the units supplied against defects in workmanship and material for a period of at least 5 years or 10,000 hours of operation, whichever is longer, beginning on the date of final acceptance by the County. The warranty shall be in printed form and shall apply to all similar units.

7.7.4 Seismic Protection. The equipment in this Section is classified as essential for seismic protection.

7.7.5 Pump Design and Construction

7.7.5.1 The discharge connection elbow shall be permanently installed in the wet well along with the discharge pipe. The pump(s) shall be automatically connected to the discharge connection elbow when lowered into place, and shall be easily removed for inspection or service. There shall be no need for personnel to enter the wet well in order to remove the pump(s).

7.7.5.2 Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump. A sliding guide bracket shall be an integral part of the pump unit. The entire weight of the pumping unit shall be guided by no less than two Type 316 stainless steel guide bars and pressed tightly against the discharge connection elbow with metal-to-metal contact. Sealing of the discharge interface by means of a diaphragm, O-ring, or other device(s) will not be acceptable.

7.7.5.3 No portion of the pump shall bear directly on the floor of the wet well.

7.7.5.4 Volute and Sliding Bracket. The volute shall be made of close-grained cast iron conforming to ASTM A48 Class 30. It is to be one-piece, constant velocity equalizing pressure with smooth fluid passages large enough to pass any size solid that can pass through the impeller. It shall have single vane design. The sliding bracket assembly shall be a part of the pumping unit constructed so that, when lowered to the discharge base/elbow, the vertical metal-to-metal seal provides a self-cleaning, non-clogging, UL listed, non-sparking assembly.

7.7.5.5 Connections. All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber O-rings. Fittings shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces. This will result in controlled compression of nitrile rubber O-rings without the requirement of a specific torque limit. No secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease or other device(s) shall be used.
7.7.5.6 Power Cable

7.7.5.6.1 Cable leads are to allow the connection of a cable to the motor, to be accomplished in the field without soldering cable. All leads are to be sealed and designed to prevent cable-wicking to the conduit box located on top of the motor. Grommets or other similar sealing systems are not acceptable.

7.7.5.6.2 The power cable shall be of adequate length to run from the wet well to the electrical control panel in a continuous run. No splices will be acceptable. Cable length shall be included in the pump submittal information.

7.7.5.7 Pump Shaft. The pump shaft shall be constructed of Type 416 stainless steel. This is a nickel-bearing chromium steel designed for heat treatment to high mechanical properties, providing superior corrosion resistant characteristics.

7.7.5.8 Pump Seal

7.7.5.8.1 Each pump shall be provided with a tandem mechanical rotating shaft seal system. Seals shall run in an oil reservoir which will be equipped with a moisture detection device wired internally to the cable. Lapped seal faces must be hydrodynamically lubricated at a constant rate.

7.7.5.8.2 The lower seal unit, between the pump and the oil chamber, shall contain one stationary silicon carbide and one positively driven rotating tungsten carbide ring. The upper seal unit, between the oil sump and motor housing, shall contain one stationary ceramic ring and one positively driven rotating carbon ring. Each interface shall be held in contact by its own spring system.

7.7.5.8.3 Shaft seals without positively driven rotating members or conventional, double-mechanical seals containing either a common single or double spring acting between the upper and lower units shall not be considered acceptable nor equal to the dual independent seal specified, as this conventional system requires a pressure differential to offset external pressure and to effect sealing.

7.7.5.8.4 The seals shall require neither maintenance nor adjustment, but shall be easily inspected and replaceable.

7.7.5.9 Bearings. The pump shaft shall rotate on two permanently lubricated bearings. The upper bearing shall be a single-row ball bearing and the lower bearing shall be a two-row, angular contact ball bearing. The bearings shall have a minimum B-10 life of 40,000 hours at or near brake horsepower.

7.7.5.10 Impeller

7.7.5.10.1 The impeller shall be of gray cast iron, Class 30, dynamically balanced, double-shrouded, non-clogging design having a long thrulet without acute turns, and capable of handling solids, fibrous materials, heavy sludge, and other matter found in normal sewage applications.

7.7.5.10.2 The pump manufacturer shall provide mass moment of inertia data for the proposed impeller when so requested by the County.
7.7.5.10.3 The impeller shall be capable of passing a minimum 3-inch solid sphere. The impeller shall be fastened to the pump motor shaft by a key and bolt, and shall be fitted with a stainless steel wear ring as specified herein.

7.7.5.11 Wear Ring. A wear ring system shall be installed to provide efficient sealing between the volute and impeller. The wear ring shall consist of a stationary ring made of hardened stainless steel, which is drive-fitted to the volute inlet.

7.7.5.12 Pump Motor

7.7.5.12.1 Each submersible solids handling pump shall be driven by a completely sealed, electric submersible squirrel cage induction motor meeting the service conditions specified on the Approved Drawings and in the design report. The motor nameplate horsepower rating shall not be exceeded by the brake horsepower requirements of the specified head and capacity conditions.

7.7.5.12.2 The submersible motor shall be UL listed for Class I, Division 1, Group C and D explosion-proof locations as defined by the NEC. All electrical parts shall be housed in an air filled (or oil filled in 210 frame) cast, watertight enclosure which is sealed by the use of O-rings, and shall have rabbet joints with an extra large overlap.

7.7.5.12.3 The stator winding and lead shall be insulated with moisture-resistant Class F insulation for continuous duty in 40º C rise liquids. The motor shall be designed for continuous duty capable of a minimum ten (10) starts per hour. At the design point the motor shall not draw more than 6 HP at the rated voltage. Motor shaft shall be constructed of Type 416 stainless steel. The rotor is to be dynamically balanced to meet NEMA vibration limits; all hardware to be stainless steel.

7.7.5.13 Spare Parts. The Contractor shall furnish the following spare parts for each pump:

1. Impeller with design trim;
2. Volute and impeller wear rings; and
3. Mechanical seal assembly (both inner and outer)

7.7.5.14 Design Concurrence. Submitting a proposal will be proof that the pump manufacturer concurs with the pump design layout for the Project, and that said manufacturer’s equipment is rated to operate without vibration throughout the specified operating range.

7.7.6 Guide Rail System

7.7.6.1 The contractor shall provide and install a stainless steel guide rail system, supplied by the pump manufacturer (Fairbanks Morse Pump Corporation), as shown on the Approved Drawings.

7.7.6.2 The minimum acceptable guide rail size shall be 2 inch stainless steel pipe. All brackets shall be stainless steel. The system shall provide for a smooth, accurate pump removal and installation.

7.7.6.3 An intermediate guide rail bracket, as supplied by the pump manufacturer (Fairbanks Morse Pump Corporation), is required for rail lengths in excess of 20 feet.
7.7.6.4 A pump lifting chain shall be installed as shown on the Approved Drawings and as indicated in the Standard Plans. The chain shall be rated at 150 percent of the pump weight, and shall include clevises at each end constructed of Type 316 stainless steel.

7.7.7 All equipment shall be installed in strict accordance with the manufacturer’s installation instructions, the Approved Drawings, and these Specifications.

7.7.8 Field Testing

7.7.8.1 The pump shall be tested at startup, and the voltage and current parameters recorded. The manufacturer shall provide a formal test procedure and results shall be recorded on the County’s standard form.

7.7.8.2 The guide rail system shall be tested to ensure smooth pump removal and installation.

7.7.8.3 The pumps shall be removed and disassembled by the Contractor in order for the County representative to inspect the volute and impeller casting for flaws. The Contractor shall install new gaskets prior to re-assembly.

7.8 CHEMICAL FEED ODOR CONTROL SYSTEM

7.8.1 The Contractor shall provide a chemical feed odor control feed system, if required, to meet the design conditions shown on the Approved Drawings and in these Specifications.

7.8.2 The system shall be a “Bioxide Feed System” as manufactured by US Filter/Davis Process. Model numbers shall be as specified in the design conditions shown on the Approved Drawings and in these Specifications.

7.8.3 Chemical Feed System Construction

7.8.3.1 Chemical Storage Tank. The chemical storage tank shall be a 4,200-gallon “SP061-U” upright polyethylene tank, as manufactured by Poly Processing, or an Approved Equal. The tank shall be constructed in accordance with the requirements of the latest edition of ASTM.

7.8.3.2 Control and Calibration Unit Enclosure. The control enclosure shall be UL approved and constructed of Type 316 stainless steel. The enclosure shall be sized to contain: two 24-hour time clocks; one 15-amp circuit breaker; one GFCI receptacle; five On/Off switches with LED indicator lights; and one calibration cylinder with flow control valves as manufactured by Siemens Water Technologies.

7.8.3.3 Bellows Pump. The Contractor shall provide two bellows-style chemical feed pumps; one pump shall be a “Model #15907-001” and the other a “Model #15907-002” as manufactured by Siemens Water Technologies, or Approved Equal.

7.8.3.4 Pipe Stand. The pipe stand shall be constructed of Type 316 stainless steel.

7.8.3.5 Piping Kit. The piping kit shall contain: 40 feet of 2-inch schedule 80 PVC pipe; one 2-inch diameter aluminum male Camlock; one 2-inch diameter PVC female Camlock cap; one 2-inch diameter ball valve; and all necessary fittings.
7.8.3.6 Ultrasonic Level Indicator System. The Contractor shall provide a "HydroRanger 1" ultrasonic level and volume measurement indicator system, as manufactured by Siemens Milltronics, conforming to the following requirements:

1. Housing – Shall be housed in a Polycarbonate CSA type 4/NEMA 4, IP65 rated enclosure measuring 6.3 inches by 9.5 inches by 3.2 inches.
2. Weight – Shall be more than 4 pounds.
3. Relays – Five form "C" (SPDT) relays shall be used. They shall be 220 volts AC, 5 amps non-inductive; contacts assignable as alarms, pump control, sample on time or flow, or totalizer.
4. Range – Shall be able to measure from 0.3 m to 10 m from the face of the sensor.
5. Resolution – The greater of ±0.1 percent of range or 2 mm.
6. Accuracy – ±0.25 percent of range.
7. Temperature Range – Shall operate to within specification from -20º C to 50º C.
8. Temperature Compensation – Range readings must be compensated for the changes of the speed of sound in air. A TS-3 probe with process temperature limits of -40º C to 73º C shall be used.
9. pH – Shall be able to withstand pH ranges of 3 to 10 without damage to the sensor or reduced functionality.
10. Cable Length – Shall support a standard cable length of 10 m.
11. Redundancy – All combinations of transmitters and receivers (one to another) shall be used to determine the depth range for each depth reading measured.
12. Measurement Technique – Shall measure the elapsed time between the transmission of the ultrasonic and the return echo. Measurements shall be repeated automatically and a statistical analysis shall be performed of the return echoes to determine and discard false or multiple echoes. Digital signal processing shall be used to detect the true water surface return. The results shall be averaged into an averaged elapsed time. The distance between the transmitter and the water surface shall be automatically calculated and the final range measurement shall be converted to flow depth and stored in the data logger memory.
13. Telemetry Output – An isolated 4-20 ma output, 1,000-ohm load maximum, shall be provided with the level sensing unit.
14. Power Input – 120 volts AC.

7.8.3.7 Bioxide. The Contractor shall provide 4,000 gallons of Bioxide as manufactured by US Filter/Davis Process. The solution shall be stored such that it does not come in contact with air (to avoid drying), organics, chlorine or hypochlorite products, and any caustic products.

7.8.3.8 Special Tools. The Contractor shall furnish two sets of any special tools necessary for the replacement of parts and the adjustment of the equipment.

7.8.3.9 O&M Manuals. The Contractor shall furnish two sets of complete O&M Manuals in accordance with Section 7.1.4.5.

7.8.3.10 Design Concurrence. Submitting a proposal will be proof that the manufacturer concurs with the design layout for the Project and that said manufacturer’s equipment is rated to operate without vibration throughout the specified operating range.
7.8.3.11 Conduit Installation. The Contractor shall be responsible for installing the following electrical conduits: one ¾-inch PVC to supply power to the chemical feed control panel; and one ¾-inch PVC from the US Filter supplied level sensor to the pump control panel.

7.9 ACTIVATED CARBON ODOR CONTROL SYSTEM

7.9.1 The Contractor shall provide activated carbon odor control system, if required, to meet the design conditions shown on the Approved Drawings and in these Specifications.

7.9.2 Activated Carbon System Construction

7.9.2.1 Modular Adsorber Unit

7.9.2.1.1 The modular adsorber unit shall be a “VentSorb-PE System” as manufactured by Calgon Carbon Corporation, or Approved Equal.

7.9.2.1.2 The adsorber unit shall be manufactured of 125-mil thick HMW high-density polyethylene (HDPE), or Approved Equal. The adsorber shall have no moving parts.

7.9.2.1.3 The adsorber shall support the carbon bed on a polyethylene grating and screen. Adsorber design shall utilize “Plug Flow” air distribution; influent air shall enter below the carbon bed support grating; this area shall pressurize equally and the air shall pass through the carbon bed uniformly, exiting through the outlet nozzle at the top of the vessel.

7.9.2.1.4 The adsorber unit shall be operable as a passive odor control system, requiring no energy to operate.

7.9.2.1.5 The adsorber unit shall have the following features:

1. Inlet: 4-inch FNPT coupling, PE construction.
2. Outlet: 4-inch FNPT coupling, PE construction.
3. Cover: Removable PE cover, 175-mil thick HMW-HDPE, 16-gauge bolt ring with polyurethane gasket.

7.9.2.1.6 The adsorber shall be capable of operation at an air flow rate of 200 CFM with a maximum head loss of 4 inches W.C.

7.9.2.1.7 The adsorber unit shall be rated at ±2 psig.

7.9.2.2 Activated Carbon

7.9.2.2.1 The activated carbon shall be “Centaur HSV” type carbon, as manufactured by Calgon Carbon Corporation, or an Approved Equal.

7.9.2.2.2 The Contractor shall provide 200 pounds of activated carbon to fill each modular adsorber unit. The activated carbon shall come preloaded in the modular adsorber units. The activated carbon shall be virgin granular activated carbon, derived from bituminous coal, and shall be suitable for the vapor phase adsorption of
sewage treatment odors. No chemical impregnation of the activated carbon is permitted. The activated carbon shall have the following specifications:

1. Iodine No., mg/g: ................................................................. 800 (min)
2. Butane Activity, weight %: .................................................. 16 (min)
3. Ash, weight %: ................................................................... 8 (max)
4. Moisture, weight % as packed: ............................................. 4 (max)
5. Hardness No.: ................................................................. 95 (max)
6. Apparent Density, g/ml: ...................................................... 0.56 (min)
7. Mean Particle Diameter, mm: ............................................. 3.7 (min)
8. H₂S Breakthrough Capacity, g H₂S removed/cc Carbon: ........ 0.09 (min)

7.9.2.2.3 The determination of H₂S breakthrough capacity will be made by passing a moist (85 percent relative humidity) air stream containing 1 percent H₂S at a rate of 1,450 cubic centimeters per minute through a 19-mm diameter by 9-inch deep bed of uniformly packed activated carbon and monitored to 50-ppm breakthrough. Results are expressed in grams H₂S removed per cubic centimeter of carbon.

7.9.2.2.4 The carbon supplied shall be of a type that does not require chemicals to be regenerated in-place. Carbons which require hydroxide, permanganate, chlorine, organic or other solutions, except clean water, to regenerate the material will not be accepted.

7.9.2.3 Blower. The blower shall be a “New York Blower, Model #CGI-106” with 1.5-HP TEXP – explosion-proof motor as manufactured by New York Blower, Inc., or Approved Equal.

7.9.2.4 Fittings. All fittings and piping shall be installed as shown on the Approved Drawings and in accordance with these Specifications.

7.9.2.5 O&M Manuals. The Contractor shall furnish two complete sets of O&M Manuals in accordance with Section 7.1.4.5.

END OF SECTION
SECTION 8

ELECTRICAL SYSTEMS

8.1 GENERAL

8.1.1 This Section includes furnishing and installing all electrical systems and appurtenances for sanitary sewer pump stations. The Contractor shall provide and install all required equipment, conduits, conductors and cables, including those specified herein, shown on the Approved Drawings, and those neither specified nor shown on the Approved Drawings but, nonetheless, required for satisfactory interconnection and operation of all electrical, mechanical and instrumentation equipment either shown on the Approved Drawings, specified in the respective portions of these Specifications or otherwise required.

8.1.2 Auxiliary Devices. Provide conduit and wire for power and control of all auxiliary devices such as solenoid valves, pressure switches, instruments, etc. This requirement applies to auxiliary devices shown on the Approved Drawings, specified in these Specifications or otherwise required by approved shop drawings. As a minimum and unless otherwise noted, the Contractor shall provide ¾-inch conduit with two No. 12 conductors for discrete systems or with one twisted shielded pair for analog systems.

8.1.3 Quality Assurance

8.1.3.1 All electrical equipment and materials, including their installation and testing, shall conform to the following applicable codes:

1. National Electrical Code (NEC), most current edition;
2. Electrical Construction Code, Chapter 296-44 WAC; and
3. General Safety and Health Standards, Chapter 296-44 WAC.

8.1.3.2 In instances where two or more codes are at variance, the most restrictive requirements shall apply.

8.1.3.3 Equipment shall conform to the applicable EIA, IEEE, and NEMA standards. The revisions of these standards in effect on the date of issuance of the governing jurisdiction's permit shall apply.

8.1.3.4 Underwriters Laboratories (UL) listing shall be required for all equipment and materials where such listing is offered by the Underwriters Laboratories.

8.1.4 Drawings

8.1.4.1 The general layout of the completed construction shall be governed by the electrical details shown on the Approved Drawings and by these Specifications. Except where special details are used to illustrate the method of installation or a particular piece or type of equipment or material, the requirements or descriptions in this Specification shall take precedence in the event of conflict.
8.1.4.2 Locations of equipment, inserts, anchors, motors, panels, pull boxes, manholes, conduits, stub-ups, fittings, lighting fixtures, power and convenience outlets, exterior lighting units and ground wells are approximate unless dimensioned. The Contractor shall field verify scaled dimensions shown on the Approved Drawings.

8.1.4.3 Review the Drawings and Specifications of other trades and perform the electrical Work that will be required for the installations.

8.1.4.4 Should there be a need to deviate from the electrical details shown on the Approved Drawings and from these Specifications, the Contractor shall submit written details and reasons for all changes to the County for approval.

8.1.4.5 Record Drawings. The Contractor shall maintain a complete and accurate set of record drawings for the electrical construction as the Work progresses. All Work that is other than described on the Approved Drawings shall be recorded, and all underground conduits shall be located by accurate, field-measured dimensions from the walls/foundation corners of surrounding structures. Upon completion of the Work, the Contractor shall provide the County with final record drawings on reproducible bond paper measuring 22 inches by 34 inches.

8.1.5 Submittals

8.1.5.1 Materials List. The Contractor shall submit manufacturer’s catalog cuts for each item for which shop drawings are not required. The catalog cuts shall include the manufacturer’s name, be identified by reference to the applicable Specification paragraph or Approved Drawings sheet number, and provide sufficient information to show that the materials meet the requirements of the Approved Drawings and these Specifications.

8.1.5.2 Shop Drawings

8.1.5.2.1 The Contractor shall submit shop drawings for each item listed below and for all equipment where shop drawings are required in the equipment specifications. The shop drawings shall include any data specifically required by the equipment specifications. A single complete submittal is required for all products covered by this Section.

1. Dry Type Transformer, nameplate data to include:
   a. KVA rating;
   b. Nominal primary voltage;
   c. Tap voltages;
   d. Nominal secondary voltage;
   e. Percent impedance;
   f. Weight; and
   g. Physical dimensions and mounting requirements.
2. Panelboard:
   a. Panelboard type;
   b. Main bus and terminal connections;
   c. Location of line connections;
   d. Cabinet dimensions;
   e. Gutter space;
   f. Gauge of boxes and fronts;
g. Finish data;
h. Voltage rating; and
i. Breaker types and trip ratings.

3. Seismic Requirements. All equipment installed for the Project shall be anchored, tied, restrained, or attached to the structure in such a manner that such equipment will remain in place and functioning when subjected to seismic forces for the seismic zone in which the facilities are located. All Subcontractors and suppliers shall be directed to furnish and install equipment and to provide anchorage in a manner that will conform to these requirements. The following listed equipment is classified as “essential”, as defined in the latest edition of the Uniform Building Code as accepted by the County. Shop drawings shall show anchorage provisions which comply with these seismic requirements for the following equipment:
   a. Control Panels.
   b. Engine-Generator Set.
   c. Load Banks.

8.1.5.2.2 The Contractor shall revise the manufacturer’s shop drawings to show any as-built changes to terminals and wire coding. Prior to Final Acceptance of the Project, the Contractor shall provide one complete set of as-built drawings to the County for approval. The approved drawings shall be submitted in both hard copy and digital format.

8.1.5.3 O&M Manuals. The Contractor shall furnish complete O&M Manuals as described in Section 7.1.4.5 for all equipment. Each manual shall include the name of the equipment, record shop drawings, operation and maintenance instructions, parts ordering data, and ratings for the equipment furnished for the Project. Manuals shall be submitted in both hard copy and digital format.

8.1.5.4 Spare Parts. The Contractor shall provide a complete set of spare fuses for each size and type of fuse installed.

