

**WESTERN HILLS WATER DISTRICT
DIABLO GRANDE WATER TREATMENT
PLANT**

**CONTRACT DOCUMENTS
AND
CONTRACT SPECIFICATIONS**

For construction of

**2012 SYSTEM MODIFICATIONS AND
IMPROVEMENTS**

**AUGUST 2012
208400**

**WESTERN HILLS WATER DISTRICT
2012 SYSTEM MODIFICATIONS AND IMPROVEMENTS**

**CONTRACT DOCUMENTS AND CONSTRUCTION SPECIFICATIONS
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August 2012

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ITEM	DESCRIPTION	UNIT	QUAN.	UNIT PRICE	AMOUNT
C. MISC. SYSTEM MODIFICATIONS AND IMPROVEMENTS					
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				SUB-TOTAL	
				CONSTRUCTION GRAND TOTAL	=====>

BIDDER: _____

BY: _____

ADDRESS: _____

CONTRACTOR LICENSE NO.: _____

DATE: _____ PHONE: _____ FAX: _____

BIDS SHALL BE SUBMITTED TO: WESTERN HILLS WATER DISTRICT
 ATTENTION: PATRICK GARVEY. 9501 MORTON DAVIS DRIVE. PATTERSON, CA 95638

SECTION 001000
NOTICE INVITING SEALED PROPOSALS (BIDS)

FOR THE CONSTRUCTION OF: **WESTERN HILLS WATER DISTRICT
2012 SYSTEM MODIFICATIONS AND
IMPROVEMENTS**

FOR THE: WESTERN HILLS WATER DISTRICT

NOTICE IS HEREBY GIVEN that WESTERN HILLS WATER DISTRICT (DISTRICT) invites and will receive sealed proposals (bids) up to the hour of **2:00 PM on the ___ day of _____, 2012**, for the furnishing to said DISTRICT of all transportation, labor, materials, tools, equipment, services, permits, utilities, and other items necessary to construct said work. At said time, said proposals will be publicly opened and read aloud at the office of the DISTRICT ENGINEER,

District Engineer
Western Hills Water District
9501 Morton Davis Drive
Patterson, CA 95638

Notice is also hereby given that a mandatory pre-bid meeting will be held at the Western Hills Water District Water Treatment Plant at the hour of 10:00 am on the _____ day of _____ 2012. Any Prime Contractor who bids on this work must attend this pre-bid meeting as a prerequisite of submitting their bid/proposal.

Bids shall conform to and be responsive to the Contract Documents for the work. Copies of the Contract Documents are on file and may be examined in the office of the DISTRICT ENGINEER

Additional copies may be obtained at the office of the DISTRICT ENGINEER by paying **\$35 per set**.

Each bid shall be submitted on a form furnished as part of the Contract Documents and must be accompanied by cash, a cashier's check, a certified check, or a Bidder's bond executed by an admitted surety insurer, or substitute pursuant to Section 995.710 of the Code of Civil Procedure, in an amount not less than 10% of the amount of the bid, made payable to the order of or for the benefit of the DISTRICT. The security of unsuccessful Bidders will be returned by the DISTRICT no later than sixty (60) days following the date of award. Each bid shall be sealed and delivered to the DISTRICT at the location designated in this notice for the opening of proposals at or before the time in this notice provided. The check or bond or substitute shall be given as security that the Bidder will enter into a contract with the DISTRICT and furnish the required payment and performance bonds, or substitutes in lieu thereof, and certificates of insurance and endorsements if awarded the work, and will be declared forfeited if the Bidder refuses to timely enter into said contract or furnish the required bonds or substitutes, or certificates of insurance and endorsements if the Bidder's bid is accepted.

The DISTRICT has obtained from the Director of the California Department of Industrial Relations a determination of the general prevailing rate of per diem wages and the general prevailing rate for legal holiday and overtime work in the locality in which said work is to be performed for each craft, classification, or type of worker needed. Not less than the determined rates shall be paid to all workers employed in the performance of the contract. Such rates of wages are on file with the Department of Industrial Relations and in the office of the DISTRICT and are available to any interested party upon request.

