Monterey Peninsula Water Management District
Sleepy Hollow Steelhead Rearing Facility

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SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. The work covered by this contract includes:

1. Constructing rehabilitation of the existing Sleepy Hollow Steelhead Rearing Facility (SHSRF) including removal and reinstallation of a channel liner, removal and reinstallation of a drain, removal and reinstallation of cobble and spawning gravel, installation of concrete slabs, removal and reinstallation of air and water lines.
2. Restoration of any disturbed areas and repair of any disturbed infrastructure as part of access to the work areas.
.

B. The above description is for general information only. Provide all work required by the Contract Documents.

1.2 CONTRACT DOCUMENTS

A. The contract drawings indicate the general arrangement and location of equipment, pipe, fixtures, outlets, etc. Follow the indicated positions as closely as possible. The exact location of the various items is subject to building construction and the actual equipment furnished by the Contractor. Contractor shall verify the location of all items furnished, installed, or connected.

B. The Drawings are not to be scaled. All implied locations shall be determined at the building site after field measurements have been taken.

C. Should interferences or discrepancies prevent the installation of any part of the work, the Owner shall be notified and will determine the steps necessary to complete the true development of the intent of the Drawings and Specifications.

1.3 TIME OF COMMENCEMENT AND COMPLETION

A. Notice to Proceed: After execution of the Contract, written Notice to Proceed will be provided by Owner to Contractor or as required in the General Conditions. The exact date of a Notice to Proceed will be determined after fish are removed and the facility operations cease. This is expected sometime in late fall or early winter. The Contractor shall begin the Work within five (5) days upon receipt of the Notice to Proceed. Notwithstanding any other provision of the Contract, Owner shall not be obligated to accept or to pay for any Work furnished by Contractor prior to delivery of the Notice to Proceed, whether or not Owner has knowledge of the Work.

B. The calendar work day count will commence on the date specified in the Notice to Proceed or as required in the General Conditions.

C. Substantial Completion

1. Substantial completion of the Work and completion of all items of Work shall be as set forth in the Agreement.

1.4 SPECIFICATIONS

A. The following standard specifications, including current revisions and supplements may be referred to in these Contract Documents to establish minimum standards for materials, construction, and inspection procedures. Unless otherwise shown or specified, the provisions for measurement and payment contained in such standard specifications will not apply.

1. Caltrans Standard Specifications, 2015, as prepared by the California State Transportation Agency.
2. American Society for Testing Materials (ASTM).
3. American Water Works Association (AWWA).
4. American National Standard Institute (ANSI).
5. National Association of Sewer Service Companies (NASSCO).
6. Manual on Uniform Traffic Control Devices (MUTCD).

B. In case of conflict between the several parts of the specifications and between the various referenced standard specifications, the most stringent shall govern as determined by the Owner. Where these specifications refer to recognized standards, such as ASTM, Federal Specifications, N.F.P.A., the reference shall be to the latest edition, unless specified otherwise.

1.5 CONTRACTOR'S COPIES OF CONTRACT DOCUMENTS

A. Owner will provide Contractor with two sets of full-size drawings, and two sets of specifications. At least one complete set of Contract Documents, including one full-size set of Drawings shall be kept at the site of construction in good condition, and at all times available to the Owner. Additional copies of the Contract Documents, if required, will be furnished by the Owner at net cost of reproduction to the Contractor.

1.6 COORDINATION OF WORK WITH OWNER AND OTHERS

A. Contractor shall coordinate its work with other contractors who may be working on and or in the Project area and cooperate with them. Contractor shall also coordinate its activities with Owner.

1.7 PERMITS AND FEES

A. The acquisition of all permits required, and payment of all fees, inspection charges and other similar costs shall be the responsibility of Contractor. Owner will reimburse Contractor for payments made to cover the fee cost of all permits.

1.8 CLEANUP AND SITE MAINTENANCE

A. Contractor shall clean daily all dirt, gravel, construction debris and other foreign material resulting from its operations from all streets and roads in the vicinity of the Work and shall maintain a clean, orderly and safe construction site at all times during prosecution of the Work. If required by the Owner, Contactor shall use wash trucks or street sweepers fitted with spray misters to minimize dust.

1.9 EXISTING UTILITIES

A. In general, the locations of existing major underground utilities and some minor utilities are indicated on the Drawings. This information has been obtained from utility maps and from oral descriptions provided by the various agencies involved. Owner does not guarantee the accuracy or completeness of this information, and it is to be understood that other above ground or underground facilities not shown on the Drawings may be encountered during the course of the Work.

B. Contractor shall notify all utility companies and public agencies affected by the construction 48 hours prior to excavation.

1.10 RESTORATION OF STRUCTURES AND SURFACES

A. General: Whenever any of the Work is accomplished on or through property other than that owned by Owner, Contractor shall furnish Owner, before final acceptance of the Work by Owner, a written release from the subject property owner or an authorized representative of the owner of the property affected, stating that the restoration of structures and surfaces has been satisfactorily accomplished. If in the opinion of the Owner the release is arbitrarily withheld, the Owner may, at its sole discretion, accept the portion of the Work involved and cause final payment therefore to be made.

B. In addition to the requirements of any applicable utility permit, street use permit or franchise relating to this Contract, Contractor shall, as a minimum for any restoration work, conform to standard plans and specifications of the agency which controls the use of the right-of-way in which this construction work is performed.

C. Existing stakes and marks: All section, section subdivision, property corners, plat, U.S.C. and G.S., U.S.G.S., and other official monuments or benchmarks, shall be carefully preserved or replaced. In the event any such monument or marker is disturbed as a result of Contractor's operations, Contractor shall replace or reset the monument or marker in a manner satisfactory to the Owner and shall provide a survey map to be recorded with the County. Replaced or reset monuments shall be of acceptable type and quality, and shall be, located so as to clear existing utilities or any other interferences. They shall be placed in a manner consistent with good and recognized engineering and surveying practices.

D. All waterways, channels, drainage ditches, drains, culverts and similar facilities that are damaged by actions of Contractor shall be restored as nearly as possible to their original condition. Where necessary, Contractor shall provide temporary facilities or temporarily realign such watercourses to maintain a continuously serviceable facility until it is restored to its original location and condition. Restoration of such facilities shall be as shown and specified.

1.11 CONSTRUCTION STAKING

A. Contractor shall provide all construction staking.

1.12 GEOTECHNICAL STUDIES

A. A geotechnical investigation at the site was performed related to other projects at the site and is titled Sleepy Hollow Rearing Facility, RAS/Treatment Building and Wet Well, Carmel Valley, CA by Pacific Crest Engineering, Inc. for Monterey Peninsula Water Management District, Monterey, CA dated April 2018. The report may be obtained from the District. Contractor shall make its own deductions and conclusions as to the nature of the materials to be excavated and the difficulties which may arise from subsurface conditions.

1.13 EXCESS MATERIALS AND DEBRIS

A. Disposal of excess materials and debris shall be in accordance with applicable federal, state and local laws. Contractor may dispose of excess materials from excavation under the rearing channel at the site under the direction of the Engineer. Construction debris (e.g., from demolition and removal) must be hauled off site. There is no designated disposal site.

1.14 ARCHAEOLOGY

A. During construction, if artifacts or any other archaeological objects are discovered, Contractor shall stop construction immediately and notify Owner. Owner will notify the appropriate authorities. Contractor shall cooperate with authorities investigating the find.

1.15 EMERGENCY RESPONSE

A. At the preconstruction meeting, Contractor shall provide Owner with a list of phone numbers of those employees responsible for responding to emergency calls outside normal working hours concerning Contractor's Work.

B. Upon failure to immediately respond to a problem with corrective action, Owner may respond without further notice to Contactor and deduct all costs thereof from any payments due or coming due Contactor. Owner shall not be required to act in any situation and nothing shall relieve Contactor of its duties in this regard.

1.16 TRAFFIC CONTROL

A. Traffic shall not be affected by the Work unless Contractor has an approved traffic control and maintenance plan.

B. Contractor shall provide all lighting, barricades, cones, signs, and flaggers necessary to direct traffic during working hours and at all other times as required to ensure the public safety and promote safe vehicular travel.

C. All traffic control measures shall meet the requirements of the Manual on Uniform Traffic Control Devices for Streets and Highways.

1.17 AS-BUILT DRAWINGS

A. Contactor shall be required to provide complete, accurate as-built data to the Owner prior to final payment. The Owner will furnish one additional set of construction plans for final as-built recording. As-built data shall be kept current daily and available for review daily by the Owner. Prior to authorization of each monthly progress pay estimate, the Owner will review Contactor's current as-built plans for completeness and accuracy.

1.18 "OR EQUAL" CLAUSE

A. In order to establish a basis of quality, certain processes, types of machinery and equipment or kinds of material may be specified on the plans or herein by designating a manufacturer's name and referring to brand or product designation. It is not the intent of these specifications to exclude other processes, equipment or materials of a type and quality equal to those designated. When a manufacturer's name, brand or item designation is given, it shall be understood that the words "or equal" follow such name or designation, whether in fact they do so or not. If Contractor desires to furnish items of equipment by manufacturers other than those specified, he shall secure the approval of Owner prior to placing a purchase order.

B. No extras will be allowed Contractor for any changes required to adopt the substitute equipment. Therefore, Contractor's proposal for an alternate shall include all costs for any modifications to the plans, such as structural and foundation changes, additional piping or changes in piping, electrical changes or any other modifications which may be necessary or required for approval and adoption of the proposed alternate equipment. Approval of alternate equipment by Owner before or after bidding does not guarantee or imply that the alternate equipment will fit the design without modifications.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01010

SECTION 01060

REGULATORY AND SAFETY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies regulatory requirements applicable to this project that include, but shall not be limited to, Environmental Protection Agency, Occupational Safety and Health Administration (OSHA), Cal/OSHA, and other applicable federal, state, and local governmental regulations.

1.2 WATER AND AIR POLLUTION CONTROL

A. During the term of the Contract, Contractor's operations shall conform to applicable laws and regulations of the California Environmental Protection Agency (CalEPA), and other agencies of the State and Federal government, as well as local Ordinances and Resolutions designed to prevent, control, and abate water and air pollution.

B. During all phases of the Work, or when directed, protect work sites, storage, and disposal areas from washout and erosion. Take precautions to control or abate dust nuisance and air pollution by cleaning up, sweeping, sprinkling, covering, enclosing or sheltering work areas, and stockpiles, and by promptly removing from paved streets earth or other material which may become airborne or may be washed into waterways or drainage systems.

C. The Contractor may be required to submit for approval an erosion control plan prior to the start of site work.

1.3 NOISE

A. Measures shall be taken to minimize noise. The Contractor shall review the site and understand the relationship of the site to surrounding facilities.

1.4 SAFETY AND HEALTH REGULATIONS

A. The Contractor shall comply with safety and health regulations for construction.

1.5 POSTING OF REGULATIONS

A. The Contractor shall comply with all Cal/OSHA posting regulations as well as State and Federal Labor Law requirements.

1.6 RESPONSIBILITY FOR DAMAGE

A. The Contractor shall bear sole responsibility for damage to completed portions of the project or to property located off the project caused by erosion, siltation, run-off, or other related items during the construction of the project.

B. The Contractor shall also bear sole responsibility for any pollution of rivers, streams, groundwater, or other waters which may occur as a result of construction operations. The Contractor shall exercise all necessary precautions throughout the life of the project to prevent pollution, erosion, siltation, and property damage.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01060

SECTION 01091

REFERENCE STANDARDS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Titles of sections and paragraphs: Captions accompanying specification sections and paragraphs are for convenience of reference only, and are not to be used to define the limits of subcontracts.

B. Applicable publications: Whenever in these Specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date that the Work is advertised for bids, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the Drawings shall be waived because of any provision of, or omission from, said standards or requirements.

C. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to or exceed the requirements of applicable codes and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of these Specifications nor the applicable codes.

D. In case of conflict between codes, reference standards, drawings and the other Contract Documents, as determined by Owner, the most stringent requirements shall govern. Conflicts shall be brought to the attention of the Engineer for written clarification and directions prior to ordering or providing any materials or labor. The Contractor shall bid the most stringent requirements.

E. Applicable standard specifications: The Contractor shall construct the Work specified herein in accordance with the requirements of the Contract Documents and the referenced portions of those referenced codes, standards, and specifications listed herein; (except, that wherever references to "Standard Specifications" are made, the provisions therein for measurement and payment shall not apply).

F. References herein to "OSHA Regulations for Construction" shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

G. References herein to "OSHA Standards" shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

H. The contractual relationship of the parties to the Contract, the du-ties and responsibilities of Owner, Contractor and Engineer mentioned in any reference document shall be governed by General Conditions contained herein.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. The following documents or agencies may be referenced in the Contract Documents.

AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturer's Association
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ACI	American Concrete Institute
ADC	Air Diffusion Council
AEIC	Associated Edison Illumination Companies
AFBMA	Anti-Friction Bearing Manufacturer's Association, Inc.
AGA	American Gas Association
AGC	Associated General Contractors of America
AGMA	American Gear Manufacturer's Association
AHAM	Association of Home Appliance Manufacturer's
AI	The Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANS	American Nuclear Society
ANSI	American National Standards Institute, Inc.
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
AREA	American Railway Engineering Association
ARI	Air-Conditioning and Refrigeration Institute
ASA	Acoustical Society of America
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASPA	American Sod Producers Association
ASQC	American Society of Quality Control
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BBC	Basic Building Code, Building Officials and Code Administrators International
BHMA	Builders Hardware Manufacturer's Association
CBM	Certified Ballast Manufacturers
Cal/OSHA	California Occupational Safety and Health Agency
CalEPA	California Environmental Protection Agency
CDA	Copper Development Association

CEMA	Conveyors Equipment Manufacturer's Association
CGA	Compressed Gas Association
CLPCA	California Lathing and Plastering Contractors Association
CLFMI	Chain Link Fence Manufacturer's Institute
CMA	Concrete Masonry Association
COE	Corp of Engineers
CRSI	Concrete Reinforcing Steel Institute
CSI	Construction Specifications Institute
CWS	Clean Water Services
DCDMA	Diamond Core Drill Manufacturer's Association
DOE	Department of Ecology
DOT	Department of Transportation
EEI	Edison Electric Institute
EIA	Electronic Industries Association
EJCDC	Engineer's Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturer's Association
EPA	Environmental Protection Agency
ETL	Electrical Test Laboratories
FGMA	Flat Glass Marketing Association
FM	Factory Mutual
FS	Federal Specification
GA	Gypsum Association
IBC	International Building Code
ICBO	International Conference of Building Officials
ICC	Interstate Commerce Commission
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IME	Institute of Makers of Explosives
IMIA	International Masonry Industry All-Weather Council
IP	Institute of Petroleum (London)
IPC	Institute of Printed Circuits
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
ISO	International Organization for Standardization
ITE	Institute of Traffic Engineers
MBMA	Metal Building Manufacturer's Association
MFMA	Maple Flooring Manufacturer's Association
MIL	Military Specification
ML/SFA	Metal Lath/Steel Framing Association
MPTA	Mechanical Power Transmission Association
MTI	Marine Testing Institute
NAAMM	National Association of Architectural Metal Manufacturer's
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards
NCCLS	National Committee for Clinical Laboratory Standards
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NESC	National Electric Safety Code
NFPA	National Fire Protection Association
NGLI	National Lubricating Grease Institute

NMA	National Microfilm Association
NWMA	National Woodwork Manufacturers Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PS	Product Standard
RIS	Redwood Inspection Service
RVIA	Recreational Vehicle Industry Association
RWMA	Resistance Welder Manufacturer's Association
SAE	Society of Automotive Engineers
SAMA	Scientific Apparatus Makers Association
SDI	Steel Deck Institute
SDI	Steel Door Institute
SIS	Swedish Standards Association
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACCNA	Sheet Metal and Air Conditioning Contractors National Association
SPR	Simplified Practice Recommendation
SSBC	Southern Standard Building Code, Southern Building Code Congress
SSPC	Steel Structures Painting Council
SSPWC	Standard Specifications for Public Works Construction
TAPPI	Technical Association of the Pulp and Paper Industry
TFI	The Fertilizer Institute
UL	Underwriters Laboratories, Inc.
WCLIB	West Coast Lumber Inspection Bureau
WCRSI	Western Concrete Reinforcing Steel Institute
WIC	Woodwork Institute of California
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association

B. Standard Specifications

1. Where indicated in these Contract Documents, Work shall be in accordance with the referenced sections of the Caltrans Standard Specifications, 2018, prepared by the California State Department of Transportation, hereinafter referred to as "Standard Specifications." Should the 2022 Standards and Specifications (due in October 2022) conflict with the 2018 version, the 2022 Standard Specifications shall govern.
2. The Specifications of these Contract Documents shall supersede any provisions of the Standard Specifications in conflict herewith.
3. Reference to measurements and payment in the Standard Specifications do not apply to this Contract.
4. References to Engineer, department, secretary, State or other similar terms in the Standard Specifications shall mean Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01091

SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

A. All submittals shall be electronic copies unless hardcopies are specified. Electronic copies shall be in PDF format unless otherwise specified.