8.1.6 Factory Inspections. The County may inspect the fabricated equipment at the factory before shipment to the job site. The Contractor shall provide the Inspector with sufficient notice so that an inspection can be arranged at the factory prior to shipment. Inspection of the equipment at the factory by the County will be made after the manufacturer has performed satisfactory checks, adjustments, tests, and operations. Equipment approval at the factory only allows the manufacturer to ship the equipment to the job site. The Contractor shall be responsible for the proper installation and satisfactory start-up operation of the equipment to the satisfaction of the manufacturer and the County.

8.1.7 Special Locations and Atmospheres. All equipment and materials shall be suitable for the locations and atmospheres in which they are located.

8.1.7.1 Hazardous Locations. Hazardous areas and classifications should be shown on the Approved Drawings. Electrical equipment, materials and installation in these areas shall comply with the Code requirements for such specified areas.

8.1.7.2 Wet Locations. All locations exposed to the weather, whether under a roof or not, are wet locations. In addition, all spaces wholly or partially underground, or having a wall or ceiling forming part of a channel or tank, shall be considered wet locations.
8.1.7.3 Damp Locations. Indoor locations not otherwise specified are damp locations.

8.1.8 Nameplates

8.1.8.1 Each piece of electrical equipment shall have a manufacturer’s nameplate showing their name, location, the pertinent ratings and the model designation.

8.1.8.2 Each piece of equipment and related controls, to include all items on the control panel door, shall be identified with a rigid laminated engraved phenolic nameplate. Engraving shall be black background with white letters. Edges shall be beveled, showing a white border. Nameplates shall be engraved with the inscriptions indicated on the Approved Drawings and, if not so indicated, with the equipment name. Nameplates for which no inscription is indicated on the Approved Drawings shall be furnished with an appropriate inscription by the Contractor upon prior request by the County.

8.1.8.3 Each device which indicates the operation of the equipment, or which may be operated to affect the equipment shall have an integral legend plat or nameplate indicating the device function. These shall be inscribed as indicated on the Approved Drawings or as approved by the County.

8.1.8.4 Nameplates shall be securely fastened in place using two stainless steel screws or, where approved by the County, with epoxy cement, and shall be thoroughly cleaned after installation.

8.1.9 Fasteners. Fasteners for securing equipment to walls, floors, etc. shall be stainless steel.

8.2 RACEWAYS, CONDUCTORS, AND MISCELLANEOUS EQUIPMENT AND INSTALLATION

8.2.1 Raceways. The minimum raceway size shall be ¾-inch diameter. Raceway material shall be determined by the surrounding atmosphere as follows:

1. “Damp” or “Wet” Locations – Conduit shall be PVC Schedule 40, approved for underground use and 90° C wires, unless otherwise shown on the Approved Drawings.
2. “Hazardous” Locations – Conduit shall be PVC factory coated rigid galvanized steel. PVC coated conduits shall be manufactured by OCAL-BLUE, Rob Roy or Approved Equal.

8.2.2 Conduit Supports. Supports for individual conduits shall be stainless steel with conduit spacer.

8.2.3 Fittings

8.2.3.1 All electrical fittings shall conform to the requirements of these Specifications.

8.2.3.2 Fittings for use with rigid steel shall be galvanized cast ferrous metal with gasketed cast covers, as manufactured by Crouse Hinds, Appleton Electric, or Approved Equal.
8.2.3.3 Fittings for use with PVC conduit shall be PVC and shall have solvent-weld-type conduit connections. If such are not available, then the specification for rigid steel fittings above shall apply, except in corrosive locations where PVC coating shall be additionally provided.

8.2.3.4 Fittings for flexible conduit shall be Appleton Type ST or Q-Z/Gedney Series 4Q.

8.2.3.5 Union couplings for conduits shall be the Erickson type and shall be Appleton Type EC or O-Z/Gedney 3-piece Series 4. Threadless couplings shall not be used.

8.2.3.6 Bushings shall be the insulated type. Bushings for rigid steel shall be insulated and grounded, O-Z/Gedney Type BLG or Appleton Type GIB.

8.2.3.7 All fittings installed in “Hazardous” locations shall be PVC factory coated rigid galvanized steel. PVC coated fittings shall be manufactured by OCAL-BLUE, Rob Roy or Approved Equal.

8.2.4 Electrical Boxes

8.2.4.1 All electrical boxes shall conform to the requirements of these Specifications.

8.2.4.2 Outlet and junction boxes for use with rigid steel conduit shall be hot-dip galvanized cast ferrous metal covers.

8.2.4.3 Pullboxes for use with steel conduit shall be of sheet steel and of the size shown on the Approved Drawings. Minimum sheet steel thickness shall be per NEC; however, thicker steel shall be provided if required for satisfactory box fabrication. Covers shall be fastened with stainless steel screws at no more than 12-inch spacing. Pullboxes shall have gaskets and drains. Each pullbox shall have a grounding lug, and shall have a factory or shop applied final paint finish except where installed in a “Wet” location. Pullboxes and covers shall be hot-dip galvanized after fabrication.

8.2.4.4 Underground pullboxes shall be precast concrete type and shall include a cover, base, body, pulling irons, drain and cable racks as indicated on the Approved Drawings. Pullbox hardware shall be hot-dip galvanized after fabrication. Pullboxes shall be suitable for an imposed load of AASHTO HS-20 and shall have a minimum size as shown on the Approved Drawings.

8.2.4.5 Boxes for use in PVC conduit systems shall be non-metallic, NEMA 4X and UL listed.

8.2.5 Conductors

8.2.5.1 All conductors shall be copper. Wire or cable not specifically shown on the Approved Drawings or specified herein, but nonetheless required, shall be of the type and size required for the application and in conformance with the applicable Code.

8.2.5.2 Power and control wire operating 600 volts or less shall be UL type THHN. The Contractor shall provide stranded copper conductors for No. 10 AWG and smaller, and Class B strand copper for No. 8 AWG and larger. Power wire shall be No. 12 AWG or
larger. Power wire shall be black; neutral wire, white; and ground wire, green. Control wire shall be red No. 14 AWG or larger.

8.2.5.3 The Contractor shall provide fixture wiring in fixtures at equipment where the specified power and control wire does not have the required temperature rating. Fixture wire shall be 600-volt, silicone rubber insulated, 200º C, UL Type SF-s fixture wire with stranded copper conductors.

8.2.5.4 The Contractor shall provide cords for equipment where a cord connection is required. Cords shall be 600-volt, 2-conductor with ground, Type SO cord. Cords shall be of adequate length and shall have a 15-amp, grounding-type plug attached.

8.2.5.5 Other Wiring. Wire not specified in any of the foregoing shall be as specified for power and control wiring, except where such wire would not be suitable; then the wire shall be the type suited for application as approved by the County.

8.2.5.6 Where special wiring is proposed by an equipment manufacturer, the Contractor shall submit the special wiring requirements to the County for approval. Special wire shall be the type required by the equipment manufacturer, as approved by the County.

8.2.5.7 Low Voltage Terminations. The Contractor shall provide each stranded conductor with a terminal lug having a crimp type sleeve connection to the conductor, except where the equipment to which it is connected has box-type terminal lugs no separate lug will be required.

8.2.5.8 Wire markers shall be plastic sleeve type. Wire numbers shall be permanently imprinted on the markers. Permanently identify each wire at each termination by means of a heat-shrink numbered sleeve.

8.2.6 Wiring Devices

8.2.6.1 All devices shall be flush type in suitable boxes. They shall be back and side wired, with screw terminals. Provide ivory-colored devices in all locations. Switches shall be rated 120/277 volts AC, 20 amperes. Receptacles for general use shall be GFCI type, parallel blade, 2-pole, 3-wire, grounding type, 20 amps, 125 volts AC, and NEMA Configuration 5-20R. Devices shall be manufactured by Leviton, GE or Approved Equal.

8.2.6.2 Boxes. Where associated raceways are exposed, boxes shall be surface mounted, cast ferrous metal with threaded hubs, unless otherwise shown on the Approved Drawings. Where raceways are concealed in dry wall construction, boxes shall be flush-mounted, pressed steel. Where raceways are concealed in concrete or CMU walls, boxes shall be cast ferrous type with threaded hubs.

8.2.6.3 Covers. On cast boxes in wet, dry or outdoor locations, covers shall be weatherproof, cast ferrous metal with single receptacle and threaded cap, and shall be suitable for use with the devices installed.

8.2.7 Dry-Type Transformers. Transformers for supplying lighting and small power loads shall be dry-type, general purpose, 2-winding, 60 hertz with Class F or Class H insulation. Capacity ratings and voltages shall be as shown on the Approved Drawings. Transformers
shall comply with all applicable provisions of NEMA Standard ST20, latest revision, and shall have NEMA Standard taps. Transformers shall be indoor type with low sound levels.

8.2.8 Panelboards

8.2.8.1 All panelboards shall be the automatic circuit breaker type. The number and arrangement of circuits, trip ratings, spares and blank spaces for future circuit breakers shall be as shown on the Approved Drawings. All circuit breakers shall be quick-make, quick-break, thermal magnetic type and 1, 2 or 3-pole as shown.

8.2.8.2 Each panelboard shall have a field mounted identifying plastic nameplate indicating the panel identification as shown on the Approved Drawings. In addition, each panelboard shall have a manufacturer’s nameplate showing the voltage, bus rating, phase, frequency and number of wires.

8.2.8.3 For panelboards used in dry locations, finish of doors and trim shall be per the manufacturer’s standard. Boxes of all such panelboards shall be hot-dip galvanized, field finished to match the fronts.

8.2.8.4 Panelboards located in “Damp” locations or outdoors shall have NEMA 4X enclosures.

8.2.8.5 Panelboards and enclosures shall conform to the standards of Underwriters Laboratories and the requirements of all relevant Codes.

8.2.8.6 Panelboard lighting shall be rated as shown on the Approved Drawings. Panelboards shall meet the requirements of Federal Specification W-P-115a for Type I, Class 1 panelboards with circuit breakers.

8.2.8.7 Panelboards shall have front doors with key latch, common keying and a typed director card and holder.

8.2.8.8 Panelboard circuits shall be arranged with odd numbers on the left and even numbers on the right. Circuit breakers shall be the molded case type with ratings as shown on the Approved Drawings. Circuit breakers shall have interrupting ratings of 10,000 RMS symmetrical amperes at 120/240 volts.

8.2.8.9 Panelboards shall be General Electric Style NCP with TEB circuit breakers, Westinghouse Type WEB and EB circuit breakers, or Approved Equal.

8.2.9 Phase Arrangement. The phase arrangement on 3-phase buses shall be labeled “A”, “B”, and “C” from front to back, top to bottom or left to right, as viewed from the front of the switchboard or panelboard. The “B” phase shall be that phase having the higher voltage to ground on 3-phase, 4-wire delta-connected systems.

8.2.10 Raceway, Fitting, and Box Installation

8.2.10.1 From pull point to pull point, the sum of the angles of all of the bends and offsets shall not exceed 270 degrees.

8.2.10.2 The contractor shall provide insulated type metallic grounding bushings for metallic conduits at all boxes and equipment. All conduits shall be bonded together to
provide continuity of the equipment grounding system. The bonding conductor shall be sized in accordance with the provisions of the NEC.

8.2.10.3 All underground raceways shall be sloped to provide drainage.

8.2.10.4 Conduit supports shall be installed as required by the applicable provisions of the NEC. All conduits shall be exposed, except where otherwise shown on the Approved Drawings. The Contractor shall support all exposed conduits within 1 foot of any outlet, and at intervals not exceeding NEC requirements. The Contractor shall coordinate conduit locations with piping, equipment, fixture, and with structural and architectural elements of the Project.

8.2.10.5 Exposed conduits fastened to the surface of a concrete structure shall be supported by one-hole clamps with conduit spacers or by channels. Wherever possible, group conduits together and support on common supports. Groupings shall be in horizontal runs located away from walls and shall be supported on trapeze hangers. Such conduits shall be arranged uniformly and neatly. Trapeze hangers shall consist of adequately sized channels, suspended by rods or other suitable means from the ceiling or from pipe hangers as approved by the County. Such runs shall be installed so as not to interfere with the operation of valves or any other equipment, and shall be kept at least 6-inches clear of any pipe that may operate at more than 100º F. Cut surfaces or damaged ends shall be treated with corrosion-resistant coatings, such as “Devcon Z”, in accordance the coating manufacturer’s instructions.

8.2.10.6 Conduits embedded in concrete shall have concrete cover at least equal to the reinforcing steel; shall be spaced no less than three diameters apart except where they cross at angles greater than 45 degrees; and shall be installed so as not to reduce the structural integrity of the concrete element.

8.2.10.7 The Contractor shall provide watertight expansion fittings and bonding jumpers when expansion joints are crossed, whether conduit is embedded or exposed. In “Hazardous” locations, the Contractor shall provide Crouse Hinds UNF/UNV, or an equivalent Appleton product. In all other locations, the Contractor shall provide Crouse Hinds XD, or an equivalent Appleton product.

8.2.10.8 All empty raceways shall be capped with an electrical fitting.

8.2.11 Conductor Installation

8.2.11.1 The raceway construction shall be complete, and all conduits shall be swabbed clean and protected from the weather before cable is pulled into it.

8.2.11.2 The Contractor shall exercise care in pulling wires and cables into conduit or raceways so as to avoid kinking, putting undue stress on the cables, or otherwise abrading them. Soapstone, talc, or other UL-approved pulling compound may be used to lubricate wires and cables as necessary when pulling. Under no circumstances shall grease be used.

8.2.11.3 Incoming wires and cables No. 6 AWG and smaller shall be bundled in panels and motor control centers; tied at intervals not greater than 6 inches; and neatly spread into trees and connected to their respective terminals. The Contractor shall allow sufficient slack in cables for alterations to terminal connections. Lacing shall be made
with plastic cable ties. Where plastic panel wiring duct is provided for cable runs, tying is not necessary when the cable is properly installed in the duct.

8.2.11.4 The Contractor shall utilize extra-flexible stranded wire for cables crossing hinges, bundled into groups not exceeding twelve cables and arranged so that they will be protected from chafing when the hinged member is moved. Cable bending radius shall be per applicable code. Feeder cables shall be installed in one continuous length unless splices are otherwise approved by the County.

8.2.11.5 Splices and Terminations. The Contractor shall install all conductors without splices except at junction boxes. Splices, when permitted by the County, and terminations shall be in accordance with the splice or termination kit manufacturer’s instructions. Splices in junction boxes shall be watertight.

8.2.11.6 Conductor Identification. Each wire and cable shall be identified at each termination and in each junction box using numbered and lettered wire markers. All electrically common conductors shall have the same number. Each electrically different conductor shall be uniquely numbered. Panelboard circuits shall be identified using the panelboard identification and circuit number. Motor control circuits shall be identified using the equipment identification number assigned to the control unit by the motor control center manufacturer and the motor control unit terminal number. All other circuits shall be identified as required by the County. Each wire or cable in each pullbox shall be identified with plastic sleeves having permanent markings. Conductors between terminals of different number shall have both terminal numbers shown at each conductor end. The terminal number closest to the end of the wire shall be the same as the terminal number. Wire identification plastic sleeves shall not be made closer than 3-inches from any splice.

8.2.11.7 The Contractor shall provide an equipment grounding conductor, whether or not shown on the Approved Drawings, in any flexible conduit or any raceway in which all or any portion of a run consists of non-metallic duct or conduit. For flexible conduit, an external bonding jumper is an acceptable alternative.

8.3 ELECTRICAL CONTROL PANELS

8.3.1 Electrical control panels shall be designed, fabricated and installed in accordance with the standards published by the following agencies:

1. Washington Administrative Code:
   a. *Electrical Construction Code*, Chapter 296-44 WAC.

2. NEMA Publications:
   a. ICS 1-1978, *General Standards for Industrial Controls and Systems*;
   b. ICS 2-1978, *Standards for Industrial Control Devices, Controllers and Assemblies*;
   c. ICS 4-1977, *Terminal Blocks for Industrial Control Equipment and Systems*; and
   d. ICS 6-1978, *Enclosures for Industrial Controls and Systems*.

3. Underwriters Laboratories Publication:
   a. UL 508, *Industrial Control Equipment*. 
8.3.2 Submittals

8.3.2.1 Shop Drawings. In addition to the general requirements of Section 8.1.5.2, the Contractor shall submit shop drawings which include the following: (1) a wiring diagram and an elementary control diagram for each unit; (2) an overall connection diagram for each control panel; (3) a dimensioned outline drawing to scale showing space for conduits, etc.; (4) details of seismic restraints; (5) complete identification of all electrical components in each control panel and their interconnections within the control panel; (6) all connections to external equipment; and, (7) if wiring deviates in any way from that shown on the Approved Drawings, a complete record and explanation of each deviation. The shop drawings shall show the device abbreviation identifications and equipment names as shown on the Approved Drawings.

8.3.2.2 Schematic Drawing. The Contractor shall submit three sets of schematic drawings, which shall include a schematic diagram, layout, engraving, and parts list. The parts list shall include the individual part, identification code, quantity, part number, and manufacturer. One set of drawings shall be placed in the pocket provided on the interior door of the control panel and two sets shall accompany the O&M Manual submittal as specified herein. In addition, the Contractor shall furnish a CD-ROM disk with the CAD drawing file.

8.3.2.3 O&M Manuals. O&M manuals shall be provided in accordance with Section 7.1.4.5 of these Specifications.

8.3.2.4 Warranty. The manufacturer shall warranty the control panel(s) supplied against defects in workmanship and material for a period of 1 year, beginning on the date of Final Acceptance of the Project. The warranty shall be in printed form.

8.3.2.5 All submittals shall be arranged in a logical manner in order to expedite and facilitate review by the County.

8.3.3 Manufacturer. The control panel manufacture site shall be located within 75 miles of the County sewer maintenance facility (using mapping site i.e. mapquest.com), located at 10311 Chambers Creek Road, University Place, WA 98467-1040, to allow three or more on-site visual inspections of the control panel during the assembly, wiring, and manufacturing process.

8.3.4 All equipment furnished under this Section shall: 1) be from a manufacturer who has been regularly engaged in the design and manufacture of the equipment with a minimum of 5 years experience; and 2) be demonstrated to the satisfaction of the County that the quality is equal to equipment made by those manufacturers specifically named herein.

8.3.5 The Contractor shall provide control panels as shown on the Approved Drawings and as specified herein. The control panels shall be pad mounted. The enclosures shall be code gauge steel of adequate strength, when installed, to withstand seismic forces. Each control panel shall be installed level and plumb, and shall be secured by the approved seismic mounting method. Doors shall swing freely and close tightly.

8.3.6 Each component within the panel shall be items normally stocked on the shelf of the panel manufacturer or available on the shelf of suppliers in the Seattle-Tacoma area, and shall be securely mounted and arranged for easy servicing such that all adjustments and component removal can be accomplished without disturbing other components. No
fastening devices shall project through the outer surfaces of the cabinet and all components and terminals shall be mounted on mounting pans within the panels.

8.3.7 The Contractor shall carefully repair any damage to the structure, components, or finish of control panels to the satisfaction of the County. Additionally, the Contractor shall exercise great care at all times after installation to keep foreign matter, dust, dirt, debris, and moisture out of control panels.

8.3.8 Underwriters Laboratories (UL) Label. Each control panel shall bear the UL label. The UL label shall apply to the enclosure, the specific equipment supplied with the enclosure, and the installation and wiring of the equipment within and on the enclosure. If required for UL labeling, the Contractor shall provide ground fault interrupters, isolation transformers, fuses, and any other necessary equipment, even when such equipment is not indicated on the Approved Drawings.

8.3.9 Wiring. Control panels shall be factory wired. Wires routed through Panduit® shall not exceed 40 percent raceway fill per the current NEC. Cable panel wiring and secure to the panel surfaces with plastic cable ties. Each wire shall be permanently identified at each termination by means of a heat shrink numbered sleeve. All electrically common wires shall be numbered the same, and each electrically different wire shall be uniquely numbered. Numbering shall correspond with the numbers shown on the Approved Drawings. Wiring crossing hinged surfaces shall be an 18-inch long, “U”-shaped hinge loop of extra-flexible wires secured at both ends, and shall be protected with Plastic Spiral Wrap. Plastic Spiral Wrap shall also be used where wires can be compromised by chafing. Wiring shall be 14-gauge, type MTW, 600-volt, stranded copper wire.

8.3.10 Enclosure

8.3.10.1 The outdoor enclosure shall be NEMA 12 with a drip shield kit, which not only supplies a drip cap but also a stainless steel hinge and hinge pins. On the outside top of the enclosure there shall be a vandal-proof red alarm light, as manufactured by Acme Dunbar, or Approved Equal. The enclosure shall be floor standing on factory supplied 12 inch stainless steel leg kit, and shall have double doors with three point latch and provisions for a padlock, and shall be provided with factory supplied hold-open devices, model A-LGDSTOP2, 50179. Manufacturer shall be Hoffman, Inc., or Approved Equal. Once the panel has been installed at the site, the lifting eyes supplied by the manufacturer shall be removed and sealed. All surfaces of the control panel enclosure(s) shall be painted as identified in Section 10.4.2 of these Specifications.