B. General:

1. All submittals shall be identified by project title and number, and shall include Contractor's name, submission date, and revision date. In addition, shop drawings, product data and samples shall include names of subcontractor and supplier, applicable specification section number and Contractor's stamp, initialed or signed, certifying to review of submittal, verification of field measurements and compliance with Contract Documents.
2. All submittals shall be accompanied by a submittal transmittal form. Equipment numbers shall be listed for items being submitted. A separate form shall be used for each specific item, class of material, equipment, and items specified in separate, discrete sections, for which the submittal is required. Submittals for various items shall be made with a single form when the items taken together constitute a manufacturer's package or are so functionally related that expediency indicates checking or review of the group or package as a whole.
3. A unique number, sequentially assigned, shall be noted on the transmittal form accompanying each item submitted. Original submittal numbers shall have the following format: "XXX"; where "XXX" is the sequential number assigned by the Contractor. Resubmittal shall have the following format: "XXXY"; where "XXX" is the originally assigned submittal number and "Y" is a sequential letter assigned for resubmittals; i.e., A, B, or C being the 1st, 2nd, and 3rd resubmittals, respectively. Submittal 25B, for example, is the second resubmittal of Submittal 25.
4. Submittal Completeness: Submittals which do not have all the information required to be submitted are not acceptable and will be returned without review.

C. Shop drawings: Show the information, dimensions, connections, and other details necessary to ensure that the shop drawings accurately interpret the contract documents. Show adjoining work in such detail as required to indicate proper connections. Where adjoining connected work requires shop drawings or product data, submit such information for review at the same time so that connections can be accurately checked.

D. Product data: Modify product data by deleting information which is not applicable to the project or by marking each copy to identify pertinent products. Supplement standard information, if necessary, to provide additional information applicable to project. It is recognized that in some cases manufacturer’s product data will be adequate and further shop drawings as stated in the specifications may not be required, unless requested by the Engineer.

E. Samples

1. Submit 2 (unless specific number is specified) of each sample required by the specifications. Samples shall show the quality, type, range of color, finish and texture of the material intended to be furnished for the work.
2. Samples shall become the property of the Owner unless specifically stated otherwise, and will not be incorporated in the work.

F. Review Procedure: Unless otherwise specified, within 14 days after receipt of the submittal, the Engineer will review the submittal. The returned submittal will indicate one of the following actions:

1. If the review indicates that the material, equipment, or work method is in general conformance with the design concept and complies with the Drawings and specifications, submittal copies will be marked "NO EXCEPTION TAKEN" and given review action 1. In this event the Contractor may begin to implement the work method or incorporate the material or equipment covered by the submittal.
2. If the review indicates that limited corrections are required, copies will be marked 'NOTE MARKINGS" and given review action 2. The Contractor may begin implementing the work method or incorporating the material and equipment covered by the submittal in accordance with the noted corrections. Where submittal information will be incorporated in O&M data, a corrected copy shall be provided, otherwise no further action is required.
3. If the review reveals that the submittal is insufficient or contains incorrect data, copies will be marked "COMMENTS ATTACHED". If the comments are of a nature that can be confirmed without a resubmittal, copies will be further marked "CONFIRM" and given review action 3. If the comments require a revision and resubmittal, copies will be further marked "RESUBMIT" and given review action 4. Except at its own risk, the Contractor shall not undertake work covered by this submittal until the attached comments have been either confirmed by a separate written communication or the submittal has been revised, resubmitted, and returned marked with "NO EXCEPTIONS TAKEN" or "NOTE MARKINGS".
4. If the review indicates that the material, equipment, or work method is not in general conformance with the design concept or in compliance with the Drawings and specifications, copies of the submittal will be marked "REJECTED" and given review action 5. Except at its own risk, the Contractor shall not undertake work covered by such submittals until a new submittal is made and returned marked either "NO EXCEPTIONS TAKEN" or "NOTE MARKINGS".

G. Effects of Review of Contractor's Submittals: Review of Drawings, method of work, or information regarding materials or equipment the Contractor proposes to provide, shall not relieve the Contractor of its responsibility for errors therein and shall not be regarded as an assumption of risks or liability by the Engineer on behalf of the Owner, and the Contractor shall have not claim under the Contract on account of the failure, or partial failure, of the method of work, material, or equipment so reviewed. A mark of "NO EXCEPTIONS TAKEN" or "NOTE MARKINGS" shall mean that the Engineer has no objection to the Contractor, upon the Contractor's own responsibility, using the plan or method of work proposed, or providing the materials or equipment proposed.

1.2 SCHEDULE

A. The Contractor shall provide the following schedules and submit them not later than 10 days after notice to proceed.

1. Contractor's construction schedule:

    a. The Contractor will be required to prepare and submit to the Engineer for review an overall construction schedule covering all work to be performed.
    b. The schedule shall indicate the sequence of the work, the time of starting and completion of each part and the installation dates for major items.
    c. The schedule shall be submitted to the Engineer for review. This schedule shall be revised and resubmitted as necessary until it is acceptable to the Engineer. Action on payment requests will be contingent upon receipt of an acceptable construction schedule.
    d. The construction schedule shall include, but not be limited to, the following items:

        1) Shop drawing receipt from Contractor, submitted to Engineer, review and return to Contractor.
        2) Material and equipment order, delivery and installation and checkout.
        3) Piping installation.
        4) Backfilling, grading, seeding, and paving.
        5) Earthwork.
        6) Subcontractor’s item of work.
        7) Final cleanup.
        8) Testing activities.
        9) Substantial Completion.
        10) Allowance for inclement weather.
        11) Final Completion.

    e. The construction schedule shall be a series of line diagram showing a step by step sequence of each construction activity. Construction activities proceeding simultaneously should be shown as parallel lines. Each activity shall be labeled and the estimated number of days to complete the activity shall be shown on the schedule.
    f. Should the Contractor fail to meet any critical dates within the schedule, the Contractor shall immediately undertake appropriate action which shall assure an acceptable return to the approved construction schedule.
    g. The Contractor will be required to accept the risk of any delays caused by the rate of progress of the work to be performed under the above contract, and that in the event the Contractor is delayed in the prosecution and completion of their work because of such conditions, they shall have no claim for damages or contract adjustment.

2. Contractor's list of subcontractors: Establish the items of work proposed to be accomplished by subcontractors, the name and address of each proposed subcontractor and the date proposed to award each subcontract.
3. Schedule of submittals: Establish for each item for which shop drawings, product data or samples are required, the date the submission will be made, and the date approval is required for the installation to be completed in accordance with the Construction Schedule.
4. The Contractor's list of subcontractors and schedule of submittals shall be based upon the Contractor's progress schedule so that the work can progress in accordance with the approved progress schedule.

B. The Contractor shall immediately advise the Engineer of any proposed changes in their submitted schedules. If, in the opinion of the Engineer, any submitted schedule is inadequate to ensure

completion of work within the time limit, or is otherwise not in accordance with the specification, or if the work is not being adequately or properly prosecuted in any respect, the Engineer shall have the right to require the Contractor to submit new schedules providing for proper and timely completion of the work. In accordance with the General Conditions, progress payments may be held until an acceptable updated schedule is provided.

C. During the term of this Contract, the Engineer may require any schedule to be modified so that the changes in the work of this Contract or related contracts (if any) are properly reflected in the schedule.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01300

SECTION 01400

QUALITY CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Work under this Section includes all testing required by the Contract as specified herein and further specified in the technical sections.

1.2 BUILDING CODE

A. Conform to the requirements of the most recent addition of the International Building Code (IBC), including California Codes for building, structural, mechanical, electrical, plumbing and as required.

1.3 TESTING METHODS

A. All tests shall be made in accordance with commonly recognized standards of national organizations unless alternate specific testing methods are set forth in the technical specifications.

1.4 COSTS

A. The Contractor shall employ and pay for an independent testing laboratory to perform all testing services as specified in the technical sections. Additional inspection and tests required because of defective work or ill-timed notices are performed at the Contractor's expense.

1.5 QUALITY ASSURANCE

A. Samples: The Contractor shall supply samples if and when required by the Specifications or the Engineer. These samples or test specimens shall be prepared and furnished with information as to their source in such quantities and size as may be required for proper examination and tests, with all freight charges prepaid. All samples shall be submitted before shipment of materials to the site of the work and in ample time to permit the making of proper tests, analysis, examination, rejections and resubmissions before the time required to incorporate the materials into the work. No such materials shall be used in work until they have been reviewed in writing by the Engineer. Samples of materials will be retained by the Engineer for reference and comparison purposes.

B. Certification: Producers and associations which have instituted approved systems of quality control and have been, approved by the building department may submit certifications of compliance in lieu of further testing. Concrete mixing plans, plants producing fabricated concrete products certified by building department lumber and plywood grademarks by approved associations and materials for equipment bearing Underwriter's Laboratory label require no

further plan inspection and testing, unless more restrictive requirements are required, or otherwise specifically required in the specifications.

1.6 COMPACTION TESTING

A. Compaction testing shall be completed by the Contractor's certified testing laboratory at the sole expense of the Contractor. Testing shall occur in accordance with Sections 02221 and 02222. All costs associated with testing shall be considered incidental to the project.

B. Payment will be considered only for excavation and backfill that have met the required compaction testing specifications, and results submitted to the Engineer. Areas not meeting specified compaction shall be recompacted and methodology for future backfill efforts modified to meet the requirements.

C. The Contractor shall assume full responsibility of the means and methods applied for compaction. Testing identified above is the minimum, and the Contractor, at Contractor's own discretion, may conduct additional testing as the Contractor deems necessary to ensure the specified compaction requirements. Any subsequent settlement during the warranty period shall be considered to be the result of improper compaction and shall be promptly corrected by the Contractor at no additional charge to the Owner.

1.7 CONTRACTOR'S RESPONSIBILITY

A. Access: Furnish free access to various parts of the work and assist testing inspection personnel in performance of their duties at no additional cost to the Owner

B. Concealed work: When directed by the Engineer, the Contractor shall open for inspection any part of the work which has been concealed. Should the Contractor refuse or neglect such a request, the Owner may employ any other person to open up the same or do so himself. If any parts of the work have been concealed in violation of the Engineer's instructions or, if on being opened, it is found not to be in accordance with the terms of the contract documents, the expense of opening and recovering, whether done by the Contractor or not, shall be charged to the Contractor.

C. Data: Furnish samples, records, drawings, certificates and similar data as may be required by testing and inspection personnel to assure compliance with the contract documents

D. Notices: The Contractor shall notify the Engineer not less than 48 hours before work requiring inspection is started. The Contractor shall schedule portions of the work requiring inspection and additional testing by the Engineer, so that the agency's time on the project is continuous and as brief as possible. Provide notice to the Engineer 48 hours prior to concealment.

1.8 INSPECTORS

A. Appointment: The Engineer or Owner may appoint inspectors to inspect any and all portions of the work. Such inspection may extend to any or all parts of the work, and to the preparation or manufacture of materials to be used.

B. Authority of Inspector: Inspectors are not authorized to revoke, alter, enlarge or relax the provisions of the Contract Documents, and the inspector is placed on the work to keep the Engineer informed as to the progress of the Work and the manner in which it is being done. He may also call the attention of the Contractor to any deviations from the plans or specifications. Failure of the inspector or the Engineer to call the attention of the Contractor to faulty work or deviation from the Contract Documents shall not constitute acceptance of said work. An inspector is not authorized to approve or accept any portions of the Work or to issue instructions contrary to the contract documents. The inspector will exercise only such additional authority as may be specially delegated to him by the Engineer, notice of which will be given in writing to the Contractor.

1.9 TEST REPORTS

A. Independent testing and inspection agency and/or agencies will prepare logs, test reports and certificates applicable to specific tests and inspections. Reports shall include description of method of test, identification of samples and portions of the work tested. They shall state description of location of work, time and date of obtaining and testing samples, weather and climatic conditions, and evaluation of results of tests, including recommendations for action. Electronic copies shall be submitted to the Owner, Engineer and Contractor.

1.10 DEFECTIVE WORK

A. Remove and replace any work found defective or not complying with requirements of contract documents, at no additional cost to the Owner.

B. Work will be checked as it progresses, but failure to detect any defective work or materials shall not in any way prevent later rejection when such defect is discovered, nor shall it obligate the Engineer for final acceptance.

C. Owner reserves the right to conduct their own quality assurance testing, obtain material samples and to test products for compliance with pertinent requirements of the Contract Documents, irrespective of prior testing and/or certification of the products by the manufacturer.

1. The Contractor shall cooperate as required for collecting and forwarding the required samples without charge, and in ample time to permit testing prior to use, and provide safety measures and devices to protect those who take the samples.
2. In the absence of any reference specification, materials shall meet the specifications and requirements of the American Society for Testing and Materials (ASTM) or the American Association of State Highway and Transportation Officials (AASHTO). When there is not pertinent coverage under ASTM or AASHTO, the material shall meet specifications and requirements of applicable commercial standards. Lacking such coverage, materials shall meet requirements established by reputable industry for a high-quality product of the kind involved.
3. The Contractor shall not rely on Owner testing for Contractor performance required to meet the requirements outlined within the Contract Documents. Copies of test results will be provided to Contractor upon Contractor’s written request to the Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01400

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 PUBLIC SAFETY AND CONVENIENCE

A. The Contractor shall comply with all rules and regulations of the city, state and county authorities regarding the closing of public streets or highways to the use of public traffic. No roads shall be closed to the public except by express permission of the Engineer. The Contractor shall conduct the work so as to ensure the least possible obstruction to traffic and normal commercial pursuits.

B. The Contractor shall protect all obstructions within traveled public roadways with approved signs, barricades and lights where necessary or where ordered by the Engineer for the safety of the public. The convenience of the general public and residents along the public route to the Work area and the protection of persons and property are of prime importance and shall be provided for in an adequate and satisfactory manner.

C. Whenever the Contractor's operations create a hazardous condition, the Contractor shall furnish flagperson(s) and guards as necessary to give adequate warning to the public of any dangerous condition encountered.

D. The Contractor shall patrol daily any traffic control area and reset all disturbed signs and traffic control devices immediately. All nonapplicable signs shall be removed or covered during periods not required. All signs and barricades necessary for nighttime traffic control shall be fully reflectorized. The Contractor shall provide and maintain, at Contractor’s own expense, all labor, tools, materials, and equipment required to maintain traffic, including flagging.

1.2 CONSTRUCTION UTILITIES AND MISCELLANEOUS FACILITIES

A. General: The Contractor shall provide the temporary facilities and controls as hereinafter specified and as required by law.

B. Power: PG&E power is delivered to the site. There is a generator back-up. If both sources are not available during construction, the Contractor shall provide all necessary power for construction work.

C. Water: Potable water is not available for the Contractor’s use on the work site. Non-potable water is available as long as there is sufficient power at the site.

D. Sanitary facilities: The Contractor shall provide adequate toilet facilities for all workers employed on the work. The Contractor shall maintain the same in a sanitary condition from the beginning of the Work until completion and shall then remove the facilities. All portions of the Work shall be maintained at all times in a sanitary condition.

E. Equipment storage: The Contractor shall be responsible for storing equipment and materials.

F. Constructions signs: No commercial or advertising signs shall be allowed on the site of the Work.

G. Contractor shall consult with the Owner to provide a suitable staging area for storage of materials and equipment.

1.3 BARRIERS

A. The Contractor shall erect and maintain guard rails or other suitable barriers where required.

1.4 FIRE PREVENTION CONTROL

A. General: Take all precautions necessary and required to prevent fires. Comply with the requirements of local authorities having jurisdiction.

B. Fuel for cutting and heating torches shall be gas only, and shall be contained in Underwriter's Laboratory approved containers.

C. Provide and maintain a 20 pound capacity, dry-chemical type fire extinguisher in the immediate vicinity of the work when welding tools or torches of any type are in use.

D. Do not use volatile liquids for cleaning agents or as fuels for motorized equipment or tools within building, except with the written approval of the Engineer.