8.3.10.2 The outdoor enclosure shall house the following equipment: duplex 4-watt fluorescent light fixture, with integral combination drip and protective shield painted with highly reflective epoxy paint, mounted to the top of each side of the enclosure; two circuit breaker disconnects; prime power and emergency power; automatic transfer switch; telemetry unit; control power transformer; and pump control panel and specialty items.

8.3.10.3 The equipment layout in the enclosure(s) shall be as shown on the Approved Drawings.

8.3.10.4 The pump controls shall be mounted in a double door NEMA 12 enclosure prepared for painting with a bonderized metal preparation process, primed and finished Gray ASA61 outside and white inside epoxy paint, and must bear the UL label. The inner door shall have a dead front with safety interlocks on all motor and main control breaker...
operators, Hand-Off-Automatic switches, US Filter LC 150 level controller, running time meter, run lights, alarm lights and ammeters.

8.3.11 Controls

8.3.11.1 All equipment shall be NEMA or IEC standard; other ratings will not be accepted.

8.3.11.2 A control transformer shall be supplied if required. Control voltage shall be 120 volts AC. Transformers shall be manufactured by Acme, or Approved Equal.

8.3.12 Circuit Breakers

8.3.12.1 Thermal-magnetic circuit breakers shall be provided for motor disconnect service and over-current protection. Thermal-magnetic circuit breakers shall be provided for control pilot circuits and for each auxiliary circuit. All 240-volt AC breakers shall have interrupting ratings UL listed RMS.SYM 10,000 amps, and all 480-volt AC breakers shall have interrupting ratings UL listed RMS.SYM 14,000 amps. The motor and main control breakers shall have integral handles attached to the breaker with the handle protruding through the door; this handle shall be lockable in the “OFF” position with space for three padlocks. Circuit breakers shall be manufactured by General Electric #TED.

8.3.12.2 Load Center. A load center shall be provided so that thermal magnetic circuit breakers can provide over-current and short circuit protection for auxiliary equipment as indicated on the Approved Drawings. The manufacturer of the load center shall be Square D, Model QO Series.

8.3.12.3 Spare Circuit Breaker. Load centers shall be sized accordingly to accommodate a spare, 20-amp circuit breaker for future use. The spare breaker shall be installed and labeled “SPARE”.

8.3.13 Ammeter. Ammeter and current transformers shall be General Electric Series 200, Type 250, 3-½ inch, and shall sense on one leg only.

8.3.14 Starters

8.3.14.1 Magnetic across-the-line starters with overload protection for each leg and under-voltage release shall be provided for each pump. The starters shall be manufactured by Allen Bradley, Series 193 with E1 Plus solid-state overloads.

8.3.14.2 Reduced voltage solid-state soft start controllers shall be provided when required by the County. The controllers shall provide a dual ramp reduced voltage soft-start for three-phase induction motors and independent sets of adjustments for acceleration rate, deceleration rate and start torque. The manufacturer shall be Siemens, or Approved Equal.

8.3.15 Each pump shall have a hand-off-automatic selector switch, a green run-light with press-to-test feature, and a non-resettable, elapsed time meter with six digits reading in hours and tenths of hours, and shall be rated at 120-volt AC, 3-½ inch. Time meters shall be manufactured by Modutech Model 3PB-ETM-115/GOH, Yokogawa Model 240-311-AAAB, or Approved Equal.
8.3.16 Control Switches

8.3.16.1 Pushbuttons, selector switches and pilot lights shall all be heavy duty and oil tight. Pushbuttons and selector switches shall have contacts rated at 10 amperes continuous, rating designation A600 in conformance with NEMA ICS 2.

8.3.16.2 Multi-position control switches shall have rotary action, round knurled handle and the number of positions and stages shown on the Approved Drawings. They shall be suitable for panel mounting. Each position shall have a positive detect. Contacts shall have a continuous current rating of 10 amps at 600 volts AC. Switches shall be manufactured by Furnas Model 523B2CAB.

8.3.17 Relays

8.3.17.1 Control Relays. Control relays shall be of the type used for general relay logic and switching control power, and shall be general purpose industrial type. They shall be of the dust cover enclosed plug-in type, with 8 or 11-pin pressure terminal, octal or spade sockets. Control relays shall have up to 3-pole Form-C contacts rated for 10 amps at 120 volts AC, and shall be equipped with neon indicator lamps. Control relays shall be manufactured by Struthers Dunn, Series 314, Square D, or Approved Equal.

8.3.17.2 Induction Type Control Relay. Seal Leakage Detector relay shall be installed to detect moisture in the submersible pump. Secondary coil of this relay is connected to conductors from sensor probes located within the pump. Upon sensing a moisture and/or leakage the relay shall close two normally-open sets of contacts. The relay shall be manufactured by B&W Controls, MagneTek Model 1500-C-L1-S7-OC-X, or Approved Equal.

8.3.17.3 Time Delay Relays. Time delay relays shall be electronic plug-in type with contacts rated at 10 amps continuous Form-C. Timing shall be adjustable by internal potentiometer in the top of the relay. Time delay relays shall be manufactured by Mann-Datton, Dayton, Diversified Electronics, Inc., or Approved Equal.

8.3.17.4 Intrinsically Safe Relays (ISR). Each ISR unit shall be fixed sensitivity type, UL approved for use with a remote pilot device (dry contact) located in Class 1, Division 1, Group C and D atmospheres. Supply power shall be 120 volt AC, 60 Hz. Final contact rating shall be 10 amps or better at 120 volts AC. The ISR unit shall be manufactured by Diversified Electronics, Inc. Model ISO-120-AFN, or Approved Equal.

8.3.17.5 Phase Loss, Reversal, and Under Voltage Relays. Phase loss, reversal, and under voltage relays shall be installed to stop pump motors for their own protection and sound alarm via telemetering. Phase loss relays shall be manufactured by Diversified Electronics, Inc. Model SLA Series, or Approved Equal.

8.3.18 Indicating Lights

8.3.18.1 LED indicating lights shall be push-to-test transformer type with lenses of the color shown on the Approved Drawings. LED indicating lights shall be manufactured by Eaton, Model HT8GTGL1 for green and Model HT8GTRL1 for red, or Approved Equal.

8.3.18.2 Neon indicating lights shall be manufactured by Siemens Model 52PA4PA, or Approved Equal.
8.3.18.3 An illuminated mushroom-head pushbutton shall be provided to initiate a “panic” alarm. The button shall be manufactured by Siemens Model 52PA2G2A, or Approved Equal.

8.3.18.4 Lighting arrestor shall be manufactured by Cutler-Hammer, Model CHSA03 for use on 3-phase, 600-volt systems, or Approved Equal.

8.3.19 Terminal Blocks. Terminal blocks shall be rated for 15 amps or better at 600 volts AC, and shall conform to the applicable requirements of NEMA ICS 4. Terminal blocks shall be either the lug box type or saddle clamp type, as required. The Contractor shall provide a terminal for each external connection as shown on the Approved Drawings, plus an additional 15 percent minimum of the total terminals required to be used as spare terminals. Each terminal shall be permanently identified with the same number as the wire being terminated.

8.3.20 Power Distribution Blocks. Power distribution blocks shall be manufactured by Marathon, Inc. Model 1423570, or Approved Equal, and must be equipped by the factory with a clear plastic shield covering the exposed lugs.

8.3.21 Panel Heater. Panel heater shall be Hoffman Model DAH2001A, or Approved Equal.

8.4 LEVEL CONTROL SYSTEM

8.4.1 Level control system shall have a 40-segment LED display, pump and alarm operation level adjustments, time and date stamped alarm/event log, volumetric flow calculator, 2 by 16-character LCD display, audible alarm silencer, sixteen DI 5-relay outputs, one AI and one AO. The manufacturer shall be Siemens-US Filter Model LC150.

8.4.2 The level control system shall be provided with a pressure transducer as manufactured by Siemens-US Filter Model A1000. The transducer cable shall be installed so that no conductor splices are made between the wet well and the control panel. An additional cable length shall be provided in the wet well to allow adequate transducer removal without unwiring the unit. The Contractor shall field verify the required cable length.

8.4.3 An isolated 4-20 mA output shall provide wet well level to the RTU. The isolator shall be manufactured by Absolute Process Instruments, Inc. Model API 4380 G.

8.5 ALARMS

8.5.1 All alarm conditions will have a red, vandal-proof indicating light on the front door of the control panel enclosure, except for intrusion, as manufactured by Acme Dunbar Model 204R, WF Harris Model 300-R-INC-TPS, or Approved Equal.

8.5.2 Alarm contacts shall be normally open and closed on alarm. The following alarm points shall be included in the control panel, or as indicated on the Approved Drawings:

1. Pump No. 1 – Overheat;
2. Pump No. 2 – Overheat;
3. Intrusion Alarm;
4. High Wet Well Level;
5. Low Wet Well Level; and
6. Panic.
8.5.3 Alarm lights for indicating the type of trouble shall lock on and stay on, even though the problem causing the alarm has been corrected. All alarms must be manually reset.

8.5.4 The first alarm shall be initiated by pressure switches and pushbutton. The intrusion alarm shall be initiated by a limit switch inside the control panel. An adjustable time delay 0-180 seconds will turn on the external alarm horn and red light. The intrusion alarm may be deactivated by a selector switch inside the control panel. If the door is closed with the selector switch in the wrong position a sonalert horn will sound warning the personnel to arm the intrusion circuit before closing the door. The intrusion alarm unit shall be manufactured by Superior Custom Controls Model 100, or Approved Equal.

8.5.5 High and low wet well level alarms shall be activated by float control switches and must be intrinsically safe. Should the level control system fail, the high and low wet well level floats shall override the level control system and either start or stop the pumps as required. In addition, the override system shall initiate a telemetry signal, activate an alarm indicating light and an external alarm light. A high wet well level alarm test button shall be mounted within the intrinsically safe barrier.

8.5.6 SCADA alarm contacts shall be normally closed and open on alarm. The following alarm points shall be included in the control panel, or as indicated on the Approved Drawings:

1. Panic Alarm;
2. Intrusion Alarm;
3. High Water Alarm;
4. Pump No. 1 Run;
5. Pump No. 2 Run; and

8.5.7 SCADA discrete signals shall include:

1. Generator Run;
2. Transfer Switch Position; and
3. Generator Composite Fail.

8.5.8 SCADA analog signals shall include:

1. Wet Well Level;
2. Pump No. 1 Amps;
3. Pump No. 2 Amps;
4. Generator Fuel Tank Level; and
5. Chemical Fuel Tank Level, if applicable.

8.6 AUTOMATIC TRANSFER SWITCH

8.6.1 Applicable provisions of Section 9 of these Specifications shall become part of this Section as if repeated herein.
8.6.2 Automatic transfer switches shall comply with the applicable requirements of the Basic Electrical Regulation for control panels and shall be designed, fabricated and installed in accordance with the following standards:

1. ICS 6 (Latest Edition), Enclosures for Industrial Controls and Systems;
2. UL 1008 (Latest Edition), Automatic Transfer Switches.

8.6.3 Submittals

8.6.3.1 Shop Drawings. The Contractor shall submit shop drawings which include:

1. Dimensioned drawings;
2. Elementary diagrams;
3. Wiring diagrams;
4. Nameplate list;
5. Evidence that the equipment will be provided with all specified accessories, options, features and characteristics; and
6. Certifications that the equipment is designed and manufactured in conformance with all applicable codes and standards.

8.6.3.2 O&M Manuals. O&M manuals shall be provided in accordance with Section 7.1.4.5 of these Specifications.

8.6.4 The Contractor shall provide an automatic transfer switch, complete with controls and accessories, as shown on the Approved Drawings. The automatic transfer switch shall transfer from the normal service to a standby engine generator in the event of power failure, and shall transfer the system back to normal power after normal power has been restored. The switch shall be UL labeled, shall meet the requirements of UL Standard 1008, and shall be suitable for total system transfer, including motor and lighting loads.

8.6.5 The automatic transfer switch shall be of the mechanically held type. All main power contacts and auxiliary contacts shall be mechanically attached to a common shaft, shall be double-break silver alloy with wiping action, and shall be protected by arcing contacts. Arcing contacts shall close before and open after the main contacts, and shall be readily replaceable. Contact design and arrangement shall permit repeated making and breaking of full-load current, in a combination of motor and other loads, without damage to the main contacts.

8.6.6 The transfer shall be produced in such a way that a time delay exists between the opening of the closed contacts and the closing of the open contacts.

8.6.7 All switch and relay contacts, coils, springs and control elements shall be serviceable or removable from the front of the mounted switch and accessory assembly without removal of either assembly from its compartment and without disconnection of drive linkages, power conductors or control conductors.

8.6.8 The enclosure shall be NEMA 1 construction with hinged doors on the front for access to the interior controls. Secure doors by a single point non-locking latch. An enamel paint finish shall be provided with a minimum dry film thickness of 3 mils.

8.6.9 Cable connections shall be accessible from the front without removing internal components.
8.6.10 The automatic transfer switch shall have the following features:

1. Continuous rating of 480 volts, 3-phase, [with 3-poles and full neutral bus.] [and 4-pole for accommodating ground fault relaying.] Current rating shall be as shown on the Approved Drawings.
2. Adequate line and load lugs for terminating the specified power conductors.
3. A terminal strip with terminals for terminating all external control circuits. Number all terminals using the wire number for the wire terminated.
4. Cable wiring with cable ties, secured in place and guarded where subject to mechanical injury.
5. Permanently identify each wire at each point of connection using numbered wiring sleeves. Electrically common wires shall have the same number. Uniquely number electrically different wires.

8.6.11 The automatic transfer switch shall include the following controls and accessories:

1. Three-Phase Relay Protection: Three adjustable close differential relays, connected phase-to-phase, all set to drop out at 90 percent and to pick up at 95 percent of nominal voltage.
2. Test Switch: A test control switch which shall cause the automatic transfer switch to start the engine, transfer, retransfer, etc., simulating a power outage. Mount this switch on the door of the transfer switch compartment.
3. Override Switch: An override control switch to prevent: (1) the automatic transfer switch from transferring from the “normal” to the “standby” position, and (2) the engine-generator from being signaled to start. This control switch shall be mounted on the door of the transfer switch compartment.
4. Indicating Lights: One each to indicate the switch is supplying “normal” or “standby” power. Provide neon type lamps with series resistors as required, in oil-tight units with clear lenses. Label each light with plastic nameplates engraved “NORMAL” and “STANDBY”, respectively. Mount lights on the door of the transfer switch compartment.
5. Engine Starting Delay: A timer which, following loss or deterioration of “normal” power, will delay closure of engine starting contact for an adjustable period of up to 2 minutes, to eliminate starts during brief or momentary outages of “normal” power. Delay to be initially set to 5 seconds.
6. Transfer Relay: A relay to prevent the transfer to “standby” until the standby power voltage and frequency are 90 percent of rated values.
7. Retransfer Delay: A timer to provide an adjustable delay from 2 to 25 minutes (minimum range) before retransfer to “normal” power. If “standby” power falls before preset delay period elapses, and if “normal” power is within set limits of voltage, override the delay and retransfer immediately.
8. Nameplates: An engraved plastic nameplate for every lamp, switch and other control device or indicator. Identify all switch and control positions. Nameplate wording shall be subject to review by the County.
9. Unloaded Generator Operation: A timer which, following retransfer to “normal” power, will maintain engine in unloaded operation for a fixed period of 5 minutes before signaling it to shut down.
10. Auxiliary Contacts: One set of normally-open and normally-closed Form C contacts which transfers each time the switch transfers.
11. Transfer Delay: A timer to provide an adjustable delay of 1 to 5 seconds in the closing of the open contacts after the closed contacts have opened. Provide this delay for both transfer and retransfer switch operations.

8.6.12 Underwriters Laboratories (UL) Label. The transfer switch shall have a UL label on the unit when it arrives at the site. Absence of the UL label shall be sufficient cause for the unit to be rejected. Provide all of the specified features, options and accessories. If the manufacturer’s standard UL unit does not have the specified features, options or accessories, then provide alternative features, options or accessories to accomplish the same purpose in a manner similar to that specified while still providing a unit with a UL label.

8.6.13 Current Ratings. The transfer switch shall have continuous ampere rating as shown on the Approved Drawings, and a short circuit withstand rating of 16,000 RMS symmetrical amperes for 3-cycles at 480 volts.

8.6.14 Manufacturer. The automatic transfer switch shall be manufactured by Onan, Model OTEC.

8.6.15 Finish. The finish shall be as recommended by the manufacturer. Color shall be light gray ANSI 61.

8.6.16 Factory Tests. Assemble, wire, and test the automatic transfer switch at the factory. Conduct tests to assure that every component functions properly. Submit prototype test reports on bus bracing for approval by the County.

8.6.17 Installation. The automatic transfer switch shall be securely mounted within the electrical control panel, as shown on the Approved Drawings. The door shall open freely and close tightly. The Contractor shall repair any defect or damage to the switch, enclosure or paint to the satisfaction of the County.

8.6.18 Field Testing. The Contractor shall demonstrate that the automatic transfer switch operates as specified. The automatic transfer switch shall be tested at least three times with the engine-generator and transfer the standby system load, as specified for the engine-generator.

8.7 REMOTE RADIO TELEMETRY UNIT (RTU)

8.7.1 A remote RTU shall be provided at each pump station as shown on the Approved Drawings and as required by these Specifications.

8.7.2 The remote RTU panel will be used for transmitting status signals from a variety of geographically distributed wastewater facilities throughout Pierce County to a set of Front End Processors (FEPs) located at the Chambers Creek Regional Wastewater Treatment Plant.

8.7.3 The communications interface between RTUs at the pump stations and the FEPs at the wastewater treatment plant shall be by 450-MHz UHF radios.

8.7.4 The RTUs shall be supplied by the hardware integrator as an integral, complete system with all required components. The hardware integrator shall supply all interfacing equipment, appurtenances and accessories, and all such devices which may be required for proper interfacing as part of the control system.
8.7.5 Standards and Codes

8.7.5.1 All equipment and materials shall conform to the latest revised editions of applicable standards published by the following organizations:

1. American National Standards Institute (ANSI);
2. Institute of Electrical and Electronic Engineers (IEEE);
3. National Electrical Manufacturers Association (NEMA);
4. Underwriters Laboratories (UL); and
5. Instrumentation Systems and Automation Society (ISAS).

8.7.5.2 All electrical equipment and materials, and the design, construction, installation and application thereof, shall comply with all applicable provisions of the National Electrical Code (NEC), the Occupational Safety and Health Act (OSHA), and any federal, state and local ordinances, rules and regulations.

8.7.5.3 All materials and equipment specified herein shall be within the scope of UL examination services, be approved by the UL for the purpose for which they are used, and shall bear the UL label.

8.7.5.4 All control panels shall bear a label by UL, or by an approved testing authority for the completely assembled panel.

8.7.6 Submittals

8.7.6.1 Shop Drawings. The hardware integrator shall develop any shop drawings required for design, fabrication, assembly, and installation of the control system which are not already included in the Approved Drawings. Shop drawings shall be drawn in AutoCAD, showing any changes to the wiring or control cabinets. The Engineer shall provide an electronic copy of the Approved Drawings to the hardware integrator for this purpose. Shop drawings shall include the following:

1. Technical data sheets for all components with the complete part number of the component clearly designated with all required options.
2. Arrangement drawings of all cabinet front- and internal-mounted instruments, switches, devices and equipment indicated. Show all panel mounting details required. Include outer dimensions of all panels on the drawing. Deviations from approved arrangements require re-submittal and approval by the County prior to installation. Arrangement drawings shall be drawn to a standard engineering scale.
3. Specific product detail such as rating, size and number of contacts, etc. Wiring diagrams shall be included for all components in the system, including control equipment supplied with mechanical devices.
4. Installation details, to include the size, number, type and location of interconnecting wiring and conduit, installation of cabinets and enclosures, installation of sensors, instruments, limit switches, and other installation requirements.
5. Shop drawing details and text shall be legible. Shop drawing packages shall be provided in a separate binder with an index for the drawings at the front. The shop drawings shall be submitted to the Contractor for review and approval. After approval by the Contractor, copies of all shop drawings shall be submitted to the County for review.
8.7.6.2 Cut Sheets. The hardware integrator shall submit cut sheets for all products, along with a Bill of Materials showing the quantity, manufacturer, catalog number, supplier name and phone number, and relevant Specification paragraph number. Each item shall be numbered in the Bill of Materials, which shall be related to the submitted product index. Reference numbers shall match those shown on the shop drawings. The cut sheets and bill of materials shall be bound in a 3-ring binder with the bill of materials in the front; provide at least one tab for every four products.

8.7.6.3 I/O Checklist. The hardware integrator shall submit an I/O checklist in EXCEL format that verifies all control and status/indication points in the control panels, both implemented and spare, have been tested. One copy of the I/O checklist shall be submitted for the start of the Factory Testing herein specified. An additional copy of the I/O checklist shall be submitted prior to the control system startup.

8.7.6.4 PLC I/O List. The hardware integrator shall submit a PLC I/O list showing any modifications after Factory Testing has been completed. The I/O checklist shall be arranged by cabinet and point information is in card order. Point information shall indicate points on the card in the order in which they appear on the card.