1.5 RUBBISH REMOVAL

A. General:

1. Clean up the debris resulting from work at least once a day and more often, if it interferes with the work of others or presents a fire hazard.
2. Remove and dispose of all debris at once if it presents a fire hazard, or when directed.

1.6 DISCONTINUANCE, CHANGES AND REMOVAL

A. When directed and no longer required, remove the temporary facilities specified herein. If any of the permanent systems are used for temporary facilities, restore them to “as new” condition. Material used for temporary facilities, which are removed, shall become the property of the Contractor which shall be removed from the site by the Contractor.

1.7 SECURITY

A. The Contractor is responsible for security of Contractor’s operations at all times.

1.8 PROJECT SIGNS

A. The Contractor shall provide and install project signs where necessary to inform the public of any construction activity having impact on public access and use of the adjacent lands, roads, or

streams. Signs shall be placed at least 48 hours prior to related operations and shall be removed promptly upon completion of the project.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01500

SECTION 01568

EROSION AND POLLUTION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. It shall be the responsibility of the Contractor to prevent pollution of air, water and soil resulting from Contractor's operations.

B. The Contractor shall perform work required to prevent soil from eroding or otherwise entering onto all paved areas and into natural watercourses, ditches, and public sewer systems and to prevent dust attributable to his operations from entering the atmosphere. This work shall be in accordance with Federal, State and Local codes.

C. Water containing suspended material from any part of the Contractor's operations shall be clarified before discharging to drains or streams.

D. Noise pollution shall be minimized through the use of proper mufflers on all construction equipment.

PART 2 - PRODUCTS

2.1 GENERAL

A. Dust palliatives (additives) shall conform to the Standard Specifications.

B. Other erosion control structures and products as shown on the drawings.

PART 3 - EXECUTION

3.1 STREETS, AND SIDEWALKS

A. Streets, haul roads and (if directed by the Owner's Representative) detours and bypass roads shall be swept by automatic self-contained sweepers as required to keep them free of dirt or debris.

B. Excessive dirt on pavements and gravel roadways shall be removed by means of hand shoveling or appropriate mechanical equipment and the area swept as directed above.

C. Sidewalks and driveways shall be cleaned by means of shovels and hand brooms or appropriate mechanical equipment.

D. Dust on unsurfaced streets or parking areas and any remaining dust on surfaced streets shall be controlled with an approved dust palliative as directed by the Owner's Representative.

E. The Contractor shall comply with the above requirements on a daily basis. If the Contractor fails to perform the above work in a satisfactory manner, the Owner's Representative may stop all work, except cleanup operations, until the Contractor has satisfactorily complied with the above requirement.

3.2 WATER DISCHARGED TO DRAINS OR STREAMS

A. The Contractor shall construct and maintain filters, sedimentation traps, or stilling basins with overflows to clarify waters containing suspended materials from fill areas, excavations, deep wells, well points and disposal sites before discharging to drains or streams. Refer to Section 02222, Excavation, Compaction and Backfill for Utilities, for desilting requirements prior to disposal of dewatering water.

END OF SECTION 01568

SECTION 01756

TESTING, TRAINING, AND FACILITY START-UP

PART 1 - GENERAL

1.1 DEFINITIONS

A. Factory Testing: A test or tests conducted on an equipment item or system at the place of fabrication by the manufacturer.

B. Functional Test: A test or tests in the presence of the Engineer and Owner to demonstrate that the installed equipment or system meets manufacturer's installation and adjustment requirements and other requirements specified including, but not limited to, noise, vibration, alignment, speed, proper electrical and mechanical connections, operating temperature, thrust restraint, proper rotation, and initial servicing. Functional tests are typically performed on individual components of a system.

C. Startup Test Period:

1. Startup of the entire facility shall be considered complete when, in the opinion of the Engineer, the facility has operated in the manner intended for 10 continuous days without significant interruption. A significant interruption will require the startup then in progress to be stopped and restarted after corrections are made.

D. Significant Interruption: May include any of the following events:

1. Failure of Contractor to maintain qualified onsite startup personnel as scheduled.
2. Failure to meet specified performance for more than 4 consecutive hours.
3. Failure of any critical equipment unit, system, or subsystem that is not satisfactorily corrected within 4 hours after failure.
4. Failure of noncritical unit, system, or subsystem that is not satisfactorily corrected within 8 hours after failure.
5. As may be determined by Engineer.

E. A day is defined as 24 continuous hours unless noted otherwise.

1.2 SUBMITTALS

A. Action Submittals:

1. Equipment Supplier’s Certificate of Installation as required.
2. Test Reports: Functional and performance testing, in format acceptable to Engineer and certification of functional and performance test for each piece of equipment or system specified.
3. Certifications of Calibration: Testing equipment.
4. Record Drawings: Accurate and current markups of electrical record drawings.

B. Informational Submittals:

1. Factory Testing: Provide written notification at least 15 days prior to any factory testing.
2. Facility startup plan and schedule for project describing all procedures and showing all activities described or referenced herein. Submit at least 30 days prior to commencement of facility startup activities.
3. Provide detailed sub-network of Progress Schedule with the following activities identified:

    a. Manufacturer's services.
    b. Installation certifications.
    c. Operator training.
    d. Functional testing.
    e. Performance testing.
    f. Operational testing.

4. Provide testing plan with test logs for each item of equipment and each system when specified. Include testing of capacities, flows, pressures, and other parameters.
5. Provide summary of shutdown requirements for existing systems which are necessary to complete start-up of new equipment and systems.
6. Revise and update start-up plan based upon review comments, actual progress, or to accommodate changes in the sequence of activities.

1.3 Contractor FACILITY STARTUP RESPONSIBILITIES

A. General:

1. Perform all Work for functional and performance test specified.
2. Demonstrate proper function of each component and feature of all equipment, systems, and control devices.
3. Complete all Work associated with the unit and related processes before testing, including related manufacturer's representative services.
4. Furnish qualified manufacturer's representatives when required to assist in testing.
5. Utilize the Equipment Supplier’s Certificate of Installation Form, supplemented as necessary, to document all functional and performance procedures, results, problems, and conclusions.
6. Prepare testing and startup plan and schedule and attend pretest meetings related to test schedule, plan of test, materials, chemicals, and liquids required, facilities' operations interface, and other required Engineer and Owner involvement.
7. Startup Coordinator. Designate and provide one person to be responsible for coordinating and expediting Contractor’s testing and startup duties. The person shall be present during all testing and startup meetings and shall be available at all times during the startup period. It is the Contractor’s responsibility to coordinate all work of vendors and subcontractors including, but not limited to, equipment suppliers and representatives. The Contractor shall ensure that all required work, testing, and documentation is completed and submitted in a timely manner to allow for an integrated and organized approach to the startup effort.
8. Schedule time for field testing and adjustment of controls. Complete testing, training, and startup within Contract Time.
9. Allow realistic durations in Progress Scheduling for testing, training, and start-up.
10. Test equipment for proper performance at point of manufacture or assembly when specified.

11. When source quality control testing is specified:

    a. Demonstrate equipment meets specified performance requirements.
    b. Provide certified copies of test results.
    c. Do not ship equipment until certified copies have received written acceptance from Engineer. Written acceptance does not constitute final acceptance.
    d. Perform testing as specified in the equipment specification sections.

B. Startup Test Period:

1. As applicable to the equipment furnished, state in writing that all necessary hydraulic structures, piping systems, and valves have been successfully tested; that all necessary equipment systems and subsystems have been checked for proper installation, started, and successfully tested to indicate that they are all operational; that the systems and subsystems are capable of performing their intended functions; and that the facilities are ready for startup and intended operation.
2. Provide all temporary water pumping, piping, and other items as required for testing, unless otherwise indicated.
3. When facility startup has commenced, schedule remaining Work so as not to interfere with or delay the completion of facility startup. Support the startup activities with adequate staff to prevent delays or process upsets. This staff shall include, but not be limited to, major equipment and system manufacturers' representatives, subcontractors, electricians, instrumentation personnel, millwrights, pipefitters, and plumbers.
4. Supply and coordinate specified manufacturer's startup services.
5. Make adjustments, repairs, and corrections necessary to complete startup.

1.4 Owner/Engineer FACILITY STARTUP RESPONSIBILITIES

A. General:

1. Review Contractor's test plan and schedule.
2. Witness testing or review testing documentation.
3. Provide water, power, and other items as required for testing, unless otherwise indicated.

B. Startup Test Period:

1. Operate air and water pump stations.
2. Designate and provide one person to be responsible for coordinating and expediting Owner and Engineer’s testing and startup duties.

1.5 CERTIFICATE OF PROPER INSTALLATION

A. At completion of Functional Testing, furnish written report prepared and signed by manufacturer's authorized representative, certifying equipment:

1. Has been properly installed, adjusted, aligned, and lubricated.
2. Is free of any stresses imposed by connecting piping or anchor bolts.
3. Is suitable for satisfactory full-time operation under full load conditions.

1.6 TRAINING OF OWNER'S PERSONNEL

A. Provide operations and maintenance training for items of mechanical equipment.

B. Satisfactorily complete functional testing before beginning operator training.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SEQUENCE OF FACILITY STARTUP ACTIVITIES

A. Complete all associated structural installations for system to be tested.

B. Startup Test Period: After successful completion of clean water testing, begin 10-consecutive-day Startup Test Period.

C. Achieve substantial completion of process system or subsystem by correcting or completing any remaining issues as identified by a process substantial completion list provided by the Engineer.

3.2 TESTING PREPARATION

A. General:

1. Schedule and attend pretest meetings related to test schedule, plan of test, facilities' operations interface, Engineer and Owner involvement.
2. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required to conduct testing.

B. Cleaning and Checking: Prior to starting functional testing:

1. Calibrate testing equipment for accurate results.
2. Inspect and clean equipment, devices, connected piping, and structures so they are free of foreign material.
3. Lubricate equipment in accordance with manufacturer's instructions.
4. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
5. Complete piping system pressure testing and cleaning as specified in Division 15.
6. Obtain completion of applicable portions of Equipment Supplier’s Certificate of Installation.

C. Mechanical Systems: As specified in the individual equipment specification sections:

1. Remove rust preventatives and oils applied to protect equipment during construction.
2. Remove temporary supports, bracing, or other foreign objects installed to prevent damage during shipment, storage, and erection.
3. Perform cold alignment and hot alignment to manufacturer's tolerances.

4. Inspect hand and motorized valves for proper adjustment. Tighten packing glands to insure no leakage, but permit valve stems to rotate without galling. Verify valve seats are positioned for proper flow direction.
5. Tighten leaking flanges or replace flange gasket. Inspect screwed joints for leakage.
6. Install gratings, safety chains, handrails, shaft guards, and sidewalks prior to operational testing.

D. Ready-to-test determination will be made by Engineer based at least on the following:

1. Notification by Contractor of equipment and system readiness for testing.
2. Acceptable testing plan.
3. Acceptable Operation and Maintenance Manuals.
4. Receipt of Equipment Supplier’s Certificate of Installation, if specified.
5. Adequate completion of Work adjacent to, or interfacing with, equipment to be tested.
6. Availability and acceptability of manufacturer's representative, when specified, to assist in testing of respective equipment, and satisfactory fulfillment of other specified manufacturers' responsibilities.

3.3 FUNCTIONAL TESTING

A. After completion of Testing Preparation, begin testing at a time mutually agreed upon by the Owner, Engineer, and Contractor.

B. Engineer will be present during test. Notify in writing Owner, Engineer, and manufacturer’s representative(s) at least 10 days prior to scheduled date of functional tests.

C. Functionally test mechanical systems for proper operation after general start-up and testing tasks have been completed.

D. Conduct continuous 8-hour test under full load conditions. Replace parts that operate improperly.

E. Conduct functional tests as specified for each equipment item or system. Demonstrate correct function of all operational features and control functions.

F. If, in Engineer’s opinion, functional test results do not meet requirements specified, the systems will be considered as nonconforming.

G. The Startup Period testing shall not commence until the equipment or system meets the specified functional tests.

3.4 STARTUP TEST PERIOD

A. After successful completion of Functional Testing and submission of Test Reports identified below commence Startup Test Period. Startup of the entire facility shall be considered complete when, in the opinion of the Engineer, the facility or designated unit process has operated in the manner intended for 10 continuous days. A significant interruption will require the startup then in progress to be stopped and restarted after corrections are made.

B. Test Reports: As applicable to the equipment furnished, certify in writing that:

1. Hydraulic structures, piping systems, and valves have been successfully tested.
2. Facilities are ready for intended operation.

C. Schedule and lead planning meetings and arrange for attendants by key major equipment manufacturer representatives as required by the Contract Documents.

3.5 CONTINUOUS OPERATIONS

A. Owner will accept equipment and systems as substantially complete and ready for continuous operation only after successful facility startup is completed and documented, reports are submitted, O&M manuals are submitted and approved by the Engineer, and manufacturers' services completed for training of Owner's personnel excluding post startup training.

3.6 SUPPLEMENTS

A. The supplements following “END OF SECTION,” are part of this Specification.

1. Startup and Performance Evaluation Form.
2. Equipment Supplier’s Certificate of Installation.
3. Electrical, Instrumentation and Control Startup Standard Procedures.

END OF SECTION 01756

SECTION 01756

SUPPLEMENT 1
STARTUP AND PERFORMANCE EVALUATION FORM

OWNER:_____ PROJECT: _____

Unit Process Description: (Include description and equipment number of all equipment and devices):

_____

_____

_____

_____

Startup Procedure (Describe procedure for sequential startup and evaluation, including valves be opened/closed, order of equipment startup, etc.):

_____

_____

_____

_____

Startup Requirements (Water, power, chemicals, etc.): _____

_____

_____

Evaluation Comments: _____

_____

_____

_____

CONTRACTOR Certification that Unit Process is capable of performing its intended function(s), including full automatic operation:

Firm Name: _____

Startup Representative: _____ Date:_____, 20____
(Authorized Signature)

SECTION 01756

SUPPLEMENT 2

EQUIPMENT SUPPLIER'S CERTIFICATE OF INSTALLATION

OWNER_____

PROJECT _____

CONTRACT NO._____

EQUIPMENT SPECIFICATION SECTION_____

EQUIPMENT DESCRIPTION_____

_____Authorized representative of
(Print Name)

_____
(Print Manufacturer's Name)

Hereby CERTIFY that _____
(Print Equipment Name and Model with Serial Number)

_____
installed for the subject project has (have) been installed in a satisfactory manner, has (have) been tested and adjusted, and is (are) ready for final acceptance testing and operation on:

Date:_____

Time:_____

CERTIFIED BY_____
(Signature of Manufacturer's Representative)

Date:_____, 20____

SECTION 02055

SITE DEMOLITION AND SALVAGE

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes all demolition, removal and/or abandonment of existing above and below grade structures and appurtenances as designated on the drawings or as necessary to clear space for new construction and/or to rehabilitate existing construction.

B. The work specified under this section includes but is not limited to the following:

1. Demolition of designated site structures and removal of materials from site.
2. Disconnecting and capping or removal of utilities.
3. Filling or removal of underground tanks and piping.
4. Filling voids in subgrade created as a result of removals or demolition.

C. The existing equipment including pipes and fittings at the Owner’s preference shall be salvaged to the Owner. Any other equipment shall be the Contractor’s responsibility to remove and dispose or salvage offsite.

1.2 SUBMITTALS

A. Submittals shall be in accordance with the requirements of these Contract Documents and shall include the following:

1. When the material and debris resulting from the Contractor's operations are disposed of at locations off the project, the Contractor shall provide a copy of the disposal invoice or bill. The Contractor shall maintain a separate bin for recyclable construction and demolition (C&D) debris such as wood, concrete, and asphalt and a separate bin for non-recyclable debris such as large quantities of cable and wire, fiberglass insulation, PVC pipe, ice plant, and poison oak.
2. An accurate record of actual locations of all existing utilities and subsurface obstructions which are to remain in place shall be submitted to the Owner's Representative prior to final acceptance of the project.
3. Demolition and equipment removal procedures at the site shall be submitted for review and approval by the Owner's Representative. The procedures shall provide for careful removal of materials and equipment and the protection of facilities that are to remain undisturbed.
4. A time schedule for all demolition work. The schedule shall show demolition in relation to new construction, including any temporary facilities. The demolition and procedures schedule shall be submitted in accordance with Section 01300.

1.3 COORDINATION AND CONTROL

A. The Contractor shall:

1. Conform to all Federal, State, and local laws and regulations for demolition, safety of adjacent facilities, dust control, runoff control, and disposal.
2. Obtain all required permits and licenses and pay all associated fees including disposal charges.
3. Notify affected utility companies before starting work and comply with their requirements.