8.7.6.5 Spare Parts. The Contractor shall submit a list of all spare parts to be provided.

8.7.6.6 O&M Manuals. In addition to the applicable requirements indicated in Section 7.1.4.5 of these Specifications, O&M manuals for RTUs shall include, but not be limited to, the following:

1. Procedures for:
   a. Preventative maintenance;
   b. Trouble-shooting;
   c. Calibration;
   d. Testing; and
   e. Replacement of components;
2. System schematics/shop drawings;
3. Electronic copy on CD-ROM of all shop drawings in AutoCAD;
4. As-built wiring diagrams of cabinet and enclosure contained assemblies;
5. Catalog data and complete parts list for all equipment and telemetry devices;
6. Listing of recommended spare parts; and
7. Listing or recommended maintenance tools and equipment.

8.7.7 RTU Base Unit Fabrication

8.7.7.1 The hardware integrator shall fabricate the RTUs in accordance with the approved shop drawings. The RTUs shall communicate with a master unit over radio transceiver equipment, and shall be microprocessor based. The processor shall be Momentum M1 (171 CCC 760 10). The RTU shall be complete with radio, power supplies [logic, radio, I/O], interposing terminals, interposing relays, lightning/surge protection and battery backup.

8.7.7.2 Provide and wire a separate contact (off of the RTU's incoming power surge suppressor) to a digital input for service power fail. The input to use for this shall be shown on the module wiring diagrams. Provide wiring such that this is a supervised circuit.
8.7.7.3  Coordinate with the County to provide the specified radio. Only the RTU, RTU I/O, and the radio (all required communications equipment) shall be on battery backup system. Battery backup shall maintain RTU functions for a minimum of 16 hours.

8.7.8  In addition to the base unit, the RTU shall have the following auxiliary components as indicated on the Approved Drawings or required for operation:

1. 172 JNN 210 32: Serial Option Adapter (Modbus Port, TOD Clock, and Battery Backup Module);
2. 170 AAI 030 00: 8-Channel Differential Input Analog Input Module Base (Provide analog modules to meet I/O requirements shown on the Approved Drawings, plus 10-percent wired spare points or an extra module, whichever is greater);
3. 170 ADM 350 11: 24-volt DC, 16-Point Input/8-Point Output at 2-amp Module Base (Provide digital modules to meet I/O requirements shown on the Approved Drawings, plus 10-percent wired spare points or an extra module, whichever is greater);
4. 170 ADM 350 00: 24-volt DC, 32-Point Input Module valid for DI expansion;
5. 170 ADM 340 00: 24-volt DC, 16-Point Input Module valid for DI expansion;
6. 170 INT 110 0: Interbus (I/O Bus) Communications Adapter (One (1) for each I/O module that does not have a M1 Processor mounted on it); and
7. 170 MCI 007 00: Low Profile Cable for I/O Bus and Interbus (Provide cable assemblies as required to connect all I/O module bases to the I/O base to which the M1 Processor is attached).

8.7.9  All RTUs shall have a minimum I/O count of 8 AI, 16 DI, and 8 DO. The exact I/O count for each RTU shall be as shown on the Approved Drawings. All I/O modules shall be supplied with terminal blocks in place on the I/O module for all termination points whether or not a particular point is wired. Provide Schneider Automation Model 170 XTS 001 00, or Approved Equal. Terminal blocks on the I/O module shall be interfaced with the RTU interposing terminal block using pre-manufactured cables.

8.7.10  Wiring of I/O modules may require the use of a 1, 2, or 3-row bus bar. Provide Schneider Automation 170 XTS 006 00, 170 XTS 005 00, or 170 XTS 004 00, depending upon I/O module used. Configure and wire all Analog Input Points as 4-20ma Current Loop. Provide a DIN rail-mounted ground terminal for every two analog inputs. This ground terminal shall be used for terminating the shield wire for analog inputs.

8.7.11  All relays installed in the RTU shall have a relay-energized indicating light.

8.7.12  Fuse terminal blocks shall be hinged, disconnect-level type with “blown fuse” indicators. Provide Phoenix Contact UK 5 HESI Series, or Approved Equal.

8.7.13  The Contractor shall provide one spare programming cable set for the Momentum M1 processor, as manufactured by Schneider Automation. The set shall include 110 XCA 203 00: RJ45 9-pin adapter and 110 XCA 282 02: RS232 communications cable.

8.7.14  Radio Requirements

8.7.14.1  The supplier of the telemetry system RTU panels shall provide all radio equipment as shown on the Approved Drawings and as specified herein.
8.7.14.2 RTU radios shall be provided as part of the RTU package. Each RTU shall have a solid-state, 450-MHz UHF licensed radio transceiver.

8.7.14.3 Remote station radio transceivers utility data system type capable of transmitting and receiving data at the 450-MHz frequency, as manufactured by Adaptive Broadband; radio shall be Data Network Series 4710 Multiple Address Radio Transceiver with Network-Wide Diagnostics. No other manufacturer shall be accepted.

8.7.15 Antenna

8.7.15.1 The hardware integrator shall provide a high-performance, 450 to 470 MHz Yagi antenna, producing 10 dBi forward gain and designed for point-to-point or multipoint applications. The antenna shall be manufactured by Telewave, Model ANT450Y10-WR.

8.7.15.2 The hardware integrator shall provide an antenna cable connection between the radio and the lightening arrester, and between the lightening arrester and the antenna. The cables shall be HELIAX® Superflex cable FSJ4-50B, as manufactured by Andrew. No other manufacturer shall be accepted.

8.7.15.3 The hardware integrator shall provide antenna connections using soldered N-Style Connectors as manufactured by Andrew, Model F4PNMV2-H or F4PNF, or Approved Equal to match all antenna cable connections. Generally, antenna cables between devices (antenna, lightening arrester and radio) are male-male. Gender changers in the antenna cable shall not be accepted.

8.7.15.4 Lightening protection shall be provided in the RTU package. The hardware integrator shall provide lightening protection between the radio and the antenna. The protection device shall be PolyPhaser IS-B50LN-C2. No other manufacturer shall be accepted. HELIAX® coaxial cabling – radio communications signal cabling shall be provided between the radio transceiver equipment and the antenna, complete with all required connectors in accordance with the radio equipment manufacturer’s requirements.

8.7.16 RTU Cabinets

8.7.16.1 The hardware integrator shall install the PLC I/O card to the terminal interface wiring with pre-manufactured multiconductor or bundled wire. Wiring shall be arranged neatly in the wire-way. Provide separate wire-ways for internal and field wiring. Right angle connectors shall be provided on cables if the cable connection prevents closing of access doors on equipment within the cabinet or on the control cabinet itself.

8.7.16.2 The hardware integrator shall order the terminal blocks 170XTS00100 for the Momentum I/O module and supply them to Entrelec to have the AI and DI (Part No. XUSI00570), and the DO (Part No. XUSI00548) cables fabricated.

8.7.16.3 Install all terminals on 2-inch standoffs from the RTU backpan. Additionally, terminals shall be installed to allow a minimum of 1-½ inch clear space between the terminal and the wire-way or any other components. Space shall be provided at the bottom of the cabinet for batteries, if applicable.
8.7.16.4 The PLC Remote I/O form factor shall be DIN rail mounted. The DIN rail shall be supplied by the hardware integrator. Adequate space shall be provided in the cabinet for installation of power supply, communications module and two additional I/O modules, up to a total of five modules for any RTU.

8.7.16.5 All equipment in the RTU shall be labeled with a name tag corresponding to the bill of materials. The label shall include the material identification and size, as applicable. All wiring shall have wire tags at both ends of the wire.

8.7.16.6 All fabricated pieces shall have smooth edges and rounded corners with no burrs or splinters. Brackets or metal pieces provided to complete the assembly of the RTU shall be painted or coated with a corrosion-resistant finish. Painted pieces shall be powder coated. Electro-coated pieces shall be cadmium plated.

8.7.16.7 If an alarm light is provided to replace an existing alarm light, the light must be mounted separately from the RTU cabinet.

8.7.17 RTU Staging and Testing

8.7.17.1 The hardware integrator shall provide and support operational testing of the telemetry system at the integrator’s facility. Testing shall be conducted in two phases. The initial testing shall be provided by the integrator and shall include, but not be limited to, operation of all input and output (I/O) points, alarm devices and any control points for a continuous period of at least 48 hours. Connections, power and communication (copper, fiber optic, RF or other media), required to provide communication between telemetry panels and other system components shall be provided by the integrator. Subsequent testing of the system shall include, but not be limited to, programming of the RTU and Operator Interfaces. The County shall provide the RTU PLC system program.

8.7.17.2 The initial testing of the telemetry system shall include configuration of the RTU and its communications equipment, including remote and base station radios, energizing each digital input and output, and simulating each analog input and output using a loop simulator and calibrator. Circuits not energized shall be tested for continuity. Energized circuits shall be tested through all components, from the terminal blocks in the telemetry panel to the hardware I/O memory locations in the RTU. Initial testing of the telemetry system shall be considered complete only after the telemetry system has operated continuously for a period of at least 240 hours.

8.7.17.3 The hardware integrator shall provide an I/O checklist for all points in the telemetry panel. The list shall include, for each point, the tag name of the point, a description of the point, comments, date and time of the test, and a signature line for the person performing the test. Show that each digital point was set and reset. Show verification of all analog points at 0, 25, 50, and 100 percent range. The checklist shall be submitted 1 week prior to the software test.

8.7.17.4 After completion of initial testing, the hardware integrator shall conduct subsequent testing for inspection by the County. The County shall not be called out by the integrator for testing on equipment until all components are installed, all wiring points have been checked, and operation has been tested and verified by the integrator. The integrator shall provide for time, equipment and support at the County’s facility for the County to load and test the program in the telemetry system for a period of up to 6 working days. All telemetry functions and all status and alarm monitoring and indication
shall be demonstrated under simulated operating conditions. Simulating equipment shall be provided and wired into the telemetry system for this testing. The integrator shall revise, modify and adjust the system as required by the County during the testing period. Testing shall be continued for the time period required by the County to observe and verify any revisions.

8.7.17.5 The hardware integrator shall coordinate with the County to ensure telemetry panels have been assembled correctly and tested 1 week prior to commencement of the software test. Software testing shall not begin until the panels have been completed and verified by the County. The integrator shall further coordinate with the County to ensure all hardware (including test cables, Volt-Ohm meters and communications equipment) and software to perform the software test are available prior to commencement of the software test.

8.7.17.6 Telemetry panels and other telemetry components shall not be shipped to the site until inspection and testing is complete to the satisfaction of the County and the hardware integrator has received written authorization from the County.

8.7.18 Wire and Cable Termination

8.7.18.1 Stranded telemetry conductors may be directly terminated using compression type terminals at telemetry panels. Terminals and connectors shall be installed with the compression tool recommended by the terminal manufacturer.

8.7.18.2 Any control or signal wire landing on a screw terminal shall be terminated with a spade connector.

8.7.18.3 Special instrumentation cables shall be terminated in accordance with the equipment manufacturer’s recommendations. These terminations are subject to review by the County.

8.7.18.4 No splices shall be used in power, control, and/or signal wiring. The wiring shall be continuous from point-to-point.

8.7.18.5 All wire and cable shall be provided with a wire tag at each termination in accordance with the wire tagging requirements in these Specifications. Terminals shall be installed such that there is a minimum of 1-½ inch clear space on both sides of the terminal for ease of wiring.

8.7.19 Calibration and Startup. The hardware integrator shall revise, modify and adjust the system as required during and following startup to provide the operation required by the County.

8.7.20 System Maintenance. The hardware integrator shall be solely and completely responsible for all maintenance of the RTUs from time of assembly to the date of Final Acceptance of the Project. The integrator shall correct all deficiencies and defects, and shall make any and all repairs, replacements, modifications and adjustments as malfunctions or failures occur. The integrator shall perform all such Work required, or considered to be required, by the County to cause and maintain proper operation of the RTUs and to properly maintain the RTUs.
8.7.21 Record Drawings. The hardware integrator and the telemetry equipment supplier shall provide the County a clean and neat set of record drawings showing any changes from the Approved Drawings. These record drawings shall be provided prior to Final Acceptance of the Project. The integrator and supplier shall be responsible for providing a neatly folded record drawing for each panel.

8.8 ELECTRIC SERVICE

8.8.1 Conduit and wire shall conform to Section 8.2 of these Specifications.

8.8.2 Metering Cabinets. A metering cabinet shall be provided as shown on the Approved Drawings, and shall conform to the requirements of the serving utility. Circuit breaker interrupting capacity shall be 14,000 amperes RMS symmetrical at the respective service voltage.

8.8.3 Grounding. The grounding system (including the ground rods, grounding conductors, etc.) shall be in accordance with all state and local electrical codes. A ground rod box shall be provided for each ground rod and must be located in an accessible location within the pump station site. Boxes shall be of precast concrete with a suitable hot-dip galvanized traffic cover at grade level, and shall permit access for the connection and removal of any pressure connectors. Boxes shall be Christy Type G5 with cast-iron lid, Brooks No. 1-RT, or Approved Equal.

8.8.4 Testing. Conductors shall be tested in accordance with Section 8.10 of these Specifications. Ground resistance tests shall be made using test equipment and methods which conform to IEEE Standard 81. Conduct tests after at least 48 hours of dry weather. Each ground rod shall be tested individually and the system as a whole shall be tested. Submit test results for review by the County.

8.9 SITE TRAINING

8.9.1 The Contractor shall provide services of a qualified person to instruct Pierce County Collection Maintenance personnel in the operation and maintenance of the electrical systems for a minimum of 4 hours. An outline of instructional topics shall be submitted to the County for review.

8.10 FIELD TESTING

8.10.1 Operational Tests. The Contractor shall operationally test all circuits to demonstrate that the circuits and equipment have been properly installed, adjusted and are ready for full-time service. Test results shall demonstrate the proper functioning of circuits in all modes of operation, including alarm conditions, and shall further demonstrate satisfactory interfacing with the data acquisition and alarm systems.

8.10.2 Insulation Resistance Tests. The Contractor shall perform insulation resistance tests on circuits to be energized with a line-to-neutral voltage of 120 volts or more. The tests shall be made after all equipment has been connected, except that equipment which may be damaged by the testing voltage. Test the insulation with 500-volts DC insulation resistance tester with a scale reading 100 megaohms. The insulation resistance shall be 20 megaohms or more.
8.10.3 Retesting will be required for all unsatisfactory test results after the equipment or system has been repaired or replaced. Retest all related equipment and systems as required by the County. Repair and retest equipment and systems which have been satisfactorily tested but later fail until satisfactory performance is obtained.

8.10.4 The Contractor shall perform calibration and adjustment on all equipment as required. Where the values for adjustment are not shown on the Approved Drawings, the Contractor shall obtain the proper values from the County.

8.10.5 The Contractor shall measure motor full-load current for each new motor, which shall include measurement of the motor terminal voltages and motor full load currents when the motor is being operated at normal operating loads.

8.10.6 The Contractor shall perform Arc Flash analysis as required by the NEC 110.16 Flash Protection and per NFPA 70E-2000, Part II 2-1.3.3. Calculations must be performed to determine the Flash Protection Boundary, Hazard Category and Protective Equipment requirements. The Contractor shall provide warning hazard labeling for each piece of equipment tested in accordance with Section 11.10.9.
SECTION 9

STANDBY ENGINE-GENERATOR SYSTEMS

9.1 GENERAL

9.1.1 This Section includes furnishing all labor, materials, equipment, services and incidentals required to provide a complete and operable standby engine-generator system. Materials and equipment shall be new and of best quality, as shown on the Approved Drawings and specified herein.

9.1.2 The applicable provisions of Section 8.6 shall become a part of this Section as if repeated herein.

9.2 QUALITY ASSURANCE

9.2.1 The Contractor shall comply with all laws, ordinances, codes, rules, and regulations of federal, state, and local authorities having jurisdiction over the Work specified herein. Permits and inspection shall be provided in accordance with all federal, state, and local codes.

9.2.2 All Work and equipment provided under this Section shall be in accordance with the following standards or their amendments:

1. National Electric Manufacturers Association (NEMA) Publication:
   a. MG (Latest Edition) – Motors and Generators.

2. National Fire Protection Association (NFPA) Publications:
   a. NFPA 30 (Latest Edition) – Flammable and Combustible Liquid Code; and

9.2.3 Location and details for the engine-generator as shown on the Approved Drawings are diagrammatic. The size of equipment and pipes, and the general method of routing, are shown, but the Approved Drawings may not show every offset and fitting, nor every structural difficulty, that may be encountered.

9.3 SUBMITTALS

9.3.1 Shop Drawings. The Contractor shall submit shop drawings in accordance with the requirements outlined below for review by the County. Incomplete submittals will be returned without review for completion. Shop drawing submittals shall include the following:

1. Floor layout drawings for the engine-generators showing location dimensions for all connections (including electrical, fuel, exhaust, cooling water and controls), and base dimensions.
2. Composite assembly drawing of the complete engine-generators showing dimensions and weight of the unit and locations of all auxiliary equipment, in front, rear and both side elevations.
3. Mounting details, including seismic anchorage.
4. Specification sheets showing performance data and engineering details adequate to demonstrate compliance with specifications for:
   a. Engine;
   b. Generator and Voltage Regulator;
   c. Base Assembly;
   d. Engine Control Panel with All Components;
   e. Jacket Water Heater;
   f. Governor;
   g. Battery System;
   h. Battery Charger;
   i. Exhaust Silencer and Exhaust System;
   j. Load Bank System;
   k. Alarms;
   l. Torsional Analysis of Engine and Generator; and
   m. Housing.

5. Electrical interconnection diagram, including generator, voltage regulator, control panel, circuit breaker, batteries, jacket heater, switches and accessories.

6. Complete identification of all components and materials by manufacturer, model number, rating and material.

7. Complete engine and generator voltage dip and load data. Provide calculations to show compliance with specified performance requirements specifically prepared for the Project.


9. Wiring diagrams for generator excitation and regulation circuits, alarm circuits, and instrument circuits.

10. Elementary control diagram and separate wiring diagram for automated engine starting and protective shutdown controls. Show a wire number for every control circuit wire. Include a comprehensive description of operation.

11. Complete surface preparation and finish data for the engine, generator, cabinet, panels, frame, housing and other surfaces.

12. One copy of the manufacturer’s installation and maintenance instructions to assist in review of the shop drawings.

13. Detailed description of field testing program, including description of the tests, testing equipment, reporting procedure, and criteria for the test passing or failure. This may be a separate submittal made at a later time, but not later than 30 calendar days before testing is conducted.

14. Parts list for all components and list of all recommended spare parts.

9.3.2 Factory Test Report. After fabrication and testing, but before shipment from the factory, the Contractor shall submit results of all factory tests for review. Do not ship any generator units until the factory test results have received approval by the County.

9.3.3 Field Test Report. The Contractor shall submit a typewritten field test report, in accordance with the County-approved field testing reporting procedure, for review within 15 calendar days of the time of completion of the field test. The test report shall indicate the test criteria and arrangement, the time of the test, the results, and pertinent data such as voltage, frequency, kilowatts, power factor, load current, oil pressure, water temperature and ambient temperature.
9.3.4 O&M Manuals. O&M Manuals shall be provided in accordance with Section 7.1.4.5 of these Specifications.

9.3.5 Seismic Protection. The generator set with silencer and exhaust piping is classified as "essential" for seismic protection. Submit calculations, details and other amplifying data demonstrating conformance to the seismic requirements to the County.

9.3.6 Affidavit. The Contractor shall furnish an affidavit from the engine-generator supplier stating that the system has been properly installed and tested, and is ready for full-time operation in conformance with these Specifications.

9.3.7 Warranty. The manufacturer shall warranty the engine-generator system against defects in workmanship and material for a period of 2 years after Final Acceptance of the Project. The warranty shall be in printed form.

9.4 STANDBY ENGINE-GENERATOR SETS

9.4.1 Each standby engine-generator set shall be a factory assembled package of new and current equipment, consisting of an engine, generator, controls, and other accessories as specified and as may be required for a complete and operable assembly, capable of automatic startup and shutdown.

9.4.2 The complete engine-generator assembly shall be provided by the manufacturer of the generators or the engine manufacturer's distributor so there is one source of supply and responsibility. This responsibility shall include coordinating the installation and successfully operating these specific engine-generator sets. The complete engine-generator assembly shall be in accordance with the National Electrical Code (NEC), and all state and local regulations.

9.4.3 Each engine-generator shall be permanently mounted on a welded steel base for anchoring to a concrete base, with vibration isolators provided between the engine-generator and the welded base.

9.4.4 The engine-generator system shall be manufactured and assembled by Onan.

9.4.5 Ratings and Performance. The engine-generator system shall be capable of providing power for motors, lighting and controls in accordance with the Approved Drawings and design report. Additionally, the engine-generator shall be capable of starting and operating the sequentially started loads as specified, and shall be rated continuous standby (defined as continuous for duration of any power outage). The instantaneous voltage dip shall not exceed 26 percent. The generator will not be required to parallel any other source.

9.4.6 Engines. The engine shall be equipped with the following:

1. Engine-driven or electric fuel transfer pump capable of lifting fuel 16 feet, fuel filter, electric solenoid fuel shut-off valve, and a fuel distribution system with an isochronous governor on 160-kW and larger generators. Generators smaller than 160-kW shall be equipped with an isochronous governor capable of +0.25 percent steady-state frequency regulation.
2. 12-volt positive engagement solenoid shift-starting motor.
3. 35-ampere minimum automatic battery charging alternator with solid-state voltage regulation.
4. Positive displacement, full pressure lubrication oil pump, cartridge oil filters, dipstick and oil drain.

5. Dry-type replaceable air cleaner elements. Note: Engines requiring glow plugs will not be acceptable when NFPA-99 ten-second transfer requirement must be met.

6. The naturally aspirated or turbocharged engine shall be fueled with No. 2 diesel, 4-cycle, liquid cooled by a unit-mounted radiator, blower fan, water pump, thermostat, and radiator duct flange shall properly cool the engine with up to 0.5-inch H₂O static pressure on the fan.

7. Block heater, 1,500 watts, 120 volts AC. Thermostatically controlled to maintain engine coolant at proper temperature to meet the startup requirement of NFPA-99 Regulation. The block heater shall be a “Kim Hotstart” as manufactured by Kim Hotstart Manufacturing, Inc. of Spokane, WA, or Approved Equal.

8. Batteries. Provide starting batteries mounted in attached battery racks with non-conducting bottoms. The batteries shall be guaranteed for 1 year and the manufacturer shall install a new battery for any battery found defective within the guarantee period. Batteries shall be mounted above the concrete floor level. Batteries shall be maintenance-free, sealed lead acid type, selected to provide engine break-away current for 1 second followed by a full cranking cycle as specified above, with a resultant voltage not less than 0.85 volts per cell and at a battery temperature of 20º F; engine shall be at the temperature maintained by the jacket heater for a 20º F ambient. The battery shall have a protective polyglass removal cover.

9. Battery Charger. For each engine, provide a charger of the automatic dual-rate type. A DC ammeter, DC voltmeter, fused AC input and DC output, and charge rated selector switch shall be included. The charger shall operate on 120 volts AC, equipped for conduit installation. Battery charger shall be manufactured by LaMarche Manufacturing Company. Each charger shall be capable of recharging its battery to full charge within 8 hours after a full cranking cycle.

10. Silencer. Exhaust noise shall be limited in accordance with WAC 173-60, or per the requirements of the governing jurisdiction. Provide a gas-proof, seamless, stainless steel, flexible exhaust connection, and stainless steel engine exhaust silencer rated for hospital use and mounted inside the generator enclosure. The internally-top-mounted exhaust silencer shall have a heat shield, protecting personnel from hot surfaces. Exhaust shall exit from the end of the enclosure and shall be directed away from the control panel. In the event that the silencer is to be externally mounted, the silencer shall be manufactured out of stainless steel. Silencer shall be manufactured by Nelson Engine Systems India LTD, Cowl, GT Exhaust Systems, Inc., or Approved Equal.

11. Safety Guards. Provide safety guards for exhaust manifold and turbocharger as specified in Section 7.5.5 of these Specifications.

12. Provide an external, pedestal-mounted oil level fill gauge having a 2-gallon reservoir, as manufactured by Power Plus Products “REN”, or Approved Equal.

13. Crankcase drain shall be piped outside of the engine base frame and shall terminate with a plugged globe valve. The drain shall be located for convenient changing of crankcase oil.
14. Engine Exhaust. Engine exhaust piping shall be Schedule 40 black steel pipe conforming to ASTM A120 with condensate drains at low points. Provide a thermal blanket on the exhaust manifold for personnel safety.

15. Exhaust piping and silencer insulation thickness (hospital silencer) shall be 4 inches.

9.4.7 Generators

9.4.7.1 The alternator shall be salient-pole, brushless, 12-lead reconnectable, self-ventilated of drip-proof construction with amortisseur rotor windings and skewed stator for smooth voltage waveform. The insulation shall meet the NEMA MG 1 (22.40 and 16.40) for Class H and be insulated with epoxy varnish to be fungus resistant per MIL-E-4970A. The excitation system shall be of brushless construction controlled by a solid-state voltage regulator capable of maintaining voltage within plus or minus 2 percent at any constant load from 0 to 100 percent of rating. The regulator must be protected from the environment by conformal coating.

9.4.7.2 Upon one-step application of any load up to 90 percent of the rated load at a power factor of 0.8, the voltage dip shall not exceed 26 percent and shall recover to within 2 percent of rated voltage within 1 second.

9.4.7.3 The generator shall be capable of sustaining at least 250 percent of rated current for at least 10 seconds under a three-phase symmetrical short by inherent design or by the addition of an optional current boost system. An optional current boost system addition shall be at the cost of the Contractor.

9.4.7.4 A resettable line current sensing circuit breaker with inverse time versus current response, which protects the generator from damage due to its own high current capability, shall be furnished. This breaker shall not trip within the 10 seconds specified above to allow selective tripping of downstream fuses or circuit breakers under a fault condition. This breaker shall not automatically reset, preventing restoration of voltage if maintenance is being performed. Field current-sensing breaker will not be acceptable.

9.4.7.5 The generator, having a single maintenance-free bearing, shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.

9.4.7.6 Line circuit breaker of 100 amps, 3-poles.

9.4.7.7 Frequency regulation shall be isochronous plus or minus 0.25 from no-load to rated load.

9.4.8 Instrument Panel. An instrument panel shall be provided with the engine-generator set and shall include the following:

1. Dual range voltmeter, 3-½ inch, 2 percent accuracy;
2. Dual range ammeter, 3-½ inch, 2 percent accuracy;
3. Voltmeter-ammeter phase selector switch;
4. Lights to indicate high- or low-meter scale;
5. Direct reading pointer-type frequency meter, 3-½ inch, 0.5 percent accuracy, 45 to 65 Hz scale;
6. Panel illuminating lights;
7. Battery charging voltmeter;
8. Coolant temperature gauge;
9. Oil pressure gauge;
10. Running time meter; and
11. Voltage adjust rheostat.

9.4.9 Controller

9.4.9.1 The Contractor shall provide a set-mounted controller capable of facing right, left or rear. The controller shall be vibration isolated on the generator enclosure and shall be capable of being remote-mounted. The microprocessor control board shall be conformal coated. Relays will only be acceptable in high-current circuits.

9.4.9.2 Circuitry shall be of plug-in design for quick replacement. Controllers shall be equipped to accept a plug-in device capable of allowing maintenance personnel to test controller performance without operating the engine. The controller shall include the following:

1. Fused DC circuits.
2. Complete 2-wire start/stop control which shall operate on closure of a remote contact.
3. Speed sensing and a second independent starter motor disengagement systems shall protect against starter engagement with a moving flywheel. Battery charging alternator voltage will not be acceptable for this purpose.
4. The starting system shall be designed for restarting in the event of a false engine start by permitting the engine to completely stop and then reengage the starter.
5. Cranking cycler with 10 seconds ON and OFF cranking periods.
6. Overcrank protection designed to open the cranking circuit after 60 seconds if the engine fails to start.
7. Circuitry to shut down the engine when signal for high coolant temperature, low oil pressure or overspeed is received.
8. Engine cool-down timer, factory set at 5 minutes, to permit unloaded running of the standby set after transfer of the load to normal.
9. Overvoltage protection will shut down the unit after 1 second of 15 percent or more overvoltage. Note: Sensitive equipment may suffer damage in less than 1 second of an overvoltage condition. On-line equipment requiring faster shutdown should have its own overvoltage protection.
10. Three-position selector switch (Automatic – OFF – TEST). In the TEST position, the engine shall start and run regardless of the position of the remote starting contacts. In the Automatic position, the engine shall start when contacts in the remote control circuit close and stop 5 minutes after those contacts open. In the OFF position, the engine shall not start even though the remote start contacts close. This position shall also provide for immediate shutdown in case of an emergency. Reset of any fault shall also be accomplished by putting the switch to the OFF position.
11. Indicating lights to signal:
   a. Switch “OFF” (flashing red);
   b. Overcrank (red);
   c. Emergency Stop (red);
   d. High Water Temperature (red);
e. Overspeed (red);
f. Low Oil Pressure (red);
g. *High Battery Voltage (red);
h. * Low Battery Voltage (red);
i. * Low Fuel (red);
j. * System Ready (green);
k. * Anti-High Water Temperature (yellow);
l. * Anti-Low Oil Pressure (yellow); and
m. * Low Coolant Temperature (red).

12. Test button for indicating lights.
14. Alarm Outputs. Provide one set of normally-closed dry (i.e. non-energized) output contacts for connections to the telemetry system “Composite Generator Alarm” for each unit. The contacts shall be actuated for any one or more of the shutdown conditions. The contacts shall remain activated during the entire period of the abnormal condition, and reset shall be automatic.

15. Generator Run Output. Provide one set of normally-closed (i.e. non-energized) output contacts for connections to the telemetry system “Generator Run” for each unit. The contacts shall be initiated on confirmation that the generator is running.

* Required to meet NFPA Regulations.

9.5 HOUSING

9.5.1 The weatherproof housing shall be constructed of 14-gauge steel. The entire housing shall be painted in accordance with Section 10.4.1.

9.5.2 An insulation package shall be provided, attached to the interior of the housing, to reduce dBA to a level that would be required in a hospital environment. Insulation package shall be provided and installed by the supplier. Insulation must be protected by 22-gauge perforated steel sheet. Sound level of generator shall not exceed 85 dBA at 10 feet when the generator is at 100 percent of full load rating.

9.5.3 The doors/side panels shall be locking with padlock handles. Doors/side panels shall be easily removed for servicing. The enclosure shall have an adequate number of doors to permit access and maintenance to all equipment within the enclosure.

9.5.4 Limit switch type contacts shall be provided on each door. Contacts shall be wired into, and become a part of, the intrusion alarm, connected to the telemetry system located at the control panel. Door alarms shall be wired in parallel. Limit switch shall be double-pole, double-throw DPDT, as manufactured by Cutler Hammer Model E50BR1, with 6-inch Nylatron® loop, Model E50KL142.

9.5.5 Louvers shall be provided at the generator and radiator ends of the housing. Screens or other method as approved by the County shall be provided at all openings, other than access doors, to prevent nesting of birds and insects.

9.5.6 The housing shall be as manufactured by Surround Technologies, Inc. (Vancouver, Canada), Viking Marine Industries, Inc., or Approved Equal.
9.6 LOAD BANK

9.6.1 The generator supplier shall provide a self-contained, permanently mounted, weatherproof, duct-radiator type load bank, complete with controls, contactors, louvers, necessary wiring and installation so as to become part of the automatic generator system specified herein. The load bank shall be located within the generator set enclosure.

9.6.2 The load bank system shall be completely automatic in operation, and shall be sized to accommodate loads of 25 to 100 percent of the generator’s kW rating.

9.6.3 The load bank controls shall be located within the generator set enclosure, and shall include a master control switch and separate, independent switches to manually initiate separate loads at 25 percent increments.

9.6.4 The load bank, complete with controls, shall be manufactured by Simplex.

9.7 FUEL TANK

9.7.1 A double-walled, top-diked, sub-base fuel tank shall be constructed with appropriate supports to allow for direct mounting of the generator set. Both the inner and outer tanks shall be equipped with emergency relief vent openings. The tanks shall be constructed so that the inner tank is sealed from the outer tank. The outer tank shall contain fuel in the event of tank rupture or leak.

9.7.2 The fuel tank shall be constructed to include a mounting surface for the attachment of the sound attenuated enclosure.

9.7.3 The outer tank top and bottom shall be constructed from 7-gauge steel. The side and end channels shall be constructed from 7-gauge steel if weight of generator is less than 12,000 pounds. If the generator weighs in excess of 12,000 pounds, the side and end channels shall be constructed from ¼-inch steel. The exterior of the tank shall be painted as identified in Section 10.4.3.

9.7.4 The inner tank shall be constructed of 10-gauge steel. The interior of the tank shall be coated with rust-inhibitor. Internal baffling shall be installed within the tank to separate cool supply fuel from hot return fuel.

9.7.5 Penetrations and equipment supplied with the tank shall include a “Low Fuel Level” switch, “Fuel in Basin” switch, emergency vent cap, “Normal” vent cap, 2-inch lockable fill cap, mechanical fuel level gauge, analogue level sensor, removable supply dip-tube, and removable return dip-tube.

9.7.6 Tanks shall be Underwriters Laboratory No. 142 approved and shall bear the UL label and file number.

9.7.7 The fuel tank shall be sized for 36 hours of full-load run.

9.7.8 The analogue level sensing transmitter shall be a NEMA 4X (IP66) with a polypropylene enclosure. The device shall have an output of 4-20mA into 500 ohms at 24 volts DC (two-wire), and shall be equipped with a Type 316 stainless steel reservoir and impulse tube, as manufactured by Venture Measurement Co., LLC, “Levelite” Model GDL 20000X.
9.7.9 The fuel tank shall be manufactured by Custom Tank Technology, or Approved Equal.

9.8 EQUIPMENT INSTALLATION

9.8.1 The Contractor shall construct suitable concrete foundations in accordance with the Approved Drawings and the Standard Plans. Portland cement concrete for equipment foundations shall conform to the requirements of Sections 6.2 and 6.3.

9.8.2 The engine-generator set shall be mounted and anchored in accordance with the approved installation shop drawings. The Contractor shall install all such equipment using skilled mechanics and complying with the manufacturer’s instructions.

9.8.3 In setting equipment, the Contractor shall make allowance for at least 1 inch of grout under the equipment bases. Shims used to level and adjust the bases shall be steel. Shims may be left embedded in the grout, in which case they shall be installed neatly so as to be as inconspicuous as possible in the completed Work. Unless otherwise approved, all grout shall be non-shrink, non-metallic grout meeting the requirements of Section 6.10.2.

9.8.4 Fuel and Lubricants. During testing and prior to Final Acceptance of the Project, the Contractor shall furnish all fuel and lubricants necessary for the proper operation of the equipment.

9.8.5 Tools. For each type of equipment furnished, the Contractor shall provide a complete set of all special tools (including grease guns and other lubricating devices), which may be necessary for the adjustment, operation, and maintenance of such equipment.

9.9 TESTING AND RUN-IN

9.9.1 General. Testing shall be performed to determine proper operation and capacity of the equipment and to demonstrate compliance with the Approved Drawings and these Specifications. All equipment that fails any test will be rejected, and complete retesting will be required after corrections or modifications to equipment are made. All field tests shall be witnessed by the County.

9.9.2 Factory Tests. The engine-generator shall be tested in the factory to assure compliance with the Approved Drawings, these Specifications, and NEMA MG-1. Test results shall be submitted to the County for review in accordance with Section 9.3.2.

9.9.3 Field Tests

9.9.3.1 The engine-generator shall be field tested to demonstrate the unit is in compliance with these Specifications and ready for service. Field tests shall be scheduled after installation of the engine-generator is complete and the unit has been serviced, tested and adjusted, and is ready for use. The Contractor shall provide notice of the testing schedule to the County at least 15 calendar days prior to the field test date.

9.9.3.2 Voltage dip characteristics shall be confirmed by field testing. Failure of this field test shall constitute evidence that the equipment has not met the voltage dip criterion, and the Contractor shall replace or modify the equipment as necessary to obtain satisfactory operation as specified herein. Under no circumstances will equipment with a voltage dip greater than specified be acceptable. Pertinent data for each test shall
be recorded at least every 30 minutes when the test requires more than 30 minutes to complete.

9.9.3.3 The Contractor shall provide the County with written records of test results within 15 calendar days of testing. Field test reports shall be submitted in accordance with Section 9.3.3.

9.9.4 Alarm, Control, and Equipment Tests. The Contractor shall demonstrate each alarm and safety shutdown provision by causing the abnormal condition, unless an alternative test condition has been approved by the County prior to the scheduling of the tests. Each control circuit and device (including the battery charger and the jacket water heater) shall be operated to demonstrate its proper operation.

9.9.5 Fuel System Tests. The Contractor shall demonstrate that the fuel system operates to the satisfaction of all regulating agencies and the County.

9.9.6 Endurance Tests. The engine-generator shall be operated for ½ hour at 50 percent of its kW rating. The engine-generator shall be operated for 6 hours continuously at 100 percent of its kW rating. The temperature rise of the generator windings shall be measured using the resistance method.

9.10 COUNTY ORIENTATION

9.10.1 The Contractor shall furnish a representative of the engine-generator supplier to meet with selected representatives of the County at the time of the final acceptance tests and review the operation and parts books, correct starting and control methods, and recommended preventive maintenance procedures. Assume 4 hours of instruction. All associated testing and training costs shall be borne by the Contractor.

END OF SECTION
SECTION 10

PAINTS AND PROTECTIVE COATINGS

10.1 GENERAL

10.1.1 This Section includes furnishing all materials and labor for the preparation and application of paints and protective coatings.

10.1.2 The Contractor shall paint all structures, machines, motors, surfaces, piping valves, operators, miscellaneous structural metals, hangers, supports, and other equipment shown on the Approved Drawings, identified in the Standard Plans, and specified herein, with the exception of the following items:

1. Fiberglass gratings and structures;
2. Stainless steel and aluminum;
3. Rubber and glass;
4. Plastic pipe;
5. Nameplates and grease fittings;
6. Copper pipe, galvanized pipe, conduit; and
7. Electrical fixtures.

10.1.3 Quality Assurance. Unless otherwise required by the coating manufacturer’s instructions, and notwithstanding any additional requirements specified herein, the Contractor shall comply with the following general requirements for the application of protective coatings:

1. Do not apply protective coatings when the ambient temperature is below the manufacturer’s printed data sheet recommendations for application.
2. Provide adequate ventilation and heating.
3. Grind concrete surfaces free from fins and sack all surfaces to fill voids.
4. Apply no less than the number of coats or minimum dry film thickness (DFT) specified.
5. Be advised that the materials specified may be harmful or fatal if contact or ingestion occurs. Appropriate action shall be taken to avoid contact or ingestion as required.

10.1.4 Submittals. The Contractor shall submit protective coating material catalog cuts for each coating system for approval by the County. Additionally, the Contractor shall obtain colors from the County and submit color samples for approval.

10.2 PROTECTIVE COATINGS FOR DUCTILE IRON PIPE

10.2.1 Interior Coating

10.2.1.1 All ductile iron pipe and fittings 4 inch nominal inside diameter and larger, except building sewers, shall be provided and installed with a ceramic epoxy coating applied to all exposed interior surfaces unless otherwise specified on the Approved Drawings or approved by the County. The ceramic epoxy coating must be a high-build,
multi-component Amine cured Novalac Epoxy Lining (Protecto 401 Ceramic Epoxy), or Approved Equal. The coating shall be smooth, even, and free of runs, sags, streaks, pinholes, holidays and overspray, and shall be applied by a one-pass methodology.

10.2.1.2 Surface Preparation. Surface preparation shall be to the coating manufacturer’s recommendations and specifications. All surfaces to be lined shall be cleaned to a near-white metal finish (SSPC-SP10) as applied to ductile iron pipe and fittings. All surfaces to be lined shall be completely dry, free of moisture, dust, grease or any other deleterious substances at the time the lining is applied.

10.2.1.3 Dry Film Thickness (DFT). The DFT of internal lining shall be 40 mils (0.040 inch) nominal. Thickness determinations using a Type 1 magnetic thickness gauge shall be conducted in accordance with Steel Structures Painting Council SSPC-PA2 Specification as applied to ductile iron pipe and fittings.

10.2.1.4 Joints. In order to minimize potential dimensional and assembly problems, the coating thickness on sealing areas in the bell socket interior and on the spigot end of the pipe exterior shall be 6 to 8 mils (0.008 inch) nominal with a maximum of 10 mils (0.010 inch). Thicker coatings in these areas are acceptable if it is demonstrated that joint dimensions are within allowable tolerances after coating. The joint coating material shall be Protecto Joint Compound for the ceramic epoxy coating, performed in accordance with the manufacturer’s recommendations.

10.2.1.5 Repair and Field Touchup. Repair and touchup materials shall be Protecto Joint Compound for the ceramic epoxy coating. Repairs and touchup shall be performed in accordance with the manufacturer’s recommended repair and touchup procedures. All field cut ends shall be repaired and sealed prior to installation.

10.2.1.6 Alternative Interior Coating. As an alternative, the interior of the ductile iron pipe can be coated with Raven 405 coating, applied in accordance with the manufacturer’s specifications.

10.2.2 Exterior Coating

10.2.2.1 The exterior of all ductile iron pipe and fittings, except ductile iron pipe and fittings installed within vaults, shall receive a factory-applied standard bituminous coating, 1 mil minimum thickness.

10.2.2.2 Vault Installation. The exterior of all ductile iron pipe and fittings installed within vaults shall be coated as follows:

1. Surface Preparation: Sweep Sandblast exterior coating to provide a surface profile. Surface shall be clean, dry and contaminant-free.
2. Primer: TNEMEC Series 1 Omnithane, 330 square feet per gallon, or Approved Equal.
3. Finish: TNEMEC Series 69 Hi-Build Epoxoline II, Color #17BR (Sandstone), 180 square feet per gallon, or Approved Equal.

10.3 PROTECTIVE COATINGS FOR CONCRETE STRUCTURES

10.3.1 This Section identifies requirements for surface preparation, repairs, and solventless epoxy coating application to the interior of new concrete structures and rehabilitation of the
interior of existing concrete structures as shown in the Approved Drawings, identified in the Standard Plans, or as directed by the County.