B. Contractor shall:

1. Not close or obstruct roadways or fire hydrants without permits.
2. Conform to applicable regulatory procedures when discovering hazardous or contaminated materials.

1.4 JOB CONDITIONS

A. Structures to be demolished shall be discontinued in use and vacated prior to start of demolition work.

B. The Owner assumes no responsibility for actual condition of the facilities or structures to be demolished. Prior to the submittal of bid, the Contractor shall visit the site and inspect all facilities to become familiarized with all existing conditions and utilities and to verify the correctness of the drawings.

C. Conditions existing at time of inspection for bidding purposes will be maintained by Owner in so far as practicable. Variations within structures may occur by Owner's removal and salvage operations prior to start of demolition work.

D. Items of value to Contractor (which are not designated by the Owner to be salvaged and delivered to the Owner) are to be removed from the site by the Contractor. Storage or sale of removed items will not be permitted on site and shall not interfere with any other work specified in the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL

A. The Contract Drawings identify the major equipment and facilities to be removed. Auxiliary utilities such as water, air, drainage, lubrication oil, electrical wiring, controls, and instrumentation are not necessarily shown. These auxiliary utilities, as well as all equipment and pipe supports and all associated instrumentation devices pertaining to piping or equipment designated to be removed shall be removed.

B. Unless otherwise specified, the Contractor shall demolish and remove below grade construction and concrete slabs on grade to a minimum depth of two (2) feet below proposed subgrade.

C. Unless otherwise shown or specified, excavation resulting from demolition and removal operations shall be backfilled with clean earth or crushed gravel and compacted to ninety five percent (95%) of maximum dry density per AASHTO T-180. Burial of debris shall be prohibited unless otherwise shown or directed.

D. Excavated areas shall be graded to adjacent existing levels and left smooth, clean, free draining and free of debris as approved by the Owner's Representative.

E. Existing structures and equipment which are damaged in appearance and/or function by performance of demolition work shall be replaced or repaired to Owner's Representative approved condition by the Contractor at no additional cost to the Owner.

3.2 PROTECTION OF EXISTING FACILITIES

A. Contractor shall provide, erect, and maintain temporary barriers and protection as necessary.

B. Existing landscaping materials, appurtenances and structures that are not to be demolished shall be protected from damage. Damage caused by demolition operations shall be replaced or repaired at no additional cost to Owner.

C. Contractor shall provide bracing and shoring as required to prevent movement or settlement of adjacent structures. Bracing and shoring shall be Contractor's design.

D. The location of all utilities shall be marked prior to demolition. Contractor shall protect and maintain in safe and operable condition the utilities to remain, and prevent interruption of existing utility service except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities as acceptable to governing authorities.

E. Contractor shall clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to conditions existing prior to the start of the work.

F. During demolition, Contractor shall conform to all Federal, State, and local laws and regulations for erosion and pollution control.

3.3 CONDUIT AND WIRING

A. All disconnected unused wiring shall be removed from the conduits back to their source and any remaining unused conduit shall be capped at a convenient location.

3.4 STRUCTURES

A. Unless otherwise noted on the drawings, existing structures designated to be removed shall be completely removed unless otherwise noted on the drawings.

B. Structures designated to be abandoned shall be removed to an elevation of at least four (4) feet below ground surface or two (2) feet below the finished subgrade, whichever is greater. The remaining void shall be filled with granular backfill material compacted to ninety five percent (95%) of maximum dry density per AASHTO T180.

C. Care shall be used in demolishing structural elements that are continuous with structural elements remaining in service. Unless otherwise permitted by the Owner's Representative, concrete and masonry shall be cut through entirely with a masonry or concrete saw before removing the unwanted portions.

D. Methods and equipment used in demolition work shall be chosen so the structural integrity and watertightness of both newly constructed and existing structures remain unimpaired by the performance of the demolition work.

E. Portions of underground structures that are in the way of new piping, and structures shall be removed from the area of conflict to a distance not less than twelve (12) inches from any closest point on the new construction.

F. Extreme care shall be used when removing existing concrete from around reinforcing steel that must be used for securing new concrete. If the reinforcing steel is damaged, the Contractor shall remove additional existing concrete until sufficient existing reinforcing steel is exposed to provide adequate embedment length in the new concrete, as approved by the Owner's Representative.

G. The Contractor shall replace, at no cost to the Owner, materials lost or damaged by negligence or by the use of improper methods.

3.5 EQUIPMENT REMOVAL

A. All equipment, valves, piping, fittings, and miscellaneous steel structures that are removed shall become the property of the Contractor unless otherwise designated by the Owner.

3.6 DISPOSAL OF DEBRIS

A. Contractor shall not allow debris and/or excess material to accumulate. All debris shall be hauled away from the site as soon as removed.

B. All debris resulting from demolition operations (i.e., broken concrete, masonry, pipe, miscellaneous metal, trees and brush, etc., as well as mechanical and electrical equipment not designated by the Owner for salvage) shall be trucked from the work site by the Contractor and disposed of at spoil sites in a legal manner, in full compliance with all Federal, State, and local laws and regulations.

C. The Contractor shall police the hauling of debris to ensure that all spillage from trucks is promptly and completely removed and cleaned up.

D. During and upon completion of the demolition and salvage operations, the Contractor shall promptly remove unused tools and equipment, surplus materials, rubbish, debris, and dust and shall leave work areas in a clean condition.

E. The Contractor shall not sweep, grade, or flush surplus materials, rubbish, or debris into storm drains, channels, lakes, or streams.

3.7 MAINTENANCE OF OWNER'S OPERATIONS

A. Demolition shall be scheduled and performed in strict conformance with these Specifications and in a manner which results in no interruption of Owner's normal operations beyond that provided for and approved by the Owner. The date and time of commencing the separate items of demolition work shall be submitted to the Owner's Representative for review, and no demolition work shall commence until the Owner's Representative's approval of date and time is given.

B. All equipment, labor and material costs which are made necessary by the requirements of the Contractor's sequence of operations shall be borne by the Contractor.

3.8 USE OF EXPLOSIVES

A. The use of explosives for the work of removal of structures and obstructions is prohibited.

END OF SECTION 02055

SECTION 02221

EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. The work covered in this section consists of structural excavation and backfill and testing necessary to construct this project as shown on the Drawings or as specified. No borrow sources or disposal sites have been designated for this project unless indicated otherwise in the general provisions.

1.2 SUBMITTALS

A. Submittals are required on all materials. The submittals shall be made at least five (5) working days prior to the time the material is required for use.

1.3 REFERENCE STANDARDS

A. American Society for Testing and Material (ASTM).

B. Standard Specifications for Construction, 2018, prepared by the California State Department of Transportation.

1.4 PROTECTION OF EXISTING FACILITIES

A. Protection of the public, adjacent facilities, contractor's personnel is the responsibility of the Contractor. Where open cuts are used the excavation slopes shall meet applicable OSHA requirements. Additionally, temporary slopes shall be no steeper than 1 vertical to 1.5 horizontal and permanent slopes shall be no steeper than 1 vertical to 2 horizontal. Cover exposed slopes if erosion threatens.

PART 2 - PRODUCTS

2.1 STRUCTURAL FILL

A. Fill for structural embankments may be made of any material from site excavation, excepting mud, silt, and clays too wet to compact, organic soils, organic debris, stone, and pieces of inorganic waste whose greatest dimension does not allow complete compaction of the material. No stone over 3-inches in any dimension shall be allowed in the embankment. No stone with broken or sharp faces shall be allowed in the embankment. Layered materials shall be processed so as to achieve a blending of dissimilar materials in the fill. In cases where the quality or

quantity of material on the site is not sufficient to form the embankment, imported borrow material shall be furnished by the Contractor. The material shall be capable of being compacted by conventional methods without weaving and heaving to a maximum dry density of 95 percent as determined by ASTM D 698.

B. Excess unusable material free from construction debris or other contaminants may be placed at locations on site designated by the Engineer. Contaminated material shall be removed and disposed of offsite.

C. Imported borrow material used for embankment fill shall be material meeting the requirements of Paragraph A in addition to the following: a minimum of 10% of the material shall pass the No. 40 sieve and a minimum of 50% of the material shall be larger than the No. 40 sieve. Pit "reject" material meeting these requirements is acceptable.

D. Engineer reserves the right to control the areas excavated and the placing of materials to ensure the most satisfactory construction.

E. Excavation Material. The Contractor shall make his or her own deductions and conclusions as to the nature of the materials to be excavated and the difficulties that may arise from subsurface conditions.

2.2 CRUSHED BASE ROCK

A. Material shall be 3/4 –inch Class 2 Aggregate Base in accordance with Section 26 of the Caltrans Standard Specifications.

2.3 STABILIZATION ROCK

A. Stabilization rock shall consist of ±1 to 4-inch minus well-graded crushed, angular gravel or rock with no more than ±15% passing the #40 U.S. Sieve.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clearing and grubbing: Remove trees, shrubs, brush, topsoil and organic soils exposed in excavations within the limits of the fill placement. Properly protect trees and shrubs which are not to be cut, from damage. Remove stumps entirely. Grub out roots and matted roots to at least 18 inches below the existing surface; grub all surface vegetation and roots from beneath the fill area. Dispose of brush, refuse, stumps, roots, and unmerchantable timber off site. All clearing to be done mechanically; no spraying shall be allowed. Topsoil, suitable for landscaping operations, may be stockpiled for future use at a location approved by the Engineer.

B. Stripping in embankment, paved or gravel surfaced areas or beneath structures shall consist of removing near surface plants, root matter, topsoil and other organics.

C. Low-lying areas shall be drained prior to placing fill.

D. Refuse from the clearing and grubbing operations shall be removed from the site within 10 days of the clearing and grubbing operations, or as directed by the Engineer. Disposal shall be the responsibility of the Contractor and shall be in accordance with applicable ordinances and environmental requirements.

E. The Contractor shall protect moisture sensitive material to be used as fill or to serve as a base for fill or foundations. The Contractor shall replace materials made unsuitable by moisture with imported borrow material at no cost to the Owner.

F. Protection of adjacent work must be accomplished. Properly slope cuts to provide stability. Temporary cuts should be no steeper than one vertical to one horizontal. Permanent slopes should be no steeper than one vertical to two horizontal. Cover exposed slopes if erosion or raveling threatens.

G. Stockpiling of Excavated Materials. Unless covered, excess native material is to be spread in such a manner so as to not stockpile material on site. Non-native excavated material not suitable for use in construction is to be hauled offsite. Stripping and stockpiling of reusable materials shall be carefully segregated into well-defined stockpiles.

3.2 PREPARATION OF SUBGRADE

A. After stripping and excavating to final grades, but before any new fill is installed, all building, pavement and fill areas shall be inspected by the Engineer. If the material is loose, wet or does not meet the requirements for placement of the fill material the surface shall be scarified to a depth of at least eight inches. The scarified soil should be aerated as necessary and then compacted to at least 95% relative compaction (ASTM D 698). Soft or wet areas that cannot be effectively dried and compacted shall have all unsuitable material removed, replaced with fill material in accordance with these specifications.

3.3 EMBANKMENT CONSTRUCTION

A. Grub areas of roots, buried vegetable matter and debris in accordance with paragraph 3.1.

B. Pump standing water from low areas to receive embankment construction.

C. Sprinkle and aerate fill materials as required.

D. Embankment Construction

1. Constructed to the lines, grades and cross-section shown on the plans.

2. Build by mechanical excavating and hauling equipment.

3. Compacted in horizontal layers not to exceed ten (10) inches.

4. Regardless of method used, fill shall be carried approximately level across entire to be filled.

5. Fill shall be brought out to required slope width.

6. Use of loose material to widen fill areas will not be permitted.

7. Areas found to be inadequate width at any time shall be removed and replaced to proper width.

8. Slopes of fill areas shall be bladed and dressed to cross-sections shown on plans.

3.4 COMPACTION

A. Contractor shall provide compaction equipment as required to do the compaction specified herein.

B. Fill and native subgrade shall be compacted for their full depth, length, and width to at least 95% of ASTM D 698.

C. Tests for density of compacted material shall be made by the Contractor as specified in 3.7. This frequency may be increased at the option of the engineer if tests fail. Deficiencies shall be corrected by the Contractor at the Contractors expense.

D. Testing shall be done at expense of Contractor.

E. No additional compensation will be made for evacuating standing water from embankment areas prior to fill placement, for evacuating water from the bottom of any structures during and after embankment liner or fill placement, or for the hauling and disposing of waste material or wasting unsuitable material.

3.5 EXCAVATION BELOW GRADE

A. Excavation Material. The Contractor shall make his own deductions and conclusions as to the nature of the materials to be excavated and the difficulties that may arise from subsurface conditions

B. Unless otherwise indicated, excavate at least 12-inches below the base of structure to provide for base stabilization. Place and compact a clean, free-draining, angular crushed base rock. Compact with light hand-operated equipment to reduce disturbance of the subgrade. Compact all fill and native subgrade to a minimum of 95% of maximum dry density per ASTM D698.

C. Unless otherwise specified, any appropriate method of excavation within the work limits shown may be employed which, in the opinion of the Contractor, is considered best, and meets applicable safety standards. The Contractor shall take whatever precautions are necessary to maintain the undisturbed state of the natural soils at and below the bottom of the excavation.

D. Where, in the opinion of the Engineer, the undisturbed condition of the natural soils below the excavation grades indicated or specified is inadequate to meet the specified compaction or maximum dry density, the Contractor shall overexcavate to adequate supporting soils and refill the excavated space to the proper elevation in accordance with the procedure specified for backfill. If the excavation exceeds by more than 1 foot the elevations shown on the drawings or identified in the soils investigation, then the excess will be paid for as extra work in accordance with the general conditions.

E. Should the excavation be carried below the lines and grades indicated on the drawings or specified herein because of the Contractor's operations, the Contractor shall refill such excavated space to the proper elevation as directed by the Engineer. Should foundation materials be disturbed or loosened because of the Contractor's operations, they shall be removed and the space refilled as directed at no additional cost to the Owner.

3.6 DISPOSAL OF EXCAVATED MATERIAL

A. Disposal shall comply with all Local, State and Federal requirements.

3.7 TESTING

A. The Contractor shall test for compaction in accordance with Caltrans CTM 231.

B. Testing frequency

1. Rearing channel: select a minimum of three nonbiased test sites. This includes test of the aggregate base below all individual structure slabs.

C. In the event that the original tests do not comply with the requirements of the specifications, additional compaction shall be performed or the fill shall be replaced with fill that does comply.

D. Material not meeting the compaction requirements shall be made to meet the requirements prior to any additional fill placed in the area not meeting the requirements.

END OF SECTION 02221

SECTION 02222

EXCAVATING, BACKFILLING AND COMPACTING FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. The work covered in this section includes but is not limited to site inspection, utility location, unclassified excavation, dewatering, shoring, bedding, backfilling, compacting, grading, cleaning and testing of utility trenches for pipes and structures.

1.2 LABOR AND SAFETY STANDARDS

A. All work to be done in accordance with these specifications and the requirements of Cal/OSHA.

1.3 REFERENCE STANDARDS

A. American Society for Testing and Material (ASTM).

B. Standard Specifications for Construction, 2018, prepared by the California State Department of Transportation.

1.4 SUBMITTALS

A. Before excavation, Contractor shall submit dewatering plans if standing or flowing water is at the site. The dewatering plan shall in accordance with specified erosion control requirements, and state and federal requirements. The dewatering plan shall also include provisions for desilting prior to release.

B. Submit material gradation and proctor test results of proposed fill materials prior to their use on site.

1.5 PROJECT CONDITIONS

A. Protection: Protect the opened trench and open pipe end against the intrusion of water and soil when stopping work for the day.

B. Notify all affected utilities at least 48 hours in advance of actual excavation.

C. Field locate all existing utilities prior to beginning construction.

PART 2 - PRODUCTS

2.1 CRUSHED BASE ROCK

Material shall be 3/4 –inch Class 2 Aggregate Base in accordance with Section 26 of the Standard Specifications. The material shall be capable of being compacted by conventional methods without undue weaving and heaving to a maximum dry density of 95 percent as determined by ASTM D 698.

2.2 STRUCTURAL FILL

A. Native or imported material meeting the requirements of paragraph 2.1 of SECTION 02221 - EARTHWORK.

2.3 NATIVE BACKFILL MATERIAL

A. Native backfill may consist of native excavated material excepting mud, silt and clays too wet to compact, organic soils, organic debris, stone and pieces of inorganic waste whose greatest dimension does not allow complete compaction of the material. No stone over 3 inches in any dimension shall be allowed. No stone with broken or sharp faces shall be allowed in the backfill where placed against pipes, structures, near the surface or other vulnerable objects.

2.4 FOUNDATION STABILIZATION

A. Stabilization rock shall consist of ±1 to 4-inch minus well-graded crushed, angular gravel or rock with no more than ±15% passing the #40 U.S. Sieve.

PART 3 - EXECUTION

3.1 SITE INSPECTION AND UTILITY LOCATION

A. The Contractor shall inspect the site before starting work. The documents shall be examined and checked with the field layout to correct any and all discrepancies which may exist.

1. The general location of all known underground utilities and other property likely to be encountered in excavation has been shown on the plans. This data has been compiled from the best available sources but is to be used for informational purposes only and accuracy is not guaranteed. The Contractor shall be responsible for contacting and working with the Owner of the particular utility or property involved to determine its exact location during construction. The Owner of the utility shall repair all damage to existing facilities at the Contractors expense. Adequate provisions shall be made for maintaining the flow of existing drains and water courses encountered during construction.
2. All costs to rectify conflicts due to failure to verify possible conflicts, shall be the Contractor's responsibility.

3.2 EXCAVATION AND TRENCHING

A. The Contractor shall do all excavation of whatever substance is encountered to the lines and grades required. Where unexpected objects, such as stumps, railroad ties, buried pavement, and the like, are encountered in the trench excavation, they shall be removed and disposed of by the Contractor. In cases where they can be removed by the same equipment or method at hand for excavation, and where it is unnecessary to employ special equipment, install shoring or bracing, or to increase the trench width or depth more than 2 feet for any one object, then in that event the removal of such obstructions shall be considered as an incidental part of the Contractor's work and no additional payment will be made therefore. No more than 50 feet of open trench shall be excavated in advance of laying of pipe outside of the rearing channel.

1. Excavation dimensions and trench sections: The bottom of the trench shall be carried to the lines and grades required with proper allowance for thickness of pipe, manhole, or structure, floor and bedding used. Trench walls shall be vertical from the trench bottom to at least 6 inches above the top of the pipe. Trench bottom width shall be as shown on the drawings. In all cases, trench must be of sufficient width to permit proper jointing of the pipe and backfilling and compacting 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 using boxes, shoring, sheeting or other means that may be necessary. Excavation for drains and other structures shall provide a minimum of 12 inches between their surfaces and the sides of the excavation.

2. Except where removal of unsuitable material is authorized by the Engineer, trench excavation beyond the limits authorized in plans and specifications and any additional costs associated with the excess excavation shall be at the Contractor's expense. Additional costs may include but are not limited to additional and/or higher quality bedding, heavier pipe, additional backfill, and additional surface restoration costs.

B. Excavation support system (if necessary) shall be designed, fabricated, installed, maintained, and removed in such a manner as to protect workers, the required excavation section, existing property, structures, utilities, pavements, and the like, and to maintain the undisturbed state of soils adjacent to excavation and at and below the excavation bottom. Support systems shall also be adequate to support static and dynamic loads incident to structures, traffic and construction activity adjacent and proximate to the work. If the Contractor elects he may use a combination of shoring, tunneling, boring, sliding trench shields or other methods of accomplishing the work provided the method meets with the approval of all applicable local, state and federal safety codes.

C. The Contractor shall be solely responsible to determine the nature and extent of excavation support required in any and all portions of the project, and any damage resulting from inadequate excavation support shall be restored at the expense of the Contractor.

D. That portion of the excavation support system extending below the spring line of rigid pipe, or below the crown elevation of flexible pipe, shall be left in place unless satisfactory means of recompacted bedding or side support, disturbed by support system removal, can be demonstrated. If a movable box is used in lieu of cribbing or sheeting, and the bottom cannot be kept above the spring line of rigid pipe or the crown elevation of flexible pipe, the bedding or side support shall be carefully recompacted behind the movable box, prior to placing backfill.

E. Temporary storage of excavated materials: All excavated material shall be piled in an orderly manner at a sufficient distance (per state and federal requirements) from the trench to prevent overloading, sliding into the trench, or other occurrences which could endanger the excavation. Material shall be placed in such a manner as will cause minimum inconvenience to public travel, will provide unrestricted access to fire hydrants, water meters, and the like, and will not impede the flow in natural and man-made drainage courses and/or structures.

F. Disposal on site of excess native material: Native material excavated from trench areas may be placed at designated areas on site. Such material shall be spread out daily. Disposal areas shall be seeded at the end of the project with a native seed mix approved by the Engineer. Non-native excavated material not suitable for project use shall be hauled off-site unless otherwise directed by the Engineer.

3.3 DEWATERING

A. No dewatering is expected during trench excavation. Should heavy rains occur during the construction period that result in water being encountered during trench excavation, the work may be halted until the saturated soil drains out.

B. The Contractor shall be responsible for all costs of temporary power.

C. During excavating, construction of drains, installation of pipelines, placing trench backfill and the placing and setting of concrete, excavations shall be kept free of water. The Contractor shall control surface runoff so as to prevent entry to, and collection of, water in excavations.

D. The Contractor shall construct and maintain temporary pipes required during the construction period as necessary to provide drainage of the site to permit continuous progress of, or to prevent damage to installed works or the work of others. All costs involved in the control of site drainage during construction shall be included in and incidental to the cost of the project.

3.4 UNSUITABLE MATERIAL REMOVAL AND REPLACEMENT

A. Unsuitable materials include but are not limited to peat, soils with high organic content, and other soft, loose, saturated, and/or disturbed soils. Removal of unsuitable material below the trench bottom shall not be authorized without prior approval of the Engineer.

B. When unsuitable material is encountered at or below the trench bottom, it shall be excavated to a depth specified by the Engineer and backfilled with stabilization material. The material shall be placed in lifts of 8 inches maximum thickness. Each layer shall be fully compacted prior to placement of subsequent layers. The Engineer reserves the right to specify an alternate trench section in lieu of the over-excavation procedure described above.

C. Unsuitable material shall be disposed of by the Contractor within 5 working days of the time of excavation, except in or adjacent to roadways or other improved areas where it shall be disposed of within 24 hours of excavation.

3.5 BEDDING

A. Bedding material shall consist of crushed base rock. Should existing bedding material appear suitable for use with new pipe material, samples may be sent to a materials testing lab to establish whether the material meets requirements in Section 2.1 of this specification.

B. Bedding material shall be placed after the bottom of the trench or excavation has been excavated to the proper depth and grade and the bottom is brought to a reasonably flat surface and dewatered. Bedding under manholes and pipe shall be placed to uniformly support the entire bottom of the manhole or pipe.

C. During bedding operations, all necessary measures shall be taken to prevent damage to the pipe and to maintain the pipe within the line and grade tolerances specified in the Caltrans Standard Specifications. Bedding shall be placed in loose lifts of 6-inch maximum depth and compacted to at least 95% of the maximum dry density as determined by ASTM D698. Each layer shall be fully compacted before subsequent layers are placed. Bedding shall be placed, compacted, and shaped to conform to the barrel of the pipe, with allowance for bells and other appurtenances, to ensure firm and continuous support for the entire length of pipe. Additional bedding required because of unauthorized excavation outside the specified limits shall be provided at the Contractor's expenses.

D. Bedding shall be handled and placed in the trench or excavation in such a manner as to prevent cave-in of trench or excavation walls or contamination with excavated material. Bedding that becomes contaminated by these or similar occurrences such that it contains prohibited substances or does not meet gradation requirements, shall be removed, disposed of, and replaced by the Contractor at Contractor’s own expense.

3.6 PIPE ZONE BACKFILL

A. Pipe zone backfill material shall be either structural fill or crushed base rock.

B. Pipe zone backfill shall be placed after the pipe has been installed, alignment and grade checked and the inside checked for possible obstructions. Place the pipe zone backfill carefully to prevent damage to the pipe. Ensure the pipe zone backfill is in contact with the entire periphery of the pipe.

C. Pipe zone backfill shall be placed in loose lifts with a maximum thickness of 6 inches and compacted to at least 95% of the dry density as determined by ASTM D 698. Side fill shall be brought up evenly on both sides of the pipe to prevent lateral movement. Each lift shall be fully compacted before subsequent fill is placed

3.7 TRENCH BACKFILL

A. Trench backfill materials

1. Within 10 feet of structures and in areas subject to vehicular traffic: material shall be structural fill or crushed base rock compacted to at least 95% of the dry density as determined by ASTM D 698.

2. Unimproved areas not subject to vehicular traffic: material shall be native backfill material or structural fill compacted to at least 90% of the dry density as determined by ASTM D 698.

B. Trench backfill shall be placed in loose lifts of 10 inches maximum thickness and compacted as specified.

C. **All backfill and compaction operations shall be completed on the same day as pipe laying.**

3.8 FINAL TRIMMING, CLEANUP, AND REPAIR

A. Final trimming, cleanup, and repair shall include but is not limited to the following: grading, cleaning, disposal of excess excavated material including rock and pavement, and repair of utilities, structures, culverts, pavements, and private property damaged or disturbed by the Contractor during construction or associated activities.

B. All irregularities shall be made smooth, washouts shall be filled, slopes made uniform, slightly rounded at top and bottom, and the entire area of the fill compacted and completed to the required lines, grades, and cross sections. Erosion control devices shall be installed as specified.

C. The Contractor shall clean up as the work progresses, and shall maintain his operations in a neat and orderly manner. Surplus excavated material, stumps, trees, brush, excavated rock, unsuitable material and other debris shall be disposed of promptly. Roadway surfaces shall be thoroughly cleaned.

D. Water service, sewer lines, sanitary service laterals and culverts which are unearthed, undermined, or damaged as a result of the Contractor's operations shall be repaired or, if necessary, replaced by the Contractor at his own expense. The Contractor shall notify the Engineer of each water or sewer line and its location. The Contractor shall repair all damage and complete the repair immediately if leakage of water or sewage is occurring. Upon completion of the repair, the Engineer shall be notified and shall inspect the repair prior to backfilling. Reconnection to an existing water main or service shall be made only at times that the Engineer is present, unless otherwise specified.

E. Unless specified otherwise, all trimming, cleanup, and re-pair shall be accomplished within 10 working days from the time that the trench was initially excavated.

F. If the Contractor fails to comply with these requirements within 24 hours after receiving written notice from the Engineer, others will be engaged to do such work and the total expense involved shall be deducted from the Contractor's payment.

3.9 TESTING

A. The Contractor shall furnish and pay for density tests showing compliance with the requirements of the specifications and drawings.

B. Density tests shall be performed for every 100 feet of trench. One of every three tests shall be below half trench depth. Tests shall be performed at locations selected by the Owner’s site representative. See Section 01400, Quality Control, for additional testing requirements.

C. In the event the original tests do not comply with the requirements of the specifications, additional compaction shall be performed or the fill shall be replaced with fill that will comply. Additional tests for the repaired areas shall be paid for by the Contractor, for either the fill or the tests. This process shall be repeated until the compaction complies with the specifications.

END OF SECTION 02222

SECTION 02270

EROSION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. The work included in this section consists of construction of temporary erosion control measures as specified and as shown on the Drawings.

1.2 SUBMITTALS

A. The Contractor shall submit manufacturer's data on all products to the Engineer prior to ordering materials.

PART 2 - PRODUCTS

2.1 SILT FENCE

A. The temporary silt fence system shall be the "Envirofence" silt fence system manufactured by Mirafi, Inc., or equal.

2.2 WATTLES

A. Compost sock shall be FilterSoxx, manufactured by Filtrexx International LLC, or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. All erosion control products and materials will be installed and maintained in accordance with Section 21 of the Caltrans Standard Specifications, the manufacturer's recommendations and as shown on the plans.

B. All sediment barriers shall remain in place until completion of the project, at which time they shall be removed by the Contractor.

END OF SECTION 02270

SECTION 02510

SURFACE RESTORATION

PART 1 - GENERAL

1.1 SUMMARY

A. The work covered by the section consists of surface restoration for utility and structure excavation.

1.2 REFERENCE STANDARDS

A. American Society for Testing and Material (ASTM).

B. Standard Specifications for Construction, 2018, prepared by the California State Department of Transportation.

1.3 SUBMITTALS

A. Submit material gradation and proctor test results of proposed aggregates prior to their use on site.

PART 2 - PRODUCTS

2.1 AGGREGATE SURFACE COURSE

A. Material shall be 3/4 –inch Class 2 Aggregate Base in accordance with Section 26 of the Standard Specifications.

2.2 SEED

A. If required by the Engineer, disturbed areas shall be hydroseeded with native seed appropriate to the Carmel Valley or as approved by the Engineer.

PART 3 - INSTALLATION

3.1 CRUSHED ROCK RESTORATION

A. All graveled roadways, graveled shoulders, graveled driveways, areas shown on the Drawings, or as required by the Engineer shall be restored using crushed rock as shown on the Drawings.

1. Surfacing shall have a compacted depth as shown on the Drawings. Compaction shall be to 95% of ASTM D 698.
2. Material shall be placed on undisturbed subgrade.
3. The finished surface shall be smooth and level with the surrounding surfacing.
4. Settlement of 1/2-inch or greater in graveled areas within one year of completion will require repair and regrading as directed by the Engineer at the Contractor's expense.

3.2 TESTING

A. Compaction testing of rock surfacing shall be done every 100 square yards of surface area, or fraction thereof.

B. All testing reports shall be furnished and certified by a certified testing laboratory; see Section 01400 or the General Provisions.

END OF SECTION 02510

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: If not as shown in the design pans, provide Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Construction Joint Layout: If not as shown in the design plans, indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Engineer.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer and manufacturer.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Waterstops.
6. Curing compounds.
7. Vapor retarders.
8. Semirigid joint filler.
9. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates**:** Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.

1. For any temporary shoring of rearing channel walls: Indicate proposed schedule and sequence of formwork and shoring removal.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: The Contractor shall engage a qualified testing agency to perform preconstruction testing on concrete mixtures. Each day that concrete is delivered to the

site or mixed on site, a minimum of one field test for temperature and slump and one laboratory test for compressive strength shall be conducted.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.9 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301.
2. ACI 117.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

F. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

G. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

H. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

2.4 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C 150/C 150M, Type I/II, gray.
2. Fly Ash: ASTM C 618, Class F.
3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
4. Silica Fume: ASTM C 1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 1N coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C 260/C 260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
7. Water proofing: Xypex Admix C-500.

F. Water: ASTM C 94/C 94M and potable.

2.6 WATERSTOPS

A. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Sika Greenstreak or approved equal.
2. Profile: Ribbed with center bulb.
3. Dimensions: 4 inches by 3/16 inch thick; nontapered.

B. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

1. Sika Hydrotite or approved equal.

2.7 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Use water filtered through the SHSRF RAS building or import potable water.

D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Dayton Superior Clear Cure VOC J7WB or approved equal.

2.8 RELATED MATERIALS

A. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, according to ASTM D 2240.

2.9 REPAIR MATERIALS

A. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150/C 150M, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.10 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

C. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Normal-weight concrete.

1. Minimum Compressive Strength: 4500 psi at 28 days.
2. Maximum W/C Ratio: 0.45.
3. Minimum Cementitious Materials Content: 560 lb./cu. yd. for 3/4-inch nominal maximum aggregate size.
4. Minimum Cementitious Materials Content: 535 lb./cu. yd. for 1-inch nominal maximum aggregate size.
5. Minimum Cementitious Materials Content: 515 lb./cu. yd. for 1-1/2-inch nominal maximum aggregate size.
6. Air Content: 4.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
7. Air Content: 5 percent, plus or minus 1.5 percent at point of delivery for 1-inch or 3/4-inch nominal maximum aggregate size.

2.12 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.

2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class B, 1/4 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.4 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.6 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
3. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
4. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to 1 inch as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

3.7 WATERSTOP INSTALLATION

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.8 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.9 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view.

C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to all floor and slab surfaces.

3.11 MISCELLANEOUS CONCRETE ITEM INSTALLATION

A. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.

3.12 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb./sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.
b. Continuous water-fog spray.
c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

3.13 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
5. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
6. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and

loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

G. All concrete surface repairs shall be coated with a slurry of Xypex concentrate.

3.15 FIELD QUALITY CONTROL – not applicable. No Special Inspections required.

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

END OF SECTION 03300

SECTION 15050 – PROCESS WATER SYSTEMS BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to process water piping and equipment systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Concrete bases.
11. Supports and anchorages.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts and spaces above ceilings.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. HDPE: High density polyethylene plastic.
2. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

C. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

D. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

E. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual piping Sections for pipe, tube, and fitting materials and joining methods. Where no joining method is indicated follow manufacturer recommendations.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual piping Sections for special joining materials not listed below. Where no joining materials are indicated follow manufacturer recommendations.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Available Manufacturers:

a. Dresser Industries, Inc.; DMD Div.
b. JCM Industries.
c. Romac Industries
d. Smith-Blair, Inc.
e. Viking Johnson.