10.3.2 References:

5. ASTM D2832 – Determining Volatile and Nonvolatile Content of Paint and Related Coatings.
6. ASTM D2240 – Rubber Property – Durometer Hardness (Type D).
10. ASTM C579 – Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
11. SSPC SP-13/NACE No. 6 – Surface Preparation of Concrete.
12. SSPWC 210-2.3.3 – Chemical resistance testing published in the Standard Specifications for Public Works Construction (otherwise known as “The Greenbook”).
14. NACE – The published standards of the National Association of Corrosion Engineers (NACE International), Houston, TX.
15. SSPC – The published standards of the Steel Structures Painting Council, Pittsburgh, PA.

10.3.3 Submittals. The following items shall be submitted:

1. Technical data sheet on each product used, including ASTM test results indicating the product conforms to and is suitable for its intended use per these Specifications.
2. Material Safety Data Sheets (MSDS) for each product used.
3. Project specific guidelines and recommendations.
4. Qualification of Applicator:
   a. Manufacturer certification that Applicator has been trained and approved in the handling, mixing and application of the products used.
   b. Certification that the equipment to be used for applying the products has been manufactured or approved by the protective coating manufacturer and Applicator personnel have been trained and certified for proper use of the equipment.
   c. Five recent references of Applicator indicating successful application of a high-build, solventless epoxy coating by plural component spray application.
   d. Proof of any necessary federal, state or local permits or licenses necessary for the Project.
5. Design details for any additional ancillary systems and equipment to be used in site and surface preparation, application, and testing.

10.3.4 Quality Assurance. Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM, NACE and SSPC standards and the protective coating manufacturer’s recommendations.

10.3.5 Delivery, Storage and Handling.

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

10.3.5.2 Protective coating materials are to be stored between 50º F and 90º F. Do not store near flame, heat, or strong oxidants.

10.3.5.3 Protective coating materials are to be handled according to their Material Safety Data Sheets.

10.3.6 Site Conditions. Applicator shall comply with all federal, state, and local regulations, including those set forth by the EPA, OSHA, RCRA, and all other applicable authorities.

10.3.7 Warranty. Applicator shall warrant all Work against defects in materials and workmanship for a period of 1 year from the date of Final Acceptance of the Project. Applicator shall, within a reasonable time after receipt of written notice thereof, repair defects in materials or workmanship which may develop during said 1-year period and any damage to other Work caused by such defects or the repairing of same.

10.3.8 Existing Products and Surfaces.

10.3.8.1 Standard Portland cement or new concrete (not quick-setting, high-strength cement) must be cured a minimum of 28 days prior to application of the coating product(s).

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

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

10.3.8.4 Thoroughly clean and prepare existing products to effect a seal with the coating product(s).

10.3.9 Repair Materials (if necessary).

10.3.9.1 Repair materials shall be used to fill voids, structurally reinforce and/or rebuild surfaces, etc. as determined necessary by the County and the protective coating Applicator. Repair materials must be compatible with the specified epoxy coating and shall be applied in accordance with the manufacturer’s recommendations.
10.3.9.2 After repairs are complete, existing manholes shall be vacuum tested as identified in Section 12.4 of these Specifications prior to coating.

10.3.9.3 The following products may be accepted and approved as compatible repair basecoat materials for epoxy topcoating for use within these Specifications:

1. 100% solids, solvent-free epoxy grout specifically formulated for epoxy topcoating compatibility. The epoxy grout manufacturer shall provide instructions for trowel or spray application and for epoxy topcoating procedures.

2. Factory blended, rapid setting, high early strength, fiber reinforced, non-shrink repair mortar that can be trowel or pneumatically spray applied may be approved if specifically formulated to be suitable for epoxy topcoating. Such repair mortars should not be used unless their manufacturer provides information as to its suitability for topcoating with an epoxy coating. Project specific submittals shall be provided, including application, cure time, and surface preparation procedures which permit optimum bond strength with the epoxy coating.

3. Shotcrete shall conform to all requirements of ACI 506.2 as published by the American Concrete Institute (Detroit, MI) except as modified by these Specifications. Shotcrete shall be composed of Portland cement, aggregate, and water so proportioned as to produce a concrete suitable for pneumatic application. Shotcrete ingredients shall be selected and proportioned in such a manner as will produce concrete which will be compatible for epoxy topcoating. Shotcrete shall have a minimum surface tensile strength of 300 psi. No coatings shall be applied prior to a full 28-day cure unless test patches of coatings exhibit acceptable bonding characteristics and no outgassing as prescribed herein, or the repair mortar manufacturer certifies acceptable topcoating parameters.

10.3.10 Exterior Coating

10.3.10.1 Bituminous coal tar epoxy, specially formulated for submerged service and exposure to raw sewage, shall be applied to the exterior of all concrete manholes, vaults, grease interceptors, oil-water separators, and commercial and residential grinder pump wet wells, to a minimum DFT of 25 mils. Coating shall be applied in accordance with the manufacturer’s recommendations.

10.3.10.2 Coal tar epoxy shall be Bitumastic No. 300M as manufactured by the Carboline Company, or similar coating by TNEMEC, Ameron, or Approved Equal.

10.3.11 Interior Coating

10.3.11.1 Coal tar epoxy, as described in Section 10.3.10 of these Specifications, shall be applied to the interior of all concrete grease interceptors, oil-water separators, and commercial and residential grinder pump wet wells, to a minimum DFT of 30 mils. Coating shall be applied in accordance with the manufacturer’s recommendations.

10.3.11.2 The interior of all concrete valve vaults, and existing or new concrete manholes with pipes 15 inch nominal inside diameter or greater and/or with pressure sewer connections, as shown on the Approved Drawings, identified in the Standard Plans, or as directed by the County, shall be coated with Raven 405 ultra high-build
coating system as manufactured by Raven Lining Systems, Inc. (Tulsa, OK) 800/324-2810 or 918/584-2810 or FAX 918/582-4311.

10.3.11.3 Raven 405 is a 100% solids, solvent-free, two-component epoxy resin system, thixotropic in nature and filled with select fillers to minimize permeability and provide sag resistance, exhibiting the following characteristics:

Product type: ................................................ Amine-cured Epoxy
Color: ........................................................... Light Blue
Solids Content, %-volume: ........................... 100
Mix Ratio: ..................................................... 3:1
Compressive Strength (ASTM D695): .......... 18,000 psi, min.
Tensile Strength (ASTM D638): .................... 7,600 psi, min.
Tensile Elongation, %:................................. 1.53
Flexural Modulus (ASTM D790): ............... 600,000 psi, min.
Hardness, Type D: ....................................... 88
Bond Strength – Concrete: ......................... > Tensile Strength of Concrete

10.3.11.4 Protective Coating Application Equipment. The Contractor shall use heated, plural-component spray application equipment, specifically designed or approved for use by the protective coating manufacturer, for use in the application of the specified protective coating. Hard to reach areas, primer application, and touch-up may be performed using hand tools.

10.3.11.5 Repair Mortar Spray Application Equipment. If repair mortar is spray applied, the Contractor shall use spray application equipment, specifically designed or approved for use by the repair mortar material manufacturer, for continuous mixing and spraying of the material.

10.3.11.6 Examination

10.3.11.6.1 The Contractor shall comply with all federal, state and local regulations, and all other applicable authorities with regard to environment, health, and safety.

10.3.11.6.2 Any active flows shall be dammed, plugged or diverted as required to ensure that the liquid flow is maintained below the surfaces to be coated. All extraneous flows into the manhole or vaults at or above the area to be coated shall be plugged and/or diverted until the epoxy has set hard to the touch. As an option, hot air may be added to the manhole to accelerate set time of the coating.

10.3.11.6.3 Installation of the protective coating shall not commence until the concrete substrate has properly cured, if necessary, in accordance with these Specifications.

10.3.11.6.4 Temperature of the surface to be coated should be maintained between 40º F and 120º F during application. Prior to and during application, care should be taken to avoid exposure to direct sunlight or other intense heat source to the structure being coated. Where varying surface temperatures do exist, care should be taken to apply the coating when the temperature is falling versus rising (i.e. late afternoon into evening vs. morning into afternoon).
10.3.11.7 Surface Preparation

10.3.11.7.1 Applicator shall inspect all surfaces specified to receive a protective coating prior to surface preparation.

10.3.11.7.2 Applicator shall notify the County of any noticeable disparity in the surfaces which may interfere with the proper preparation or application of the repair mortar and protective coating.

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

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

10.3.11.7.5 All voids and/or flaws on interior concrete surfaces to be coated shall be filled with a 100% solids, solvent-free epoxy grout specifically formulated for epoxy topcoating compatibility. Factory blended, rapid setting, high early strength, fiber reinforced, non-shrink repair mortar that can be trowelled or pneumatically spray applied may be approved if specifically formulated to be suitable for topcoating with the specified coating products. The Contractor shall provide confirmation from the coating manufacturer that the repair grout to be used is compatible with the coating product. Repair mortar applicators should be trained to properly apply the cementitious mortar according to the manufacturer’s recommendations.

10.3.11.7.6 All surfaces shall be primed with Raven 155 Water Borne Epoxy Primer™, or other product as recommended by the manufacturer.

10.3.11.7.7 Surface preparation method(s) should be based upon the conditions of the substrate, service environment and the requirements of the epoxy protective coating to be applied.

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

10.3.11.7.9 Surfaces to receive protective coating shall be cleaned and abraded to produce a sound surface with adequate profile and porosity to provide a strong bond between the protective coating and the substrate. Generally, this can be achieved with high-pressure water cleaning using equipment capable of 5,000 psi at 4 gpm. Other methods, such as high-pressure water jetting (refer to NACE Standard No. 5 / SSPC SP-12), abrasive blasting, shotblasting, grinding, scarifying or acid etching, may also be used. Detergent water cleaning and hot water blasting may be necessary to remove oils, grease or other hydrocarbon residues from the concrete. Whichever method(s) are used, they shall be performed in a manner that provides a uniform, sound, clean and neutralized surface that is not excessively damaged. For existing manholes, no debris from concrete surface preparation shall be permitted to be washed into the sanitary sewer pipeline. All surplus material and debris shall be collected and disposed of in accordance with Section 2.4 of these Specifications.

10.3.11.7.10 A mild chlorine solution may be used to neutralize the surface to diminish microbiological bacterial growth prior to final rinse and coating.
10.3.11.7.11 Infiltration shall be stopped by using a material which is compatible with the specified repair mortar and is suitable for topcoating with the specified epoxy protective coating. All manholes shall be vacuum tested in accordance with Section 12.4 of these Specifications prior to coating.

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

10.3.11.7.13 The area between the manhole and the manhole ring, and any other area that might exhibit movement or cracking due to expansion and contraction, shall be grouted with a flexible or elastomeric grout or gel. Castings can be abrasive blasted and coated to prevent corrosion if desired.

10.3.11.7.14 All surfaces should be inspected by the Inspector during and after preparation and before the repair mortar is applied.

10.3.11.8 Application of Repair Materials

10.3.11.8.1 Areas where structural steel has been exposed or removed shall be repaired in accordance with the protective coating manufacturer’s recommendations.

10.3.11.8.2 Repair materials shall meet the specifications stated herein. The materials shall be trowel or spray applied on to specified surfaces utilizing proper equipment. The material thickness shall be as specified by the manufacturer’s recommendations.

10.3.11.8.3 If using approved cementitious repair materials, such shall be troweled to provide a smooth surface with and average profile equivalent to coarse sandpaper to optimally receive the protective coating. No bugholes or honeycomb surfaces should remain after the final trowel procedure of the repair mortar.

10.3.11.8.4 The repair materials shall be permitted to cure according to the manufacturer’s recommendations. Curing compounds should not be used unless approved for compatibility with the specified protective coating.

10.3.11.8.5 Application of the repair materials, if not performed by the protective coating Certified Applicator, should be inspected by the Applicator to ensure proper finishing for suitability to receive the specified coating.

10.3.11.8.6 After abrasive blast and leak repair is performed, all surfaces shall be inspected for remaining laitance prior to protective coating application. Any evidence of remaining contamination or laitance shall be removed by additional abrasive blast, shotblast or other approved method. If repair materials are used, refer to these Specifications for surface preparation. Areas to be coated must also be prepared in accordance with these Specifications after receiving a cementitious repair mortar and prior to application of the epoxy coating.

10.3.11.8.7 All surfaces should be inspected during and after preparation and before the protective coating is applied.
10.3.11.9  Application of Protective Coating

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

10.3.11.9.2  The coating shall be applied on-site, after the concrete structures are installed and backfilled, in accordance with the manufacturer’s recommendations. Pipe intrusions and manufacturer’s installed poly-ladder rungs shall be masked prior to coating application.

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

10.3.11.9.4  The protective coating material must be spray applied by a Certified Applicator of the protective coating manufacturer.

10.3.11.9.5  Specified surfaces shall be coated by spray application of a moisture-tolerant, solventless, 100% solids, self-priming epoxy protective coating as further described herein. Spray application will be allowed to an average wet film thickness of 125 mils, with a minimum wet film thickness of 100 mils.

10.3.11.9.6  Airless spray application equipment approved by the coating manufacturer shall be used to apply each coat of the protective coating to avoid any potential contamination from compressed air oil which may encourage inter-coat delamination.

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

10.3.11.9.8  Application of the protective coating shall not occur until the manhole structure has been vacuum tested and accepted as watertight.

10.3.11.10  Testing and Inspection

10.3.11.10.1  During application, a wet film thickness gage, such as those available though Paul N. Gardner Company, Inc. meeting ASTM D4414 – Standard Practice for Measurement of Wet Film Thickness by Notched Gages, shall be used to ensure a monolithic coating and uniform thickness during application. The Contractor shall provide the wet film thickness gage.

10.3.11.10.2  After the protective coating has set hard to the touch it shall be inspected with high-voltage holiday detection equipment. An induced holiday shall be made on to the coated concrete surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays at that particular area. The spark tester shall be initially set at 100 volts per 1 mil (25 microns) of film thickness applied, but may be adjusted as necessary to detect the induced holiday.
All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional protective coating material can be hand applied to the repair area. All touch-up/repair procedures shall follow the protective coating manufacturer’s recommendations.

10.3.11.10.3 Measurement of bond strength of the protective coating to the substrate shall be measured in accordance with ASTM D4541. A minimum of three adhesion tests shall be conducted in each structure, or more as determined by the County. The tests shall be placed at intervals (top, middle and bottom) in an attempt to obtain an equal representation of the entire application. Test dollies shall be 20 mm diameter and attached to the coated surface with an adhesive. The adhesive shall be rapid setting with tensile strengths in excess of the coating product, and permitted to cure in accordance with the manufacturer’s recommendations. The coating and dollies shall be adequately prepared to receive the adhesive. Failure of the dolly adhesive shall be deemed a non-test and require retesting. Prior to performing the pull test, the coating shall be scored within 30 mils of the substrate by mechanical means without disturbing the dolly or bond within the test area. A minimum of two out of the three total adhesive tests must pass in order for the structure to be considered passing. If additional tests are required by the Engineer, a minimum 75 percent of the samples must pass. Adhesion tests which are to be considered “passing” shall indicate “Concrete Substrate Failure” as evidence by not less than 50 percent of concrete substrate bonded to the test sample. If “Concrete Substrate Failure” is not achieved and the bond is broken between the applied product and the substrate during testing, a pull strength of 200 psi minimum shall be “passing”. Any areas detected to have inadequate bond strength shall be evaluated by the County. Further bond tests shall be performed in that area to determine the extent of potentially deficient bonded area and repairs shall be made by the Applicator in strict accordance with the manufacturer’s recommendations.

10.3.11.10.4 Testing shall be conducted by an independent NACE certified testing firm which specializes in protective coating testing, unless otherwise approved by the County. The Contractor shall be responsible for the cost(s) of any and all testing, which shall be included as part of his/her bid.

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

10.3.11.10.6 The system may be put back into non-severe operational service as soon as the final inspection has taken place.

10.4 PROTECTIVE COATINGS FOR MISCELLANEOUS EQUIPMENT AND ENCLOSURES

10.4.1 Housings for Standby Engine-Generator Systems

10.4.1.1 The entire housing shall be painted at the housing manufacturer’s facility with a coat of high-build gloss polyurethane enamel, product number KM-370, color number 16492, as manufactured by Kelly-Moore Paint Company, Inc.

10.4.1.2 Surfaces to be painted shall be free from all oil, grease, dirt, water or other foreign matter, and shall be primed in accordance with the paint manufacturer’s
recommendations. Primer and top coat shall be applied in accordance with the paint manufacturer’s recommendations.

10.4.2 Electrical Control Panel Enclosures

10.4.2.1 The entire enclosure shall be painted at the enclosure manufacturer’s facility with a coat of high-build gloss polyurethane enamel, product number KM-370, color number 16492, as manufactured by Kelly-Moore Paint Company, Inc.

10.4.2.2 Surfaces to be painted shall be free from all oil, grease, dirt, water or other foreign matter, and shall be primed in accordance with the paint manufacturer’s recommendations. Primer and top coat shall be applied in accordance with the paint manufacturer’s recommendations.

10.4.3 Fuel Tank for Standby Engine-Generator Systems

10.4.3.1 The exterior of the fuel tank shall be painted at the fuel tank manufacturer’s facility with a coat of general purpose, short oil alkyd, high-gloss enamel, product number KEM® 400 Enamel, color number F75B401, as manufactured by The Sherwin Williams Company.

10.4.3.2 Surfaces to be painted shall be free from all oil, grease, dirt, water or other foreign matter, and shall be primed in accordance with the paint manufacturer’s recommendations. Primer and top coat shall be applied in accordance with the paint manufacturer’s recommendations.

END OF SECTION
SECTION 11

MISCELLANEOUS MATERIALS AND EQUIPMENT

11.1 GENERAL

11.1.1 This Section includes furnishing all materials, labor and equipment for the construction, fabrication and placement of miscellaneous materials and equipment as shown on the Approved Drawings, identified in the Standard Plans, specified herein, or otherwise required for completion of the Work.

11.2 MATERIALS

11.2.1 Stainless Steel Fabrications

11.2.1.1 Unless otherwise shown on the Approved Drawings, identified in the Standard Plans or specified herein, the Contractor shall use Types 304L and 316L for Types 304SS and 316SS stainless steel fabrications.

11.2.1.2 Piping shall be Schedule 40S, unless otherwise shown on the Approved Drawings.

11.2.1.3 Cutting stainless steel shall be conducted with guillotine, shear or saw materials.

11.2.1.4 Welding. The Contractor shall use a certified welder for stainless steel. Electrodes shall be ER 308L rod with Type 304L base metal, and ER 316L rod with Type 316L base metal. Electrodes shall be stored in a moisture-proof container to prevent moisture absorbance which can result in weld porosity.

11.2.1.5 Fasteners for all stainless steel materials shall be manufactured from Type 316 stainless steel, unless otherwise shown on the Approved Drawings or specified herein. All stainless steel fasteners shall conform to the requirements of ASTM F593 and ASTM F594.

11.2.1.6 Finishing. The Contractor shall remove scale, heat staining, and weld discoloration with one of the following methods:

1. Pickling. Pickling shall be with from 10 to 15 percent nitric acid to which from ½ to 3 percent hydrofluoric acid has been added. After removal from the pickling bath, wash material shall be washed thoroughly with water.
2. Electrolytic weld cleansing with a current transformer and from 50 to 85 percent phosphoric acid.
3. Grinding and Polishing. Grind with a grit wheel, then buff with a polishing wheel and buffing compound.
11.2.2 Plastic Fabrications

11.2.2.1 Submittals. The Contractor shall submit the manufacturer’s descriptive details and/or samples of the manufacturer’s standard product to the County for approval, even though items proposed to be furnished conform to the exact descriptions stated in these Specifications or shown on the Approved Drawings. Submittals shall be made sufficiently prior to the start of the affected Work to allow time for approval by the County without delaying the Work.

11.3 EXPANSION ANCHORS

11.3.1 Expansion anchors, as shown on the Approved Drawings or specified herein, shall be Type 316 stainless steel when the assembly will be subject to wet or below-grade conditions. They shall be of a type which, once installed, the shield is not removable. The shield shall be the insert type which expands against the side of the drilled hole when the wedge cone expands the shield when forced into the shield by impact. Size shall be as shown on the Approved Drawings. The Contractor shall submit a sample, accompanied by certification of load test capacity, to the County for approval.

11.3.2 The embedment for expansion anchors shall be as shown on the Approved Drawings. In cases where no dimension is provided, the Contractor shall provide the minimum depth(s) as follows:

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</tbody>
</table>

11.3.3 Expansion anchors shall be manufactured by ITT Phillips-Redhead, or Approved Equal.

11.4 STEPS AND LADDERS

11.4.1 Precast Concrete Manhole Steps and Ladders

11.4.1.1 Reflective steps shall be installed in base sections, riser sections and taper sections so that the completed manhole will have a continuous vertical ladder with equally spaced rungs as shown on the Approved Drawings, and as identified in the Standard Plans.