2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
4. Thermal Expansion Couplings: AWWA C221, Romac EJ400 Series or equal
5. Aboveground Pressure Piping: Pipe fitting.

B. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Available Manufacturers:

a. Fernco, Inc.
b. Mission Rubber Company.
c. Plastic Oddities, Inc.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Available Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.

d. Hart Industries, International, Inc.
e. Watts Industries, Inc.; Water Products Div.
f. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
1. Available Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:

a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Metraflex Co.
    d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

    1. Finish: Polished chrome-plated and rough brass.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping to permit valve servicing.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    c. Insulated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with concealed hinge and set screw.
    f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough brass finish.
    g. Bare Piping in Equipment Rooms: One-piece, cast-brass type with rough brass finish.
    h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

K. Sleeves are not required for core-drilled holes.

L. Install sleeves for pipes passing through concrete floor slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

      a. Steel Pipe Sleeves: For pipes smaller than NPS 6.

   4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint.

M. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

   1. Install steel pipe for sleeves smaller than 6 inches in diameter.
   2. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

N. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

   1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

O. Verify final equipment locations for roughing-in.

P. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 42 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to ASW's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

J. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fitting according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fitting according to ASTM D 2855.
3. PVC Nonpressure Piping: Join according to ASTM D 2855.

K. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

L. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

M. HDPE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

B. Where indicated on the drawings or schedules, paint exterior exposed PVC pipe with two coats of Acrylic latex paint, minimum dry film thickness of 4 mils each coat for UV protection.

3.6 IDENTIFICATION

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.

1. Stenciled Markers: According to ASME A13.1.
2. Plastic markers, with application systems. Install on insulation segment if required for hot noninsulated piping.
3. Locate pipe markers on exposed piping according to the following:

    a. Near each valve and control device.
    b. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.
    c. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.
    d. At manholes and similar access points that permit view of concealed piping.
    e. Near major equipment items and other points of origination and termination.

B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.

1. Lettering Size: Minimum 1/4 inch high for name of unit if viewing distance is less than 24 inches, 1/2 inch high for distances up to 72 inches, and proportionately larger lettering

for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.

2. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

C. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

3.7 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions, where indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Unless otherwise indicated, use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section 033000 – Cast-in-Place Concrete.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Section 05120 – Structural Steel for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.10 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 15050

SECTION 15110

PROCESS WATER SYSTEMS VALVES AND GATES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The work covered by this section consists of furnishing labor, materials, and equipment required to provide and install process water systems valves and gates as shown on the Drawings and as specified.

1.2 REFERENCE STANDARDS

Reference	Title
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings ASTM A48-83 Gray Iron Castings
ASSE 1060	Performance Requirements for Outdoor Enclosures for Backflow Prevention Assemblies
ASTM A108	Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A216/A216M	Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service
ASTM A276	Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A351	Standard Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure Containing Parts
ASTM A436	Austenitic Gray Iron Castings
ASTM A536	Ductile Iron Castings
AWWA C500	Metal-Seated Gate Valves for Water Supply Service
AWWA C504	Rubber-Seated Butterfly Valves
AWWA C508	Swing-Check Valves for Waterworks Service, 2 In. through 24 In. NPS
AWWA C509	Resilient Seated Gate Valves for Water Supply Service
AWWA C510	Double Check Valve Backflow Prevention Assembly
AWWA C511	Reduced-Pressure Principle Backflow Prevention Assembly

1.3 SUBMITTALS

A. Manufacturer's product data, catalog cuts, or shop drawings describing construction, pressure classification, end connection, dimensions, weights, and materials. Include a list indicating each valve and its application.

B. Affidavits of compliance with AWWA C504 for butterfly valves.

C. Operation and maintenance information for each type of valve and operator.

D. Hydrostatic test results.

1.4 DELIVERY, STORAGE AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set gate valves closed to prevent rattling.
4. Set butterfly valves closed or slightly open.
5. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use slings to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

1.5 QUALITY ASSURANCE

A. Backflow preventers shall meet the factory and field test provisions of AWWA C510 or C511.

PART 2 - PRODUCTS

2.1 GENERAL

A. Valves shall be manufacturer's standard design unless otherwise specified and shall be furnished with operating wheel, wrench nut or lever. Unless otherwise indicated, the direction of rotation of the wheel, wrench nut or lever to open the valve shall be to the left (counter-clockwise) and shall have cast thereon the word OPEN. Unless otherwise specified or shown on the drawings, 2-1/2 inch or larger buried valves shall have nonflanged ends, 2-1/2 inch or larger exposed valves shall have flanged ends, and 2 inch or smaller valves shall have threaded ends. Flanges shall conform to ANSI B16.5. A union, flanged, grooved or shouldered type connection shall be provided within 2 feet of each threaded end valve unless the valve can be otherwise easily removed and such technique of removal is approved by the Owner’s Representative. Exposed valves four-inch and smaller shall have lever operators with 10-position stops. Exposed valves 2-inch and smaller shall be ball valves or globe valves as designated on the Drawings.

B. Valves of the same type shall be from a single manufacturer. Valves three inch and larger shall be identified with labels.

C. All buried valves shall have restrained end connections to match the pipe system shown on the drawings and specified in Section 15200 – Process Piping Systems.

2.2 BUTTERFLY VALVES

A. Butterfly Valves to be used in exposed conditions for flow control to fish process water systems shall be Hayward BYV or equal specified as follows.

B. All thermoplastic wafer-style butterfly valves shall be manufactured from PVC Type 1, Grade 1 (ASTM D1784, Cell Classification 12454) or glass filled Polypropylene (ASTM D4101, Cell Classification 85580). All valve bodies shall contain integral top mounting flange with dimensions and bolt circles conforming to ISO 5211. Bodies shall contain fully supported flange bolt holes, be one piece construction and meet ANSI B16.10 narrow face-to-face dimensions in all sizes. If LUGGED butterfly valves are required, lugs shall be over-molded, 316 stainless steel and be the full width of the body. Liners shall be EPDM, Viton® or Nitrile. Liner shall be FULL BOOT design, and shall be retained in the body via rib and groove engagement. Liner shall serve as primary disc seal and face seals for mating flanges. Secondary upper bearing and lower seal retainer o-ring seals to be EPDM or FPM. Stem shall be 316 stainless steel, non-wetted and provide full engagement over length of disc. Stem shall have position retention design.

C. Lever handle shall be trigger-style with 360° interlocking splines allowing the handle to position the disc in 5° increments. Mounting of stop plate for lever handle shall be non-invasive to the valve body and shall not incorporate self-tapping screws or other fasteners that connect directly to the valve body. Trigger shall contain hole for padlock, as well as slot for cable tie, to lockout valve. Lever handle material to be 30% glass filled Polypropylene with UV Inhibitor. Lever operated valve stem extensions, where required on the Contract Drawings, shall be supplied by the valve manufacture as a complete assembly to the height required to meet installation requirements.

D. Sizes 2″ through 8″ will be lever-operated as standard, and sizes 10″ and 12″ will be gear-operated as standard. Gear operators will be available for all sizes of valves as needed. All sizes of butterfly valves (2″ through 12″) shall be pressure-rated for 150 PSI at 70°F non-shock.

E. All butterfly valves shall carry a two-year warranty, and shall be manufactured by Hayward Flow Control products or equal.

2.3 BALL VALVES

A. Process water valves 2-inch and smaller shall be true union ball valves, PVC body and ball, EPDM seals, rated for 150 psi operating pressure at 75 degrees F, Asahi America, Hayward, George Fischer or approved equal.

B. Ball valve stem extensions kits shall be supplied by the valve manufacture where indicated on the Contract Drawings. The PVC pipe extension shall be supplied by the contractor to the height required to meet installation requirements.

2.4 SWING CHECK VALVE WITH LEVER AND SPRING

A. Materials of construction shall be as follows:

Component	Material
Class B Flanged Body	Cast iron, ASTM A126, Class B
Disc	Cast iron, ASTM A126, Class B
Seat rings	Stainless steel,
Hinge shafts and hinge pins	Stainless steel, 18-8
Spring	Steel

B. Valve body shall be full water way design, with replaceable stainless steel body seat.

C. The valve shall have external lever and spring to assist valve closure.

D. Manufacturer: Golden Anderson 230, or approved equal.

2.5 AIR VALVES

A. Pump Air and Vacuum Valve:

1. Regulate the exhaust of air on pump start-up, and admit air to protect against vacuum conditions in the pipeline.
2. Dual port design, with an adjustable air discharge regulator port and a separate vacuum port.
3. Air/vac valve shall be Valmatic VMC-100S or approved equal.
4. Materials of construction

    a. Body, Cover: Cast iron, ASTM A 126, Grade B.
    b. Float: Stainless steel, T316.
    c. Seat: Buna-N.
    d. Exterior Paint: Alkyd primer.

2.6 OPERATORS

A. Except as specified in valve and gate specification sections, manual operators shall be as specified herein. Operators shall be mounted on the valve, damper or gate and provided as a unit. Each valve body or operator shall have cast thereon the word "OPEN," an arrow indicating the direction to open, and flow direction arrows.

B. Manual Operators - General: Manual operators shall have operating torques less than 80 foot-pounds. Unless specified otherwise, each manual operator shall be provided with an operating wheel. Unless specified otherwise, the direction of rotation of the operator shall be counterclockwise for opening.

C. Wrench Nuts: Wrench nuts shall comply with Section 3.16 of AWWA C500. A minimum of two operating keys, but no less than one key per every ten valves, shall be provided for operation of the wrench nut operated valves.

D. Chain Wheels: Chain wheels shall be ductile iron. Operating chains shall be galvanized.

PART 3 - EXECUTION

3.1 GENERAL

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Valves shall be installed where indicated on the Drawings, and in accordance with the manufacturer's recommendations.

C. Gate valves shall be installed in the closed position.

D. Manufacturer’s authorized representative shall be available for customer service during installation and start-up and to train personnel in the operation, maintenance, and troubleshooting of each valve type.

E. Valve operators shall be located so that they are readily accessible for operation and maintenance. Valve operators shall be mounted for unobstructed access, but mounting shall not obstruct walkways. Valve operators shall not be mounted where shock or vibration will impair their operation. Support systems shall not be attached to handrails, process piping, or mechanical equipment.

3.2 OPERATORS

A. General: Valves and gates shall be provided with manual operators, unless specified otherwise. Where possible, manual operators shall be located between 48 inches and 60 inches above the floor or a permanent work platform.

B. Wrench Nuts: Wrench nuts shall be provided on buried valves, on valves which are to be operated through floor boxes, and where specified. Extended wrench nuts shall be provided if necessary so that the nut will be within 6 inches of the valve box cover.

C. Chain Wheels: Unless otherwise specified, valves with centerlines more than 7 feet, 6 inches above the specified operating level shall be provided with chain wheels and operating chains. Chain wheel operated valves shall be provided with a chain guide. Operating chains shall be looped to extend within 4 feet of the specified operating level below the valve. For plug-type valves 8 inches and larger, the operator shall be provided with a hammer blow wheel. Hooks shall be provided for chain storage where the chain may hang in a walkway.

3.3 PAINTING

A. Exposed valving and fittings shall be factory epoxy coated or standard factory coating.

END OF SECTION 15110

SECTION 15200

PROCESS PIPING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. The work covered by this section consists of utility and process piping systems. The systems shall include piping, fittings, hangers, couplings, and connections to equipment. Building domestic and sanitary plumbing shall be as specified in this section. Valves are specified in section 15110. Electrical conduits shall be as specified in Division 16.

B. All work performed under this section shall be in accordance with all approved trade practices and manufacturers' recommendations.

1.2 REFERENCE STANDARDS

Reference	Title
ANSI A13.1	Scheme for the Identification of Piping Systems
ANSI B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings
ASTM A74	Cast Iron Soil Pipe and Fittings
ASTM A403/A403M	Wrought Austenitic Stainless Steel Piping Fittings
ASTM D1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-Series)
ASTM F679	Poly (Vinyl Chloride) (PVC) Plastic Drain Pipe –Large Diameter
AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	Ductile-Iron and Gray-Iron Fittings, 3 Inch Through 48 Inch, for Water
AWWA C111	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C115	Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast for Water
AWWA C200-05	Steel Water Pipe – 6 in. and Larger
AWWA C227	Bolted, Split Sleeve Couplings for Plain End Pipe.
AWWA C651	Disinfecting Water Mains

AWWA C900/905	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings
AWWA C906-07	Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 63 In. (HDPE)
Handbook of PE Pipe	Plastic Pipe Institute (PPI) Handbook of Polyethylene Pipe for applicable HDPE pipe sizes and applications
UPC	Uniform Plumbing Code

1.3 SUBMITTALS

A. Manufacturer's product data and other information for each pipe size and fitting to be furnished. Individual submittals shall be marked to indicate each system where the piping item is to be used.

B. Piping layouts and layout schedule by area showing pipeline locations for all piping systems in that area with respect to structures, other piping and utilities and details and location of joints, anchors, supports, fittings, connections, penetrations, supports, valves, piping appurtenances, flexible couplings, manholes, and cleanouts as applicable. Drawings shall be original layouts by the Contractor; photocopies of contract drawings are not acceptable.

C. Restrained joint anchorage calculations required by this section of the specifications. Joint restraint product data for fittings and pipe joints. Pipe joint restraint schedule.

D. Installation Instructions: Manufacturer’s printed instructions for installation of each type and size of pipe, fitting, and appurtenance.

E. Certified copies of all tests required by the standards for the manufacture of pipe, fittings, joints, coatings, valves, and pipe supports.

F. Affidavit of compliance that each type and size of pipe complies with all provisions for pipe manufacture and materials as specified in this section.

1.4 CONTRACT DRAWINGS

A. The contract drawings indicate the general design, arrangement and extent of piping systems. The indicated positions shall be followed as closely as possible. Do not scale drawings for roughing in measurements nor use as shop drawings. Prepare shop drawings per “Submittals,” specified herein. The exact location of various items is subject to building construction, and the actual materials and equipment furnished. Verify the location of items to be furnished, installed, or connected, and incorporate this information when preparing shop drawings. Coordinate work with other specification sections and divisions.

B. Piping systems shall be located from dimensions given on drawings or implied locations shall be determined at the building site after field measurements have been taken.

C. Should interferences or discrepancies prevent the installation of any part of the work, the Owner’s Representative shall be notified, and the Owner’s Representative will determine the steps necessary to complete the true development of the intent of the drawings and specifications.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for domestic water service and fish process water piping and components. Any pipe, fittings, components, and chemicals used on fish water supply systems will also comply with NSF 61 unless indicated otherwise.

C. Comply with pipe and fitting manufacturer installation requirements and perform recommended testing, unless more stringent requirements are specified herein. General requirements are:

1. Clean and protect pipe ends, and securely cover ends when waiting for work to proceed.
2. Backfill with recommended materials and perform compaction testing.
3. Document flange torque procedure.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery, storage, and handling for all ductile iron materials shall be in accordance with ANSI/AWWA C600 and AWWA C605 for PVC materials. Other pipe materials shall be as required by the manufacture and including the Plastic Pipe Institute for HDPE pipe.

B. Flanges: Securely attach metal, hardboard, or wood protectors over entire gasket surface.

C. Threaded or Socket Welding Ends: Fit with metal, wood, or plastic plugs or caps.

D. Linings and Coatings: Prevent excessive drying.

E. Cold Weather Storage: Locate products to prevent coating from freezing to ground.

F. Handling: Use heavy canvas or nylon slings to lift pipe and fittings.

1.7 MATERIAL RESTRICTIONS

A. The Contractor shall not install any material containing cadmium, brass, bronze, copper, zinc, or their alloys, which could come in contact with fish rearing water. These heavy metal materials have been shown to be toxic to fish.

B. All pump, valve, piping, wetted components, etc. that may come in contact with water shall be a material specified and approved by the Owner.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Pipe material types and systems or pipe schedules shall be as shown in the Contract Drawings.

B. Unless otherwise specified, piping materials, including pipe, gaskets, fittings, connection and joint assemblies, linings and coatings, shall be selected from those listed in the Contract Drawings on the Pipe Schedule and indicated in the Pipe Systems table. Piping materials shall conform to detailed specifications herein for each type of pipe.

C. Where temporary piping and valving are required, piping material and accessories shall be selected by the Contractor. Such piping shall be suitable for operation at the test pressure and maximum range of operating service temperature of the permanent piping system which the temporary piping is replacing, as specified. Plastic, steel, RCP, ductile iron, and polyethylene pipe may all be used at the Contractor's discretion. Temporary piping shall be provided with supports at intervals which prevent sagging or liquid accumulation.

2.2 COUPLINGS

A. Flanges, gaskets, and bolts: Ductile-iron or Cast-iron flanges shall conform to ANSI B16.1, Class D. Steel flanges including AWWA C207 flanges may be bolted to cast-iron valves, fittings, or other parts having either integral Class 125 companion flanges or screwed Class 125 companion flanges. When such construction is used, the raised face on mating flanges shall be removed. Flanges shall be flat faced unless otherwise noted. Flange gaskets shall be full-face type, synthetic rubber or other material, suitable for the intended service including working media, pressure and temperature. Substitution of other gasket materials shall be only with the express written consent of the Owner’s Representative or as noted herein. Gasket thickness shall be 1/16 inch for pipe 10 inches and less and 1/8 inch for larger pipe. Flange assembly bolts shall be heavy pattern hexagon head carbon steel machine bolts with heavy pattern, hot pressed, heavy hexagon nuts, all ANSI B18.2. Threads shall comply with ANSI B1.1, coarse threads series, Class 2 fit. Bolts and nuts for normal service including buried and above ground conditions shall conform to the chemical and mechanical requirements of ASTM A307B and shall be zinc plated. Bolts and nuts for use in submerged or under continual water spray service conditions shall be 304 stainless steel ASTM A193, Grade B8 bolts and ASTM A194 Grade B8 nuts. Stainless steel nuts shall be coated to prevent galling.

1. Forged steel flanges, where required, shall be welding neck, conforming to ASTM A 181 Grade I and ANSI B16.5. Forged steel flange gaskets shall be suitable for intended service. On 3-1/2-inch forged steel flanges and smaller, gaskets shall be 1/16 inch thick. Forged steel flange assembly bolts shall be alloy steel studs, ASTM A 193 with 2 F.S. hexagon nuts ASTM A 194 per stud.
2. For low-pressure service, 20 psig and under, Class B lightweight flanges conforming to AWWA C 207 may be used.
3. Fittings and Coupling Compatibility: To assure uniformity and compatibility of piping components, fittings and couplings for grooved end piping systems shall be furnished by the same manufacturers.

B. Pipe threads: Unless otherwise noted, all pipe threads shall conform in dimension and limits of size to ANSI B2.1 Class 2 NPT, taper pipe thread.

C. Flexible rubber couplings, for pump connections or where otherwise shown or specified, shall be of resilient arch type specifically designed for the intended exposure and shall be standard or tapered as shown. Couplings shall be filled arch type.

1. Couplings shall have a liner of neoprene and shall have a smooth surface to the flow, extending through the bore of each coupling in one single unbroken piece to full face both flanges. The carcass of each coupling shall be constructed of elastomers with internal reinforcing materials sufficient to provide pressure resistance at temperatures in accordance with a design to burst safety factor of 3 to 1 and shall contain integrally molded flanges. Each coupling shall be covered with a heavy-duty neoprene-hypalon jacket designed to be resistant to abrasion, heat, petroleum products, ozone, and weathering. Flanges shall be fitted with steel retaining rings. Drilling and bolting shall comply with ANSI B16.1, Class 125, or as required by the conditions of service. Flexible couplings for pump inlets shall be Uniroyal Style 4150, Belmont Style 5404, General Rubber Style 1050, Unaflex Style 150, or equal. All couplings shall be rated for a minimum working pressure of 140 psig and shall be equipped with suitable expansion restraints designed for a minimum total pressure of 150 psig or as required by the conditions of service specified. Numbers and size of restraints shall be as determined by the manufacturer. Restraints shall be hot-dip galvanized. Discharge couplings shall be American Rubber Manufacturing Company Style P, Belmont Style 5404, General Rubber Style 1075, Unaflex Style 150, or equal.
2. A flexible coupling shall be provided in all piping at all structural expansion joints unless otherwise directed by the Owner's Representative. The flexible coupling shall be located within 2.5 pipe diameters of the structural expansion joint.

D. Mechanical pipe couplings

1. Flexible pipe couplings: Where flexible pipe couplings are shown or specified for use with plain end steel, ductile-iron, or PVC pipe installed above or below grade. The couplings used shall be Dresser Style 38, Smith-Blair Type 411 or 441, Romac 501, or equal and shall conform to AWWA C219 Bolted, Sleeve-Type Couplings. Couplings used for pipe under pressure where not otherwise secured or anchored against expansion shall be equipped to take tension by means of joint harnesses with shackle rods meeting the requirements of AWWA Manual M11, Section 19.8. Use of locking pins in drilled holes is not acceptable. Restraint components shall be hot-dip galvanized.

    a. Couplings for connecting steel pipe to ductile-iron pipe shall be Smith-Blair Type 413, Dresser Style 62, or equal. Insulating couplings shall be Smith-Blair Type 416, Dresser Style 39, or equal.
    b. Flanged coupling adapters shall be used where shown or where valve and piping are secured against expansion with shackle rods or other means, they shall be Dresser Style 128, Romac Style FCA 501, or equal, for plain end pipe.
    c. Donut-type fittings may be used on gravity drain lines only.
    d. All coupling gaskets shall be a synthetic rubber suitable for exposure to water containing grease or petroleum products and shall be as recommended by the coupling manufacturer for the service intended. Mechanical pipe couplings and flexible pipe couplings shall be provided where required by good piping practice and as necessary for disassembly.

2. Bolted split sleeve coupling: Victaulic Depend-O-Lok, Romac Armor Seal, or Straub couplings conforming to AWWA C227. Shall be used where shown or may be used as a flexible pipe coupling when working pressure is less than 20 psi for use with plain end steel, ductile-iron, or PVC pipe.

E. Expansion joints: Expansion joints and anchors shall be provided as recommended by the manufacturer to accommodate pipe movement due to temperature changes. Details shall be submitted to the Owner's Representative for acceptance before installation. All expansion joints shall be suitable for pressures and temperatures set forth in the Piping System Table, without crimping of corrugations. Corrugated types shall be suitable for a minimum 100,000 pressure, temperature, and deflection cycles. Packed type joints shall have packing suitable for the service involved and shall be Certain-Teed Fluid Tite PVC, Johns-Manville PVC double bell expansion joint, or equal, for buried services.

1. The location and spacing of expansion joints, anchors, hangers and supports shall be as required by good piping practice and as recommended by the Expansion Joint Manufacturers Association to accommodate pipe movement due to temperature changes, unless noted otherwise.
2. Expansion joints for polyvinylchloride piping shall be Celanese "Chemtrol," CPVC slip type with teflon impregnated seal ring; Certain-Teed Fluid Tite PVC; Johns-Manville PVC double bell expansion joint, or equal.

F. Thermal Expansion Joints: AWWA C221, Type A36 steel body, type 304 stainless steel slip pipe, high strength, low alloy corrosion resistant stell nuts and bolts per AWWA C111alternating rubber and wax impregnated flax packing, flanged ends, fusion bonded epoxy coating, Romac EJ-401 or Approved equal.

G. Modular mechanical expanding rubber seals (link seals) shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely watertight seal between the pipe and wall opening. The seal shall be constructed so as to provide electrical insulation between the pipe and wall, thus reducing chances of cathodic reaction between these 2 members.

1. Contractor shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabricating, or installing. The inside diameter of each wall opening shall be sized as recommended by the manufacturer to fit the pipe.

H. Unions 1-1/2-inch and smaller: Ground joint, malleable type; 2 inches and larger, flange type. Grinnell, Crane, Walworth, or equal.

I. Dielectric unions shall meet the dimensional requirements and tensile strength of pipe unions in accordance with Fed. Spec. WW-U-531. The unions or flanges shall be suitable for the required operating pressures and temperature conditions. The unions shall have metal connections on both ends of union. The ends of the unions shall be threaded or soldered to match adjacent piping. The metal parts of the union or flange shall be separated to prevent current flow between the dissimilar metals.

J. Escutcheons shall be Grinnell Figure 13 nickel-plated, or equal.

K. Quick connect/disconnect (Cam-Lok) adapters shall be aluminum and come with end cap and stainless steel chain attached to both items. The fitting shall be as manufactured by P.T. Coupling or equal.

2.3 SCHEDULE 40/80 PVC PIPE AND FITTINGS

A. Polyvinylchloride pipe: Polyvinylchloride (PVC) material for pressure pipe fittings and couplings shall conform to ASTM D 1784, Type 1, Grade 1, with 2,000-psi design stress. Pipe and fittings shall be Schedule 80 unless indicated otherwise on the drawings and shall be in accordance with ASTM D 1785. Thickness schedule shall be as specified on pipe specification sheets.

B. PVC fittings shall be socket type conforming to ASTM D 2466/2467 unless specifically called out otherwise elsewhere on the specifications or drawings. Solvent cement shall comply with ASTM D 2564.

C. Exposed PVC pipe shall be coated with a single coat of an epoxy coating system, Tnemec Series N69 Hi-Build Epoxoline, or equal. Total dry film thickness shall be 4 to 6 mils.

2.4 C900 PVC PIPE AND FITTINGS

A. Pipe 4” to 12” diameter shall meet requirements of AWWA C900. Wall thickness shall be DR 25 unless shown otherwise on the drawings. Pipe 14” and larger shall meet requirements of AWWA C900. Wall thickness shall be DR 25 unless shown otherwise on the drawings.

B. PVC shall comply with ASTM D 1784 and gasketed joints shall comply with ASTM D3139. The gaskets shall comply with ASTM F 477.

C. Fittings shall be ductile iron with restrained mechanical joints. See section on ductile iron pipe and fittings for additional fitting requirements.

2.5 D3034 / F679 PVC GRAVITY PIPE AND FITTINGS

A. PVC gravity pipe and fittings sizes 4” through 15” shall conform to ASTM D3034. PVC gravity pipe and fittings sizes 18” through 48” shall conform to ASTM F679. Pipe shall be DR 35 unless shown otherwise on the drawings. PVC material shall comply with ASTM D 1784 cell class 12454.

B. Pipe shall have integral bell gasket joints. Rubber gaskets shall be factory installed and conform to ASTM F477. Joint design shall meet requirements of ASTM C3212 under both pressure and 22” Hg vacuum. Pipe shall be installed according to ASTM D2412.

2.6 STEEL PIPE AND FITTINGS

A. Steel pipe shall meet the requirements of ASTM A 53 or ASTM A-106, Grade B, and shall be standard weight except as otherwise specified or shown on the drawings. Ends of pipe shall be flanged or plain end, as indicated on the Drawings. Where flanges are used, they shall be ANSI B16.5, Class 150, with flat face.

B. Fittings shall meet ASME/ANSI B16.9, standard weight.

C. All welded joints shall be performed in a shop with AWS certified welders, and conform to the requirements of AWWA C200. Pipe shall be joined in the field with either flanged joints or solid sleeve solid sleeve flexible couplings.

D. Galvanized pipe and fittings shall be zinc hot-dip galvanized complying with ASTM A 153

E. Pipe that is not galvanized shall be epoxy lined and coated per AWWA C213.

2.7 STAINLESS STEEL PIPE AND FITTING

A. Stainless-steel pipe shall meet the requirements of ASTM A 312 or ASTM A 409. Stainless-steel pipe shall be of the following minimum thickness unless otherwise noted for specific usage:

Diameter	Minimum Thickness
2-1/2 inches and smaller	Schedule 40S
3 inches and larger	Schedule 10S

B. Ends of pipes shall be threaded with couplings for 2-1/2 inches and smaller and butt-welded for 3 inches and larger pipes. All welding shall be performed in a shop with AWS certified welders. Pipe and fittings shall be joined in the field with flexible couplings or flanges. Flanges shall be class 150 with flat faces.

2.8 DUCTILE IRON PIPE AND FITTINGS

A. Ductile-iron pipe and fittings: All ductile-iron pipe shall conform to the current provisions of ANSI A21.51. Unless otherwise designated, ductile-iron pipe shall be standard thickness Class No. 52 for pipes with non-grooved joints and Class 53 for pipes with grooved joints.

B. Joints for pipe and fittings for exposed piping shall be flanged or flexible couplings. Flanged fittings shall conform to AWWA/ANSI C110/A21.10.

C. Buried fittings shall be mechanical joint per ANSI A21.11. Fittings shall be restrained with a Mega Lug or similar retainer gland. Buried pipe joints may be of the push-on type, provided it is restrained at bends, tees, and dead-ends, for sufficient distance on each side of the fitting to prevent pulling at the joint during testing. Mechanical joints, exclusive of grooved mechanical, shall not be used for exposed piping.

D. Ductile iron pipe and fittings shall have a cement mortar lining per ANSI/AWWA C104/A21.4. Cement shall be ASTM C150, Type II or V, low alkali, containing less than 0.60 percent alkalies. There shall be no seal coat over the cement mortar lining.

E. Exposed pipe and fittings shall be furnished with a shop primer and coated with 2 coats of an epoxy-polyamide coating, Tnemec N69 Hi-Build Epoxoline or approved equal. Dry film thickness (DFT) of the first and second coats shall be 4 to 6 mils each, for a total DFT of 8 to 12 mils.

F. Buried pipe and fittings shall be furnished with the manufactures standard asphaltic per ANSI/AWWA C151/A21.51

PART 3 - EXECUTION

3.1 PIPING IDENTIFICATION

A. Pipe coding and marking shall be as specified in Section 15050.

3.2 INSTALLATION

A. General: The types and sizes of pipes to be used shall be as specified and shown. Where sizes or locations of small pipe are omitted from the drawings and not mentioned in the specifications, the sizes to be used shall correspond to the latest edition of the Uniform Plumbing Code requirements. In any event, undesignated pipe shall be proper for the functions to be performed and as accepted by the Owner's Representative. Installation shall be in accordance with the manufacturer's written manual.

1. Location: Piping shall be provided as specified except for adjustments to avoid architectural and structural features and shall be coordinated with electrical construction. Piping installed adjacent to equipment and machines shall be located to allow for service and maintenance.
2. Joint and Fitting Options: Pipe connection (joint and fitting) options for a particular piping system shall be as specified unless otherwise indicated in the Pipe Schedule and Pipe System information shown on the drawings. Takedown couplings shall be provided for all piping systems. Takedown couplings shall be provided both around equipment and at standard pipe lengths for all straight runs of pipe. Continuous welding for straight runs of pipe is acceptable only where the individual pipe system allows welding as a connection option. Where connections are shown, the connections shall be specifically where shown; however, if several connection options are allowed for the particular piping system, then any option may be consistently used; i.e., if flanged or grooved are acceptable and flanged are shown, then grooved may be substituted. Integrity of rigid, non-rotating connections must be maintained at all valves and other equipment.
3. Unless otherwise specified, the crowns of all buried pipe shall be at least 30 inches below finished grade. Pipes with less than 30 inches of cover shall be encased in concrete.
4. All pipes shall be carefully placed and supported at the proper lines and grades, and where possible shall be sloped to permit complete drainage. Piping runs shown on the drawings shall be followed as closely as possible, except for minor adjustments to avoid equipment, architectural, and structural features. If major relocations are required, they shall be acceptable to the Owner's Representative.
5. In erecting the pipe a sufficient number of screw unions, flanged or grooved end type joints shall be used to allow any section or run of pipe to be disconnected without taking down adjacent runs. Flanged and mechanical pipe coupling joints shall be employed on pipelines 3 inches in diameter and larger. The provision of an adequate number of appropriate take-down fittings must be rigidly adhered to whether or not such fittings are indicated on the drawings. Take-down fittings shall also be provided for removal of valves and other appurtenances. Where piping passes through concrete or masonry walls, take-down fittings shall be employed as near the wall as possible. Dielectric unions shall

be used at all locations to join pipe or equipment of dissimilar metals. Eccentric reducers shall be used to keep the top of piping at pump suctions level.

6. Unless otherwise specified, all pipes passing from concrete or steel to earth shall be provided with a flexible coupling. Wherever a metallic pipe 1 inch in diameter or larger passes from concrete to earth horizontally, 2 flexible pipe couplings spaced from 2 feet to 4 feet apart depending on pipe size shall be installed, whether shown or not. Only one flexible pipe coupling is required on vertical runs from the Structure. One coupling shall be within I foot of the structure. Particular care shall be taken to ensure a full support of the pipe in the earth between and beyond the joints.
7. All pressure taps on the suction and discharge sides of all pumps, blowers, and compressors shall be provided with ball valves unless otherwise shown. Provide taps in all piping for flow switches, pressure switches, etc., as required, to match instrumentation drawings. Taps to be a minimum diameter of 3/4 inch with bushings for smaller sizes. For taps larger than 3/4 inch, tap actual size to be coordinated with electrical instrumentation.
8. Unless otherwise specified, the suction and discharge of all pumps, blowers, fans, and compressors shall be provided with flexible couplings suitable for the intended service.