11.4.1.2 Polypropylene manhole steps shall meet the requirements of ASTM C478 and AASHTO M-199. The polypropylene material shall be made of a copolymer polypropylene superior in its resistance to corrosiveness, meeting the requirements of ASTM D4101, and shall completely encapsulate a deformed ½ inch diameter steel reinforcing rod conforming to ASTM A615, Grade 60.
11.4.1.3 Polypropylene steps shall be installed in complete accordance with the manufacturer’s instructions. This shall be accomplished by pre-drilling two parallel 1 inch diameter holes, 3-¾ inch deep and 13 inches on center in the cured concrete base, riser and taper sections of the manhole. In no case will the pre-drilled hole be allowed to penetrate through the wall of the manhole section. The insertion ends of the steps shall be fully coated with non-shrink grout, then driven into the holes to the prescribed depth. Infiltration from around steps will not be permitted.

11.4.1.4 Steps shall be “Lane Poly Steps”, Model P-14938, as manufactured by Lane International Corporation (Tualatin, Oregon), or an Approved Equal.

11.4.1.5 Ladders may be used in precast base sections in lieu of steps only as directed by the County. Ladders shall be manufactured by Lane International Corporation (Tualatin, Oregon), or an Approved Equal. The material shall conform to the requirements specified above for manhole steps. Mounting hardware shall be Type 316 stainless steel. The ladder shall be firmly anchored to the wall of the manhole base section, no less than 6 inches from the top of the base section. The bottom of the ladder shall not rest on the fiberglass manhole shelf.

11.4.2 HDPE Manhole Ladders

11.4.2.1 Ladders shall be installed in base and riser sections of HDPE manholes so that the completed manhole will have a continuous vertical ladder with equally spaced rungs as shown on the Approved Drawings and as identified in the Standard Plans.

11.4.2.2 The ladders shall be fiberglass reinforced plastic, mounted to HDPE brackets attached to the manhole or pump station wet well wall with a full-penetration weld. The ladder shall be firmly anchored to the HDPE brackets, no less than 3 inches from the top of the manhole bench.

11.4.2.3 Ladders shall be installed level, plumb, and per the manufacturer’s instructions. Mounting bolts shall be a minimum ½-inch diameter, Type 316 stainless steel.

11.4.2.4 Ladders shall be manufactured by Safrail, or an Approved Equal.

11.4.3 Pump Station Wet Well Ladders

11.4.3.1 Ladders for pump station wet wells above the fiberglass landing grate shall be fabricated of Type 316 stainless steel as shown on the Approved Drawings and as identified in the Standard Plans. The rungs shall be 16 inches wide and a minimum of 1 inch deep, and shall be flat with a non-skid surface. The ladder assembly shall allow for attachment of a confined space rescue and retrieval system in accordance with Section 11.8 of these Specifications. The Contractor shall submit catalog cuts or detailed drawings of all items specified. The manufacturer shall guarantee the ladders for a period of 5 years from the date of Final Acceptance of the Project.

11.4.3.2 Ladders for pump station wet wells below the fiberglass landing grate shall meet the requirements for fiberglass reinforced plastic ladders as specified in Section 11.4.2 above.
11.4.3.3 Ladders shall be installed level, plumb, and per the manufacturer’s instructions. Mounting and anchor bolts shall be a minimum ½-inch diameter, Type 316 stainless steel.

11.4.3.4 Ladders shall meet or exceed all ASTM C-497 load requirements and OSHA specifications.

11.4.4 Valve and Force Main Cleanout Vault Ladders

11.4.4.1 Ladders for valve and force main cleanout vaults having circular access openings as shown on the Approved Drawings and as identified in the Standard Plans shall consist of aluminum reinforced copolymer polypropylene rails with steel reinforced copolymer rungs. Polypropylene material shall conform to ASTM D-4101. Polypropylene ladders shall be manufactured by Lane International Corporation (Tualatin, Oregon) or Approved Equal.

11.4.4.2 Ladders for valve and force main cleanout vaults having rectangular access doors as described in Section 11.9 of these Specifications shall be fabricated of Type 316 stainless steel as shown on the Approved Drawings and as identified in the Standard Plans. The rungs shall be 16 inches wide and a minimum of 1 inch deep, and shall be flat with a non-skid surface. The ladder assembly shall allow for attachment of a confined space rescue and retrieval system in accordance with Section 11.8 of these Specifications. The Contractor shall submit catalog cuts or detailed drawings of all items specified. The manufacturer shall guarantee the ladders for a period of 5 years from the date of Final Acceptance of the Project.

11.4.4.3 Ladders shall be installed level, plumb, and per the manufacturer’s instructions. Mounting and anchor bolts shall be a minimum ½-inch diameter, Type 316 stainless steel.

11.4.4.4 Ladders shall meet or exceed all ASTM C-497 load requirements and OSHA specifications.

11.5 FIBERGLASS GRATING

11.5.1 Fiberglass grating shall be provided as shown on the Approved Drawings. The grating shall be fiberglass, having reinforced polyester with complete wetting of all glass fiber by the resin. The resin shall be corrosion resistant with a grid pattern of 1-½ inch by 1-½ inch square. Color shall be a green shade.

11.5.2 The grating shall have a non-skid surface on all walking areas. All cut or sanded surfaces shall be coated with resin.

11.5.3 Depth of grating shall be no less than 1-½ inch. Grating shall be suitable for a uniform load of 100 pounds per square inch, or a concentrated load of 250 pounds per lineal foot with a maximum deflection of ¼ inch and a factor of safety of 10:1. The maximum span between grating support members shall be in accordance with the manufacturer’s recommendation.

11.5.4 The fiberglass grating shall be Chemgrate® CP84 as manufactured by Fibergrate Composite Structures, Inc. (Dallas, TX), or Approved Equal.
11.5.5 All mounting clips and hardware shall be Type 316 stainless steel.

11.5.6 The Contractor shall provide a minimum 1-½ inch wide support for all grating edges.

11.5.7 The Contractor shall provide: ¼ inch clearance from adjacent grating panels, support edges and/or metal surfaces; and ½ inch clearance from all concrete surfaces.

11.5.8 Installation. All connections and support details shall be as shown on the Approved Drawings, or as required by the manufacturer. Use ¼-inch diameter stainless steel bolts, nuts, and washers to fasten fiberglass pieces. Observe a minimum edge distance on all bolt holes of 2.0 x bolt diameter, or as shown on the Approved Drawings. Coat all cut or sanded fiberglass surfaces with resin. All elements are to be erected true and square, as shown on the Approved Drawings.

11.6 CHAIN-LINK FENCING

11.6.1 This Section sets forth the requirements for providing chain-link fencing as shown on the Approved Drawings and as indicated in the Standard Plans.

11.6.2 Fabric. The fencing shall be 9-gauge (0.148-inch diameter) wire with a breaking strength of 850 pounds, coated with 15 mils of chocolate brown or black (as approved by the County) PVC over 0.3 ounces zinc substrate and woven into a 2-inch diamond mesh. Knuckle both selvages on fabric 60 inches high and under. Knuckle one selvage and twist and barb the other on fabrics greater than 60 inches high. Use 9-gauge, PVC-coated tie wires at not more than 24-inch spacing.

11.6.3 Line Posts. Line posts shall be 2 inch nominal inside diameter, Schedule 40, standard weight steel pipe, conforming to ASTM A53. Provide 6-inch long top rail couplings spaced at not more than 21 feet. All top and brace rails shall be galvanized and PVC-coated.

11.6.4 Terminal Posts. Terminal posts shall be 3 inch nominal inside diameter, Schedule 40, standard weight steel pipe, conforming to ASTM A53. All terminal posts shall be galvanized and PVC-coated.

11.6.5 Gates. Gate frames shall be constructed of not less than 1-½ inch inside diameter, hot-dip galvanized pipe with a nominal weight of 2.72 pounds per lineal foot. The corners of the gate frame shall be fastened together and reinforced with a malleable iron to pressed steel fitting design. Cross trussing shall be ¼ inch galvanized adjustable rods. The chain-link fence fabric for filling the gate frame shall meet the fabric requirements specified herein. Each gate shall be furnished complete with necessary hinges, latch, and drop bar locking device designed for the type of gate posts and gate. Gates shall have positive-type latching devices with provisions for padlocking.

11.6.6 Framework. All fittings and hardware shall be hot-dip galvanized as described in ASTM A153. Hot-dip galvanize all frames and fabrications with a 2.0 ounce per square foot coating, per ASTM A123, before color application. Coat the framework with thermal fusion coating of 15 mils PVC, applied to the manufacturer’s specifications.

11.6.7 Bottom Tension Wire. Bottom tension wire shall be 7-gauge, coil spring steel wire, with 0.8 ounce per square foot zinc coating. All tension wire attachments shall be hot-dip galvanized steel, unless otherwise approved by the County.
11.6.8 Installation. Posts shall be placed in a vertical position and, except where otherwise directed by the County, shall be spaced 10 feet on center as measured parallel to the slope of the ground. All posts shall be set in concrete with 3 feet of embedment and bases 12 inch minimum diameter, or attached to concrete deck with appropriate mounting hardware. The fence line shall conform to the ground profile.

11.7 SPECIALTY ITEMS FOR PUMP STATION SITES

11.7.1 This section covers furnishing and installing the below listed specialty items at the pump station site.

11.7.2 Submittals. For each item listed, the Contractor shall submit the manufacturer’s descriptive details of the manufacturer’s latest standard product to the County for approval, even though items proposed to be furnished conform to the exact descriptions stated in these Specifications or shown on the Approved Drawings. Submittals shall be made sufficiently prior to the start of the affected Work to allow time for approval by the County without delaying the Work.

11.7.3 First Aid Cabinet. One first aid cabinet shall be tagged and mounted inside the electrical control panel. The cabinet shall contain the following items:

- **16-Package Kit**
  - 2-pkg. adhesive bandage, ¾ inch (16 per pkg.)
  - 1-pkg. antiseptic soap or pads (5 per pkg.)
  - 2-pkg. bandage compress, 4 inches (1 per pkg.)
  - 1-pkg. burn ointment (6 tubes per pkg.)
  - 2-pkg. triangular bandage, 40 inches (1 per pkg.)
  - 1-pkg. scissors and tweezers (1 each per pkg.)
  - 1-pkg. adhesive tape, ½ inch by 2-½ yards
  - 3-pkg. absorbent gauze, 24 inches by 72 inches (1 per pkg.)
  - 1-pkg. roller bandage, 2 inches by 6 yards
  - 2-pkg. sting kill swabs (10 per pkg.)

11.7.4 Ear Muffs. Two sets of earmuffs, meeting OSHA requirements for protection against loud noise, shall be installed in a dust-proof cabinet located within the electrical control panel. Earmuffs shall be manufactured by Wilson, Model 358A.

11.7.5 Fire Extinguisher. One fire extinguisher shall be mounted within the electrical control panel. The extinguisher shall be listed by Underwriters Laboratories, and shall be manufactured by Kidde, Part No. 466112, or Approved Equal.
11.7.6 Accident Prevention Tags. One package of 25 identical accident prevention tags shall be provided for each pump station. The tags shall be laminated plastic or vinyl, measuring approximately 5-¾ inches by 3 inches, with grommet and wire tie, and shall have the following message printed on one side in fade-resistant red and black ink:

```
DANGER
WORKING ON
MACHINES
DO NOT START
```

11.7.7 Flashlight. One industrial grade flashlight, approved for Class I locations, shall be provided and stored inside the electrical control panel. The flashlight shall be Maglite® Model ML-3, as manufactured by Mag Instrument, Inc.

11.7.8 Portable Blower. One 12-volt DC portable blower, for blowing air into the wetwell during entry, shall be stored inside the electrical control panel. The portable blower shall be Pelsue® Model 1475B, as manufactured by Pelsue Equipment Company, Inc.

11.7.9 Portable Gas Detector. One portable gas detector shall be provided and stored inside the electrical control panel. The portable gas detector shall be equipped with sensors to detect the following gases: Oxygen (O2); Hydrogen Sulfide (H2S); Flammables (LEL's); and Carbon Monoxide (CO). The portable gas detector shall include the following standard accessories: clothes clip; operators guide; training CD-ROM; laminated quick reference guide; and calibration adapter. Additionally, the portable gas detector shall be supplied with a foam-lined carrying case with carrying strap, an alkaline battery pack, spare AA alkaline batteries, a Li-ion battery back, a 12-volt DC slip-in fast charger and a sample draw kit (sample draw adapter, squeeze bulb, 10 feet of draw tubing, and sample probe assembly). The portable gas detector shall be Sperian MultiPro 4, Part No. 54-48-314N, with battery charger Part No. 54-49-103-12 and alkaline battery pack Part No. 54-49-106.

11.8 CONFINED SPACE RESCUE AND RETRIEVAL SYSTEMS

11.8.1 This section covers the retrieval system utilized for entering wetwell and valve vault locations. The Contractor shall provide all necessary equipment and labor to install a functional system as shown on the Approved Drawings and in accordance with these Specifications.

11.8.2 Submittals. The Contractor shall submit a list of items to be furnished for approval by the County, even though these items conform to the exact descriptions stated in these Specifications or shown on the Approved Drawings.

11.8.3 The confined space rescue and retrieval system shall include the following components, as manufactured by DBI/SALA (Red Wing, MN):

1. Winch Ladder Mast Assembly (Model 6116038) or Tripod (Model 8000000), at the option of the County. One per station.
2. Retrieval Self Retracting Life Line, 50 feet, stainless steel (Model 3400108), with Mounting Bracket (Model 8510207). One per station.
3. Stainless Steel Bottom Bracket Assembly (Model 6116127). A minimum of two each shall be supplied. One shall be installed in the wetwell, and one shall be installed in the valve vault, or as indicated on the Approved Drawings.

11.8.4 Installation. The unit(s) shall be completely assembled, with fasteners, and secured to the ladder rungs in accordance with the manufacturer’s instructions.

11.9 ACCESS DOORS

11.9.1 This section describes the materials and installation of access doors for each wetwell and valve vault entrance. The Approved Drawings shall identify the number of doors required for each structure.

11.9.2 Submittals. The Contractor shall submit catalog cuts or detail drawings and designs for all items specified.

11.9.3 Access doors shall be manufactured by L.W. Hatch Company (Bothell, WA) or Bilco Company (New Haven, CN), as specified on the Approved Drawings. The door manufacturer shall guarantee the access doors against defects for a period of five (5) years.

11.9.4 Channel Frame. The channel frame shall be ¼-inch aluminum with an anchor flange around the perimeter.

11.9.5 Door Leaf. The door leaf shall be ¼-inch aluminum diamond pattern plate, reinforced to withstand HS-20 wheel loading. For all double and triple-leaf door combinations, the ladder side door shall open first.

11.9.6 Drain Coupling. Provide a 1 inch by 1-½ inch aluminum drainage half-coupling, located as shown on the Approved Drawings.

11.9.7 Doors shall be equipped with the following:

1. Type 316 stainless steel:
   a. Lifting mechanism housing;
   b. Automatic hold-open arm and cover release;
   c. Pins;
   d. Slam lock and spoon handle; and
   e. Release handle.
2. Corrosion resistant stainless steel lifting spring.
4. Red vinyl grip on the release handle.

11.9.8 Frame Finish. The exterior of the frame that will be in contact with concrete shall have a mill finish with a minimum 10-mil dry film thickness, holiday-free coating of Bitumastic No. 50, as manufactured by Koppers Company. The coated surface shall be covered with 10-mil thick pressure-sensitive tape to protect it from damage during installation.

11.9.9 Hardware. Use only Type 316 stainless steel hardware.

11.9.10 Mill Finish. Provide a mill finish on all aluminum surfaces.

11.9.12 Warning Signs. Furnish a warning sign on the underside of the access door, adjacent to the hold-open latch, reading:

1. DANGER, MAKE SURE “HOLD-OPEN LATCH” IS ENGAGED BEFORE USING.
2. CONFINED ENTRY REQUIRED – APPROVED SAFETY DEVICE MUST BE UTILIZED.

11.9.13 Installation. Access doors shall be installed in accordance with the manufacturer’s instructions. For all double- and triple-leaf door combinations, the ladder side door shall open first.

11.10 IDENTIFYING DEVICES (SIGNS)

11.10.1 Identifying devices shall be provided as shown on the Approved Drawings, identified in the Standard Plans, and as required by these Specifications, and shall comply with the following reference standards:

1. Federal Occupational Safety and Health Act (OSHA): Referenced sections, specifications for accident prevention signs and tags and exit signs, and comparable Sections in WISHA;

11.10.2 Installation shall comply with the manufacturer’s published recommendation for installation of the materials used.

11.10.3 Submittals. The Contractor shall submit product literature on all items required to be furnished.

11.10.4 Signs shall be manufactured by Brady Corporation, Seton Name Plate Company, or Approved Equal, unless otherwise specified herein. The Contractor shall provide signs as indicated below.

11.10.5 Sign Number 1: FIRE EQUIPMENT LOCATION MARKERS

1. Size: 4 inches wide by 18 inches high (approximate size).
3. Text: Bright, fade-resistant red on white, with downward facing directional arrow on red field. Test as shown on schedule below.

<table>
<thead>
<tr>
<th>Sign #</th>
<th>Sign Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FIRE EXTINGUISHER</td>
</tr>
</tbody>
</table>
11.10.6 Sign Numbers 2 through 4: CAUTION SIGNS

1. Size: 14 inches wide by 10 inches high.
3. Text, Format and Color:
   b. Text as scheduled below.
4. Provide eyelet holes at each corner for mounting.

<table>
<thead>
<tr>
<th>Sign #</th>
<th>Sign Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>CAUTION ACID WEAR PROPER PROTECTION</td>
</tr>
<tr>
<td>3</td>
<td>CAUTION THIS EQUIPMENT STARTS AUTOMATICALLY</td>
</tr>
<tr>
<td>4</td>
<td>CAUTION NO SMOKING</td>
</tr>
</tbody>
</table>

11.10.7 Sign Numbers 5 through 7: DANGER SIGNS

1. Size: 14 inches wide by 10 inches high, unless otherwise approved by the County.
3. Text, Format and Color:
   b. Text as scheduled below.

<table>
<thead>
<tr>
<th>Sign #</th>
<th>Sign Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>DANGER HIGH VOLTAGE</td>
</tr>
<tr>
<td>6</td>
<td>DANGER EXPLOSIVE GAS, NO SMOKING</td>
</tr>
<tr>
<td>7</td>
<td>DANGER CONFINED SPACE ENTER BY PERMIT ONLY</td>
</tr>
</tbody>
</table>
11.10.8 Sign Number 8: IDENTIFICATION SIGNS

1. Size: 24 inches wide by 18 inches high.
3. Text, Format and Color:
   a. Text as scheduled below. The County will provide pump station name and number.
   b. White reflective field with blue letters. Font shall be Arial.
   c. Blue border around perimeter.
4. Provide eyelet holes at each corner for mounting.
5. Sign shall be manufactured by Zumar Industries (Tacoma, WA).

<table>
<thead>
<tr>
<th>Sign #</th>
<th>Sign Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>PIERCE COUNTY PUBLIC WORKS AND UTILITIES DEPARTMENT (NAME) PUMP STATION NO. (#) IN CASE OF EMERGENCY CALL 24 HR (253) 565-3440</td>
</tr>
</tbody>
</table>

![Identification Sign Example](image-url)
11.10.9 Sign Number 9: ARC FLASH RATING SIGNS. The Contractor shall provide weatherproof warning hazard labeling for each equipment tested which specifies the following:

1. Hazard Category;
2. Required Personal Protective Equipment; and
3. Minimum Arc Rating (cal/cm²).

<table>
<thead>
<tr>
<th>Sign #</th>
<th>Sign Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>As Required</td>
</tr>
</tbody>
</table>

![Arc Flash and Shock Hazard](image)

11.10.10 Installation. The Contractor shall install signs only after surfaces to receive signs have been painted, and in accordance with the sign manufacturer’s written instructions. Fasteners shall be used as follows:

1. To concrete and masonry materials: Four ¼-inch diameter stainless steel expansion anchors and bolts.
2. To sheet metal (gauges 28 to 6): #10 stainless steel sheet metal screws.
3. To wood doors and hollow metal doors: Adhesive backing tape.
4. To plywood backing boards: #10 wood screws.
5. To machinery: Stainless steel fasteners, as suitable.
11.10.11 Sign Location Schedule. Signs shall be installed where directed by the County, or as indicated in the following schedule:

<table>
<thead>
<tr>
<th>Sign #</th>
<th>Quantity</th>
<th>Location Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>At each fire extinguisher.</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>At each emergency generator battery.</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>At the emergency generator.</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>In the emergency generator enclosure.</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>Inside of meter enclosure.</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Outside of meter enclosure.</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>On the electrical control panel.</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>Underside of wetwell hatch.</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>Underside of wetwell hatch.</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Underside of valve vault hatch.</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Underside of chemical tank vault (if applicable).</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>Location to be determined by the County.</td>
</tr>
<tr>
<td>9</td>
<td>As Required</td>
<td>Location and quantity of signs to be determined by Arc Flash study as identified in Section 8.10.6 of these Specifications.</td>
</tr>
</tbody>
</table>

END OF SECTION
SECTION 12

PIPELINE, MANHOLE, AND VAULT TESTING

12.1 GENERAL

12.1.1 This Section includes furnishing all equipment and labor required to perform testing of all pipelines, manholes, vaults and pump stations after completion of their installation and prior to Final Acceptance of the Project. Leakage tests shall be performed on all piping, manholes, vaults and pump stations at a time agreed upon and in the presence of the County. All labor and materials to perform the tests shall be provided by the Contractor. All pipelines, manholes, vaults and pump stations shall be flushed and left thoroughly clean when testing is completed.