B. Pipe supports

1. Unless part of a pipe system indicated as designed by the Contractor (Delegated Design), all pipe shall be secured in place by use of the standard piping support details shown on the mechanical detail drawings. The Contractor shall make use of these standard pipe supports in order to support the piping in accordance with the criteria outlined in the general mechanical (or plumbing where applicable) drawings and specified herein.

    a. Supplemental to the above, the contract drawings indicate the location of pipe stanchions and/or special supports where required.
    b. Additional pipe supports shall be installed where required to comply with pipe manufacturer recommended spacing to prevent sag, deflection of joints, and excess stress in the pipe system.
    c. In addition, in order to prevent swaying in piping system supported by hangers, the Contractor shall install side-sway bracing. Sway bracing shall be sufficient to eliminate horizontal pipe deflection during operation for all piping 4 inches and greater. As a minimum, sway bracing shall be installed at 20-foot intervals on system where hanger supports are used. Bracing shall be installed on pipe rack assemblies or other supported pipe runs that have observable movement during system operation. When directed by the Owner’s Representative additional bracing shall be installed to minimize pipe movement.

2. Supports for exposed piping shall conform to the latest requirements of the ANSI Code for Pressure Piping B31-10 and MSS standard Practice SP-58, except as supplemented or modified by the requirements of this specification.

    a. Designs generally accepted as exemplifying good engineering practice, using stock or production parts, shall be utilized wherever possible.

3. Hanger supports shall be as noted, with at least one support adjacent to the joint for each length of pipe, at change in direction and at branch connections. Sufficient hangers shall be provided to maintain proper slope without sagging. Support spacing shall not exceed

the pipe and hanger manufacturer's recommendations or those stipulated on the drawings whichever is more stringent.

4. Spacing of clamps for support of horizontal or vertical piping shall be spaced close enough to keep the pipe in alignment as well as to support the weight of the piping and contents, but in no case shall be more than 10 feet.
5. Provide adjustable hangers complete with adjusters, swivels, rods, etc. Size hangers to clear insulation and guide where required, as well as support piping. All rigid hangers shall provide a means of vertical adjustment after erection. Hanger rods shall be machine-threaded. Continuous threaded or "all thread" rods will not be allowed unless otherwise noted.
6. Clevis or band-type hangers: Grinnel. 260 or 269, Elcen, or equal, shall be provided. Strap hangers not permitted.
7. Provide floor stands, wall bracing, concrete piers, etc., for all lines running near the floors or near walls and which can be properly supported or suspended by the walls or floors. Pipelines near concrete or masonry walls may also be hung by hangers carried from wall brackets at a higher level than pipe. Hanging of any pipe from another is prohibited.
8. Equipment shall be so positioned and aligned that no strain shall be induced within the equipment during or subsequent to the installation of pipework.
9. When temporary supports are used, they shall be sufficiently rigid to prevent any shifting or distortion of the piping or related work.
10. Flexible couplings shall be installed where shown on the drawings and shall be added at such other points as required for ease of installation or removal of the pipe, subject to approval of the Owner’s Representative. Flexible couplings shall be of the restrained type where necessary to prevent separation of pipe due to internal pressure.
11. All pipe supports, hangers, racks, and anchors shall be hot-dip galvanized after fabrication.

C. Installation at concrete walls and footings

1. Whenever a pipeline of any material terminates at, or extends through, a structural wall or sump, the Contractor shall install in advance of pouring of concrete the fittings, sleeves or special casting required for the particular installation.
2. Unless otherwise shown on the drawings, no pipe other than ductile iron, steel, and concrete shall be cast in concrete or masonry walls.
3. Pipe other than concrete to be cast in water-bearing walls or more than 4 feet below grade shall have water-stop rings (or seep rings). Water stop rings shall be cast integrally with pipe or fabricated. If fabricated, they shall be at least 6 inches larger diameter than pipe, 1/4-inch thick, and continuous welded all around on both sides.

D. Piping through walls, slabs, and footings: Unless otherwise indicated, pipes passing through walls and slabs shall be installed with sleeves in accordance with the standard details shown on the drawings. Care shall be taken to ensure no contact between embedded sleeves or pipes and reinforcing steel. Pipe must be isolated from reinforcing steel.

E. Pipe welding: All welding of steel pipe shall be by the shielded arc method. All welders must be qualified for pipe welding in all positions and for the materials to be welded in accordance with the requirements of ASME Boiler and Pressure Vessel Code, Section IX. The Contractor shall provide the Owner’s Representative with welding certificates specifically validated for this project. This certification supersedes all other certification requirements of other specifications noted herein.

1. All butt welding of stainless steel shall be by the MIG or TIG method. Fillet welds at slip-on flanges shall be by MIG, TIG or SMA method. Qualification, certification shall be as noted above for steel piping.
2. Gas purging of the backside of the weld during the initial root pass is required. Purge gas shall be the same composition as the shielding gas supplied to the welding gun.
3. Fill and cover passes on butt welds are required to provide a cross section of weld metal equal to, or greater than, the parent metal.
4. All welding, weld testing, and weld repair shall be in accordance with ANSI B31.1 and B31.3, as applicable.
5. All pipe welding on system not previously noted shall conform to the requirements of AWWA C206, and all weld repairs shall be in accordance with AWWA C206.

F. Pipe cutting: The Contractor shall perform all work of cutting pipe and fittings or special castings necessary to the proper and accurate assembly, erection, and completion of the work. All pipe shall be cut to fit accurately with smooth edges and faces.

G. Pipe threads: Pipe ends shall be reamed to the full bore of the pipe. Threads shall conform in dimension and limits of size to ANSI B2.1, tapered pipe thread. In making up threaded joints, an accepted thread lubricant shall be applied to the male threads only.

H. Flanged joints shall be made up square with even pressure upon the gaskets and shall be watertight.

I. Solder joints: Solder to be used in copper piping shall be 95% tin and 5% antimony. All pipe and fittings to be joined with solder shall be free from all burrs and wire brushed or steel wool cleaned. After cleaning, a paste flux shall be evenly and sparingly applied to the surfaces to be joined. Solder shall then be applied and flame passed toward the center of the fitting until the solder disappears. All excess solder shall be removed while it is still plastic. Absolutely no acid flux or acid wipe shall be used in making solder joints.

J. Grooved and shoulder-type joints shall be in accordance with AWWA C606.

K. Pressure piping

1. Anchorage: Buried pressure pipe and where indicated drain pipe shall have restrained joints.
2. Manual air vents and pipe drains: Manual air vents shall be installed at the high points of all pipelines carrying liquid, except acids, caustics, or other dangerous liquids, as instructed by the Owner's Representative, of any service class which cannot be vented through service connections or vent cocks provided with equipment. Manual air vents for liquid pipelines 2-1/2 inches and larger shall consist of a 1/2-inch valve as specified for flushing and for smaller piping shall be 3/8-inch size consisting of bronze cock and short copper tubing return. Vents shall include piping to floor level with valve located 4 feet above floor.

    a. All exposed liquid lines 4 inches and larger shall be provided with a tap or guided nipple and valve drain on the bottom of the pipe. This drain connection shall be provided at all low points with a spacing not to exceed that in the table and where shown. Size and minimum spacing shall be as follows:

Size	Water and Other Liquids	Sewage and Sludge
4" through 12"	1" at 200 feet	2" at 200 feet
14" and larger	2" at 100 feet	2" at 100 feet

b. Drain piping and isolating valves shall be the size noted above unless otherwise shown and shall be the same as shown in the Piping Specification Sheets. Drains shall be piped to a sump, gutter, floor drain, or other collection point.

c. Vent and drain provisions do not apply to buried or encased pipe except where shown.

3. Laying and jointing of buried piping

a. Pipe laying: Laying of ductile-iron, cast-iron, and steel pressure pipelines shall conform to applicable portions of AWWA C600, and AWWA C605 for PVC. Laying of high density polyethylene pipe shall conform to Plastic Pipe Institute standards and ASTM D 2774.

1) Anchorage shall be provided for fittings where there is a possibility of pulling the joint under pressure. Anchors shall be in accordance with applicable portions of AWWA C600, except as otherwise shown.

2) Pipe shall be handled with canvas slings or devices to prevent damage to the pipe exterior. Each piece of pipe shall be laid in such a manner as to prevent any sudden offsets in the flow line. As the work progresses, the interior of the pipe shall be cleared of all dirt and debris of every description. Pipe shall not be laid when the condition of the trench or the weather is unsuitable. At times when work is not in progress, open ends of pipe and fittings shall be closed.

3) Unless otherwise indicated or directed by the Owner’s Representative, pipe shall be placed on bedding material at least 6 inches deep below the barrel of the pipe. The bedding and backfill material shall be as specified in Section 02222.

b. Pipe jointing

1) Restrained joints and fittings shall be installed in accordance with the manufacturer's recommendations. Grooved and shoulder type couplings shall not be used for buried services.

L. Gravity pipelines

1. General: The types and sizes of pipe to be used shall be as specified and shown. Bell-and-spigot pipe laying shall proceed upgrade with the spigot ends of pipe pointing in the direction of flow. Each piece shall be laid true to line and grade and in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets in the flow line. As the work progresses, the pipe interior shall be cleared of all dirt and debris of every description. Where cleaning after laying is difficult because of small pipe size, a suitable swab or squeegee shall be kept in the pipe and pulled forward past each joint immediately after jointing has been completed. Pipe shall not be laid when the condition of the trench or the weather is unsuitable. At times when work is not in progress, open ends of pipe and fittings shall be closed.

a. Dewatering, excavation, backfill, bedding, etc., shall be in accordance with the contract drawings and other sections of these specifications.
b. Gravel or crushed rock required to stabilize a soft, wet, or spongy foundation shall be provided at the Contractor's expense.

M. Temporary piping and pipelines: All temporary piping shall conform to the appropriate Piping Specification Sheet and shall be cleaned and tested as specified herein. All buried temporary lines shall be filled with sand, capped, and abandoned in place or shall be removed. Temporary lines on the ground surface shall be removed and salvaged.

N. The Contractor shall have on the site at all times three inflatable pipe plug for each size pipe up to and including 12 inches in diameter and one inflatable plug for all pipes greater than 12 inches in diameter. The plugs shall be used to exclude dirt and debris from pipelines during construction. Temporary blocking of pipe with anything other than inflatable plugs (unless all are in use) will not be allowed.

3.3 PIPELINE TESTING

A. General: All piping, both gravity and pressure pipelines, shall be subject to acceptance tests. The Contractor shall provide all necessary utilities, labor, and facilities for testing and shall dispose of all waste, including water.

1. All piping including valves, fittings, hydrants, etc., shall be pressure tested prior to connection to equipment such as pumps. Perform tests in sections between isolation valves or structures. Test all pipe penetrations with clean water in wet wells.
2. All exposed piping shall be pressure tested and flushed in accordance with these specifications before they are either painted or insulated. Furthermore, no concrete or concrete slabs shall be poured over or around any piping (except wall penetrations) until the pipe has been tested for acceptance. If a piping system (or portion thereof) fails to meet an acceptance test, repairs shall be made at the Contractor's expense. The repair method used shall be subject to the Owner’s Representative approval and the unacceptable portion shall be retested until it meets these testing specifications.
3. Any equipment which may be damaged by the specified test shall be isolated.

B. Gravity pipelines

1. Obstructions: After backfilling and restoration of surfaces, all gravity pipelines shall be inspected for obstructions and shall be cleaned. Pipes 24 inches in diameter and smaller shall be cleaned using the sewer ball method. Lines larger than 24 inches in diameter may be cleaned by flushing as long as it is first visually inspected to assure that no physical obstructions exist. Flushing shall be such that velocities are at least 2.5 feet per second.
2. Leakage: All gravity pipe drain lines including interior buried and encased lines shall be tested for leakage after backfilling in accordance with Acceptance Test by Pressure Drop Method shown below. The Contractor shall, at its own expense, correct any excess leakage and repair any damage to the pipe and their appurtenances or to any structures resulting from or caused by these tests. No pipe sealant or welding will be allowed in the repair. Where required by the Owner’s Representative, the line shall be retested at the Contractor's expense to meet the specifications.

a. Install access tees, valves, temporary caps or plugs, gages, meters and fittings not called out on the Drawings if required to isolate pipe for testing.

3. Acceptance Test by Pressure Drop Method leakage criteria:

a. All gravity sewers shall be tested by the low pressure air test for plastic gravity sewer lines per ASTM F-1417

4. Acceptance test by pressure drop method procedures:

a. Plug all pipe outlets with suitable test plugs. Brace each plug securely.
b. All gauge pressures in the test should be increased by the amount of groundwater pressure at the center of the pipe.
c. Add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to 4.0 psig.
d. 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 pressure.
e. After the 2 minute period, disconnect air supply.
f. When pressure has decreased to 3.5 psig, start stop watch. Determine the time in seconds that is required for the internal air pressure to reach 2.5 psig. This time interval should then be compared with the time required by ASTM F-1417
g. List size, length, and pressure drop allowed of all portions of pipe under test in a table format. Test record shall include appropriate description of the test and sketches of the test configuration and apparatus. Perform testing in the presence of the Owner’s Representative. The maximum reach to be tested in one operation shall be the reach between two consecutive manholes.

C. Pressure pipelines

1. General: Test pressures, testing media, and test duration shall be as specified in Piping System Table. Care shall be exercised to isolate equipment which is not rated for the specified test pressure to avoid damage to the equipment. System operating at less than 15 psi will be subject to 24 hours of leak proof operation as an additional requirement to pressure tests. All joints which will later be encased in concrete or insulated, whether buried or not, shall be tested prior to encasement. Pipe with leakage greater than allowed herein shall be repaired and retested at the Contractor's expense.

2. Liquid system: Leakage for all unburied liquid piping shall be zero throughout the duration of the test. Leakage for buried piping conveying chemicals shall be zero throughout the duration of the test.

3. Leakage for other buried liquid piping shall not exceed the allowable leakage as set forth in AWWA C600 Hydrostatic Testing. Contractor shall be responsible for making all necessary provisions for conveying water to the points of use and for disposal of the test water, including temporary taps and plugs.
a. Seal pipe ends and secure pipe with temporary thrust restraint, as required, to maintain line and grade and to prevent damage.
b. Furnish all equipment and materials for the test including:

1) Test pump approved by the District.

2) Suitable suction and discharge pipes and hoses.
3) Suitable graduated containers for measuring water loss.
4) Pressure gages with pressure range at least 20% greater than the required test pressure and with graduations in 2 psi maximum increments.

c. Conduct the hydrostatic test so the lowest point along the test section is subjected to a hydrostatic pressure of 100 psi or 1.5 times the operating pressure, whichever is greater.

d. Expel air from the test section. Install corp stops at all unvented high points to expel air. After filling the pipeline and before and before application of the test pressure, the test section shall be maintained at the operating pressure for 30 minutes to demonstrate that the pressure has stabilized. Several cycles of pressurizing and air bleeding may be required prior to beginning the test.

e. Apply and maintain the test pressure for a minimum duration of two hours and measure the leakage during this period. Operate the test pump as required to maintain the pressure within plus or minus 5 psi of the test pressure throughout the test period.

f. At the conclusion of the test period, operate the pump until the test pressure is obtained. The pump suction shall be in the graduated container so the amount of water required to restore the test pressure is accurately measured.

g. The measured leakage shall not exceed the allowable leakage amount calculated by the following formula:

$$AL = \frac{LD(P)^{1/2}}{148{,}000}$$

Where: AL = Allowable leakage in gallons per hour
L = Length of pipe tested in feet
D = Diameter of pipe (nominal) in inches, and
P = Test pressure in pounds per square inch

h. If the measured leakage is in excess of the allowable leakage, the section of pipe tested shall be repaired and retested until the actual leakage is reduced below the allowable amount.

i. Visible leaks in the wet well and vaults shall be eliminated regardless of the leakage amount.

j. Record pressure test data in a standard format to document all pipe tests. Document pipe size, length, location, material type and conditions of the test. Provide a sketch of the pipe segment tested and the test apparatus. Perform testing in the presence of the Owner’s Representative.

3.03 CLEANING

A. Flush system after testing by circulating test medium and filtering until clean.

END OF SECTION 15200