12.1.2 The Contractor shall furnish all equipment, materials, and labor necessary for testing pipe, manholes, vaults, and pump stations. The Inspector may at any time require a calibration test of gauges or other instrumentation that is incorporated in the test equipment. All testing shall be made by the Contractor in the presence of the County. The Contractor shall provide certified calibration results, dated within 6 months of the test, for any gauges to be used on the Project.

12.1.3 All pumping, distribution, furnishing and disposal of water or air shall be accomplished by the Contractor during the construction and testing of the various pipelines.

12.1.4 The Contractor shall disconnect instruments or other devices in the system that are not capable of withstanding testing pressures and these elements shall be tested at the rated pressure of said instruments or devices and reconnected after testing is complete.

12.1.5 Pipeline testing shall be conducted after all pipe in the section to be tested is installed and all other utility trench Work/excavation is complete and the backfill satisfactorily compacted, but before resurfacing or landscape restoration. The quantity of pipe that can be installed before the pipeline is tested may be limited by the County.

12.1.6 All supports, anchors and blocks shall be installed prior to pressure test of pipe and shall adequately withstand all forces imposed by test pressures. Concrete for thrust blocks and supports shall have developed full design compressive strength before testing.

12.1.7 The complete and satisfactory test for each and every section of piping shall be a condition for final acceptance of the Work by the County. Testing shall be repeated as necessary until conformance of the leakage test requirements has been fulfilled.

12.1.8 All newly constructed pipeline, manholes, vaults and pump stations shall be completely tested and approved by the County prior to discharging any wastewater through the facilities, unless otherwise approved in writing by the County.

12.2 TESTING OF GRAVITY PIPELINES

12.2.1 All sanitary sewers, including side sewers and drop structures shall be cleaned and tested after backfilling by the low pressure air method for all mainline construction, unless
otherwise directed by the County. The exfiltration method shall be permitted for side sewer installation only. However, where the groundwater table is such as to preclude a proper exfiltration test, the County may require infiltration tests.

12.2.2 Each section of sewer shall be flushed and cleaned by high-velocity water jet prior to testing.

12.2.3 Air Test Method

12.2.3.1 Testing performed by the air pressure test method shall be in accordance with applicable sections of these Specifications and Section 12.2.3.2 below, for the time pressure drop method.

12.2.3.2 Air Pressure Test for Sanitary Sewers Constructed of Non-Air-Permeable Materials.

1. Pipelines shall be tested with low-pressure air by the pressure drop method; however, no pressure drop shall be permitted during the testing period. The test pressure shall be 4.0 psig.
2. The Contractor shall furnish all equipment, materials and labor necessary for making the air leakage tests. Any arrangement of test equipment, which will provide accurate means of measurement, will be approved by the County. The Inspector may at any time require a calibration test of gauges or other instrumentation that is incorporated in the test equipment. The leakage test shall be made by the Contractor in the presence of the County.
3. Safety Provisions. Plugs used to close the sewer pipe for the air test must be securely braced to prevent the unintentional release of a plug which can become a high-velocity projectile. Gauges, air piping manifolds and valves shall be located at the top of the ground. No one shall be permitted to enter a manhole where a plugged pipe is under pressure. It should be noted that 4 pounds (gauge) air pressure develops a force of approximately 450 pounds against the plug in a 12-inch diameter pipe. Air testing apparatus shall be equipped with a pressure release device such as a rupture disk or a pressure relief valve designed to relieve pressure in the pipe under test at 6 psi.

12.2.3.3 Air Test Procedure

1. Clean pipe to be tested as specified in Section 12.2.2 of these Specifications.
2. Plug all pipe outlets with suitable test plugs. Brace each plug securely.
3. If the pipe to be tested is submerged in groundwater, insert a pipe probe, by boring or jetting, into the backfill material to the elevation of the pipe crown. Determine the pressure in the probe when air passes slowly through it. This is the back pressure due to groundwater submergence over the pipe crown. All gauge pressures in the test shall be increased by the groundwater back pressure.
4. Add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to 4.0 psig.
5. Check exposed pipe and plugs for abnormal leakage by coating with a soapy water solution. If any failures are observed, bleed off air and make necessary repairs.
6. After an internal pressure of 4.0 psig is obtained, allow at least 2 minutes for air temperature to stabilize, adding only the amount of air required to maintain pressures.
7. After the 2-minute period, disconnect the air supply.
8. Start the stopwatch. Test time shall be in accordance with Section 12.2.3.4 below. If the pipeline section fails the no loss air test, the Contractor shall be required to isolate and air test the side sewer stubs. The Contractor shall be required to retest pipeline after corrective measures are taken to repair leaks.

12.2.3.4 The duration of the air pressure test shall be in accordance with the following table:

<table>
<thead>
<tr>
<th>Pipe Diam. (in.)</th>
<th>Min. Time (min:sec)</th>
<th>Length for Min. Time (ft.)</th>
<th>Time for Longer Length (sec.)</th>
<th>Specification Time for Length (L) Shown (min:sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100 ft</td>
</tr>
<tr>
<td>6</td>
<td>2:50</td>
<td>398</td>
<td>0.427*L</td>
<td>2:50</td>
</tr>
<tr>
<td>15</td>
<td>7:05</td>
<td>159</td>
<td>2.671*L</td>
<td>7:05</td>
</tr>
</tbody>
</table>

12.2.3.5 Air Test Equipment. Air test equipment used for sewer acceptance testing shall be subject to approval by the County, and shall utilize pressure gauges certified as being correct within plus or minus 5 percent. The use of air pressure for testing sewer lines creates hazards that must be recognized. The Contractor shall be certain that all plugs are securely blocked to prevent blowouts. A supply air regulator shall be installed on the air supply line to the sewer that shall permit a maximum of 6 psig in the line to be tested. All pressures shall be relieved from the sewer section being tested prior to removal of test plugs.

12.2.3.6 The Contractor shall air test individual joints on pipes greater than 36 inches inside diameter, unless otherwise approved by the County. The Contractor must submit a testing procedure for review and approval by the County prior to implementation in the field.

12.2.4 Exfiltration Test Method for Side Sewer Pipelines

12.2.4.1 Prior to making exfiltration leakage tests, the Contractor shall fill the pipe with clear water. The leakage test shall be completed within 24 hours after filling the pipe. When under test, the leakage allowable shall comply with the following provisions.
12.2.4.2 The time of exfiltration tests shall be a minimum of 1 hour. The static head above the crown of the sewer at the lower end of the test section shall be a minimum of 6 feet. No leakage shall be observed during the test duration. In the event that measurable leakage occurs, the Contractor shall remove and discard all defective pipe and relay new pipe to conform with the requirements of the leakage test. Repair by chemical grouting will not be allowed.

12.2.4.3 The Contractor shall furnish all equipment, materials and labor necessary for making the exfiltration tests. Any arrangement of test equipment, which will provide accurate means of measurement, will be approved by the County. The leakage test shall be made by the Contractor in the presence of the County.

12.2.5 Infiltration Requirements. No infiltration will be permitted into any segment of gravity sewer pipeline. If any pipe segment fails to meet the infiltration requirements, the Contractor shall determine the source, or sources, of leakage and shall repair or replace all defective materials or workmanship. No repair shall be made until the repair method has been submitted to and approved by the County. The completed pipe installation shall meet the infiltration requirements before being considered acceptable.

12.3 TESTING OF PRESSURE PIPELINES

12.3.1 Testing of all pipelines and appurtenances, which under normal operating conditions will be subjected to hydraulic pressure, shall be hydrostatically tested at the greater of 150 percent of the design working pressure or 100 psi hydrostatic pressure for a duration of not less than 2 hours. Any leaks which develop shall be eliminated by the Contractor. Pipelines shall be cleaned and flushed before testing. Hydrostatic pressure testing shall include drop piping for force mains where shown on the Approved Drawings.

12.3.2 The testing method shall be in accordance with Section 5.2 of AWWA C600 for ductile iron pipe, and with Section 7.3 of AWWA C605 for PVC pipe. All certified gauges, meters and taps shall be furnished by the Contractor.

12.3.3 Water used for testing pressure pipelines shall be furnished by the Contractor.

12.4 VACUUM TESTING OF MANHOLES AND VAULTS

12.4.1 The method of testing shall be in accordance with ASTM C1244. All gauges, meters, boot clamps and appurtenances shall be furnished by the Contractor.

12.4.2 Vacuum testing shall occur prior to the application of interior coatings on all concrete manhole and vault structures per Section 10.3.11.
12.4.3 Testing of all manholes and vaults shall be in accordance with the following:

1. Initial Pressure Test – 5 inches Hg (i.e. 34 inches Hg absolute).
2. Test Time – A vacuum of 5 inches of Hg shall be drawn and the vacuum pump shut off. With the valve closed, the time shall be measured for the vacuum to drop to 4-½ inches. The manhole shall pass if the time is greater than that shown on the following page.

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<th>Depth (ft.)</th>
<th>48” Diam.</th>
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12.4.4 If pressure drop exceeds ½ inch of Hg in 2 minutes, the unit shall be repaired and retested.

12.4.5 Joint repairs by parging are to be done on the inside of joint to ensure a permanent seal. Vacuum testing draws together the joint and applies high-pressure to the elastomeric joint material. Properly placed and sized elastomeric joint material must be used to avoid leakage or to enable sections to be separated if necessary to affect a repair.

12.5 TELEVISION INSPECTION

12.5.1 All portions of the completed pipelines shall be inspected using television equipment. Inspections will be conducted at times agreed upon by the County and the Contractor, and will be scheduled to coordinate with the Project progress schedule.
12.5.2 The Contractor shall be responsible for flushing and cleaning the pipelines in preparation for all television inspections.

12.5.3 If television inspections reveal areas where the construction is unsatisfactory, the Contractor shall repair/replace and retest all defective materials or workmanship. No repair shall be made until the repair method has been approved by the County. The results of the television inspections on those portions of the Work so inspected shall be satisfactory to the County before the Final Acceptance of the Project.

12.5.4 If the Contractor requests a television inspection and the inspection reveals construction deficiencies which must be corrected, the cost of reinspection by television will be charged to the Contractor. Final inspection acceptance shall be withheld by the County until payment for reinspection is made.

12.5.5 The County will provide all the equipment and labor, and will pay all costs of performing the initial television inspection, except as stated above. If a reinspection is necessary, all Work necessary to perform the reinspection shall be accomplished at the Contractor’s expense.

END OF SECTION
SECTION 13
SITE RESTORATION

13.1 GENERAL

13.1.1 This Section includes provisions for the restoration of the various surfaces that will or may be encountered during construction of a Project. All surfaces disturbed in the process of construction shall be restored as near as physically possible to those conditions existing prior to commencement of Work, or better. For clearing of sod and other plant material and removal of pavement, refer to Section 2 of these Specifications.

13.1.2 Warranty Period. Any soft, unstable, or depressed areas that appear within the actual limits of trench excavation or in any surface paved by the Contractor within 12 months after Final Acceptance of the Project, or as required by the governing jurisdiction, whichever is more stringent, shall be repaired in the manner directed by the County or the governing jurisdiction.

13.1.3 Where sanitary sewer construction occurs within the city limits of a city in Pierce County’s sanitary sewer service area, restoration conditions identified on the Right-of-Way/street works permit shall take precedence over these Specifications.

13.1.4 All man-made improvements damaged by the Contractor’s operations shall be completely restored. Such improvements include, but are not limited to, fences, walls, rockeries, driveways, sidewalks and other paving, bark mulch, and sprinkler systems.

13.2 TEMPORARY SURFACING AND MAINTENANCE

13.2.1 The Contractor shall provide a temporary surfacing for trenches in roadways that will carry traffic before the pavement is restored. As a minimum, temporary surfacing shall consist of installing crushed surfacing top course material to the elevation of the top of the adjacent pavement. Crushed surfacing top course material and installation shall be as specified in the latest edition of WSDOT Standard Specifications or as required by the governing jurisdiction. The Contractor shall be responsible for maintaining that temporary surfacing in a safe and passable condition and for dust control as specified in these Specifications, as identified in the Right-of-Way/street works permit, or as required by the County or governing jurisdiction.

13.2.2 Temporary Pavement Patching. During construction of the sewer system, the Contractor shall complete the trench backfill through intersections to within 0.2 feet below the existing pavement surface. The area(s) shall then be patched with asphalt cold-mix or hot-mix asphalt as approved by the County or governing jurisdiction. The temporary patch shall be maintained by the Contractor until such time as the pavement is restored as defined in these Specifications, specified in the Right-of-Way/street works permit, or as directed by the County or governing jurisdiction. The Contractor shall have adequate patching material available to insure the patch will be completed before the end of a Work shift. After the sewer pipe has been accepted, or when directed by the County, the patched area(s) shall be excavated and prepared for pavement restoration. The pavement restoration shall be completed within the same day the temporary patch is removed.
13.2.3 Dust Control. Dust shall be controlled at all times during the progress of the Work. The Contractor shall furnish and apply water and/or a dust palliative, as ordered by the County or governing jurisdiction, for the alleviation or prevention of dust nuisances. A water truck shall be assigned to the Project for full-time use.

13.2.4 Ditch Restoration. The Contractor shall be required to preserve and maintain all existing ditches, drainage channels, culverts, pipes, etc. to the lines and grades that presently exist. If, during the course of construction, ditches are plugged, buried, excavated, and/or destroyed, they shall be immediately re-opened and restored by the Contractor.

13.3 PAVEMENT RESTORATION

13.3.1 All street, roadway, and driveway surfacing that is removed or damaged by the Contractor’s operations shall be restored by repairing or replacing the surfacing as specified in the Right-of-Way/street works permit or as specified herein. Unless otherwise noted on the Right-of-Way/street works permit, in these Specifications, on the Approved Drawings, or as directed by the County or governing jurisdiction, asphalt and cement concrete pavement shall be restored using the same type of material as the existing pavement, and the existing surfacing on unimproved public streets shall be replaced with gravel surfacing as specified herein. Particular care shall be taken to minimize damage to pavement adjacent to the construction area(s).

13.3.2 If subgrade surfaces are not suitable during pavement restoration, the Contractor shall remove all unsuitable materials and replace with Gravel Base, or other suitable material as approved by the County, to provide a firm and stable base just prior to placement of crushed surfacing and hot-mix asphalt.

13.3.3 Placement of crushed surfacing and plant-mixed hot-mix asphalt, where shown on the Approved Drawings or indicated in the Standard Plans, shall conform to Section 4-04 and Section 5-04, respectively, of the WSDOT Standard Specifications, except as otherwise required by the governing jurisdiction.

13.3.4 Unless otherwise noted, all valve boxes, manhole frames, catch basin gratings and other utility appurtenances located within the paved areas shall be set or raised to finished grade after paving. Cutouts shall be concentric with the appurtenance, and the patch shall be as specified in the latest edition of WSDOT Standard Specifications or as required by the governing jurisdiction.

13.4 LANDSCAPING RESTORATION IN EASEMENTS AND PUBLIC RIGHTS-OF-WAY

13.4.1 Particular care shall be taken to minimize damage to landscaping within and adjacent to indicated public Rights-of-Way, public easements and construction access areas. If landscaping located outside the indicated Rights-of-Way, easements and construction access areas is damaged by the construction Work, it shall be replaced or restored by the Contractor to the satisfaction of the County or governing jurisdiction.

13.4.2 For all public easements, a Public Easement Release Form signed by the Property Owner(s) must be submitted to the County prior to Final Acceptance of the Project.
13.4.3 Lawns

13.4.3.1 Lawn areas to be restored shall be resodded over a minimum depth of 6 inches of topsoil. Topsoil shall be a friable loam soil free from weed seeds, roots, subsoil, stones and other debris, and from materials toxic to plant growth. Lawn areas shall be restored using sod removed from the original lawn wherever possible.

13.4.3.2 The finished grade, after shaping and compacting the topsoil, shall be thoroughly dampened prior to and immediately before replacing the sod. The sod shall be replaced to the required grade, taking care to butt each piece tightly against the adjacent one. Upon completion, the sod shall be dampened and rolled with a lawn roller.

13.4.3.3 Resodding shall be completed within 10 calendar days after removal of the sod. Sod which is held for more than 10 calendar days may be rejected by the County.

13.4.4 Plants

13.4.4.1 The Contractor shall not remove any trees or shrubs without the authorization of the County or governing jurisdiction. The Contractor shall not remove, even temporarily, any trees or shrubs which exist on easements across private property or in parking strips without first having notified the Property Owners or authorities maintaining the same. DO NOT REMOVE any trees from the temporary construction access without obtaining written permission from the Property Owner. A copy of the written permission shall be transmitted to the County.

13.4.4.2 Serious injuries to trees shall be avoided. The Contractor shall prevent damage to major roots, particularly those larger than 2 inches in diameter.

13.4.4.3 Trees, shrubs and other plants that are to be replaced may be removed and replanted, or may be replaced with new plants. New plants shall be the same size and species as the plant to be replaced. New plants shall be well established stock with normal branch systems and vigorous root systems, and shall be free from pests, diseases, and disfiguring injury.

13.4.4.4 Plants that are to be replanted shall be carefully removed and the root ball shall be wrapped in burlap. Balled roots shall be kept continually moist. Plants shall be replanted in their original positions within 48 hours in topsoil extending 12 inches beyond the diameter of branches and to a depth of 12 inches below the root ball. All plants shall be fertilized and watered.

13.4.4.5 Where trees with trunks less than 4 inches in diameter and cultivated shrubs and other plants exist in an easement obtained for a pipeline, the County may, at its discretion, order the Contractor to dig up and salvage said trees and shrubs and to replant them after installation of the pipeline. All trees in easements which are to be replaced shall be replaced as follows:

13.4.4.5.1 Trees less than 8 feet in height shall be replaced with trees of the same size and species.
13.4.4.5.2 Trees greater than 8 feet in height shall be replaced as follows:

- Evergreens – same species, 7 feet in height;
- Deciduous – same species, 8 feet in height; and,
- Fruit or Flowering – same species, 5 feet in height.

13.4.5 Private Easements and Construction Access Areas.

13.4.5.1 Landscaping and improvements within private easements and temporary construction easement areas shall be restored in accordance with the terms, conditions and stipulations of the easement agreements.

13.4.5.2 Construction across, and restoration and cleanup within, private easements and construction access areas shall be performed expeditiously and on a continuous basis until the Work is completed.

13.4.6 Maintenance. The Contractor shall maintain all restored landscape plantings and lawn areas for the duration of the Project. The Contractor shall replace dead or damaged plantings until the landscape restoration is accepted by the County or governing jurisdiction.

13.5 MONUMENT RESTORATION

13.5.1 The Contractor shall comply with WAC 332-120-040. The Contractor shall be required to preserve, where possible and practicable, all survey monuments and property corners whether shown the Approved Drawings or not. Should any survey monuments or property corners need to be removed for construction, or is accidentally disturbed as a result of the Contractor’s operations, the Contractor shall be responsible to provide and enlist a Washington State licensed land surveyor to reference the monuments and property corners with “reference points” and otherwise preserve the location of said reference points prior to removing or destroying the monuments and/or property corners. Should any permits, forms, or any other documentation need to be acquired to temporarily remove and replace any reference point, the Contractor shall also be required to procure and acquire the same. The monuments shall be replaced, in kind, according to WAC 332-120-040, or as required by the governing jurisdiction.

END OF SECTION
SECTION 14

CLEANUP

14.1 GENERAL

14.1.1 During the progress of the Work, the Contractor shall keep the Project area and premises occupied by him/her in a neat and clean condition, disposing of refuse in a satisfactory manner.

14.1.2 At no time shall the Contractor permit any accumulation of rubbish, excavated material, equipment or any other material that would interfere with the convenience or operations of others or result in unsafe working conditions. The Contractor shall program the Work in a manner that will keep streets and landscaped areas free of dust, mud and debris. For additional requirements for the disposal of clearing debris and excavated material, see Sections 2 and 3 of these Specifications.

14.1.3 Paved streets and other paved areas shall be swept clean as soon as repaving is completed and at such other periods deemed necessary by the County or governing jurisdiction to prevent nuisance to the adjacent Property Owners or users of the street or area. Power brooms that do not catch and contain the dust and dirt being swept are prohibited.

14.2 CLEANUP

14.2.1 On completion of the Work, the Contractor shall promptly remove from the vicinity all equipment, temporary structures and surplus materials, including construction debris, lumber, dirt, etc.

14.2.2 The Contractor shall return all lands disturbed by their operations to a condition at least equal to that existing prior to construction of the Project, including removal and backfilling of temporary construction access roads, vehicular and equipment storage areas, etc. All damage to earthwork by erosion shall be filled, regarded and seeded (if necessary) as required to conform to these Specifications and the requirements of the governing jurisdiction.

14.2.3 All pipelines shall be flushed and debris shall be removed from all manholes prior to Final Acceptance of the Project. All material shall be removed from all surfaces not intended to receive them.

14.3 PROTECTION OF WORK

14.3.1 The Contractor shall be responsible for the care of all Work until Final Acceptance of the Project. The Contractor shall replace damaged or lost material, and repair damaged parts or Work, as necessary, until such time as Final Acceptance is granted.

END OF SECTION