Pursuant to Public Contract Code Section 22300, equivalent securities may be substituted for monies withheld to ensure performance of the contract. The DISTRICT reserves the right to solely determine the adequacy of the securities being proposed by the CONTRACTOR and the value of those securities. The DISTRICT shall also be entitled to charge an administrative fee, as determined by DISTRICT in its sole discretion, for substituting equivalent securities for retention amounts. The DISTRICT's decisions with respect to the administration of the provisions of Section 22300 shall be final and shall include, but not be limited to, determinations of what securities are equivalent, the value of the securities, the negotiability of the securities, the costs of administration and the determination of whether or not the administration should be accomplished by an independent agency or by the DISTRICT. The DISTRICT shall be entitled, at any time, to request the deposit of additional securities of a value designated by DISTRICT, in DISTRICT's sole discretion, to satisfy this requirement. If the DISTRICT does not receive satisfactory securities within twelve (12) consecutive days of the date of the written request, DISTRICT shall be entitled to withhold amounts due CONTRACTOR until securities of satisfactory value to DISTRICT HAVE been received.

The CONTRACTOR's license classification(s) required for this project is Class A.

These classifications are provided for information purposes only. The Engineer does not warrant that all classifications required for the project are listed.

It is the DISTRICT's intent that "plans," as used in Public Contract Code Section 3300, is defined as the construction contract documents, which include both the drawings and the specifications.

The DISTRICT reserves the right to select the schedule(s) under which the bids are to be compared and contract(s) awarded, to reject any and all bids, and to waive any and all irregularities in any bid.

The Bidder is required to sign the attached Noncollusion Affidavit and submit it with his bid.

BY THE ORDER OF THE DISTRICT ENGINEER OF THE
WESTERN HILLS WATER DISTRICT

Dated: _____

END OF SECTION

SECTION 004100
BID FORM

PROPOSAL TO: WESTERN HILLS WATER DISTRICT

FOR THE CONSTRUCTION OF: WESTERN HILLS WATER DISTRICT
2012 SYSTEM MODIFICATIONS AND
IMPROVEMENTS

Name of Bidder: _____

Business Address: _____

Phone No. _____

TO THE GOVERNING BODY OF THE
WESTERN HILLS WATER DISTRICT (OWNER)

Pursuant to and in compliance with your Notice Inviting Sealed Proposals (Bids) and the other documents relating thereto, the undersigned Bidder, having attended the pre-bid meeting, being fully familiar with the terms of the Contract Documents, local conditions affecting the performance of the contract, subsurface and physical conditions, the character, quality, quantities, and scope of the work, the cost of the work at the place where the work is to be done, and having given such notice to the DISTRICT ENGINEER of all conflicts, errors and deficiencies that the Bidder has detected and that the resolution thereof by the DISTRICT ENGINEER is acceptable and that the Contract Documents are sufficient to convey an understanding of the terms and conditions for performing the work, hereby proposes and agrees to perform within the time stipulated in the contract, including all of its component parts and everything required to be performed, and to furnish any and all of the labor, material, tools, equipment, transportation, services, permits, utilities, and all other items necessary to perform the contract and complete in a workmanlike manner, all of the work required in connection with the construction of said work all in strict conformity with the plans and specifications and other contract documents, including Addenda Nos. ____, ____, ____, and ____, for the prices hereinafter set forth.

The undersigned as Bidder, declares that the only persons or parties interested in this proposal as principals are those named herein; that this proposal is made without collusion with any person, firm, or corporation; and he proposes and agrees, if the proposal is accepted, that he will execute a contract with the OWNER in the form set forth in the Contract Documents and that he will accept in full payment thereof the following prices, to wit:

The CONTRACTOR shall comply with the Subletting and Subcontracting Act as set forth in Chapter 4100 of the Public Contract Code. As required by Section 4104 of the Public Contract Code, the CONTRACTOR bidding shall hereinafter list the subcontractor(s) who will be the subcontractor(s) on the job for each particular trade or subdivision of the work and will state the firm name and principal location of the mill, shop, or office of each:

Division of Work or Trade	Name of Subcontractor	Subcontractor's License No.	Subcontractor's Address and Telephone No.

ACCOMPANYING THIS PROPOSAL IS _____ (insert the words "bidder's bond," "cashier's check," "certified check," or appropriate description of substitute security, as the case may be) in an amount equal to at least 10% of the total amount of the bid, payable to the

WESTERN HILLS WATER DISTRICT

The undersigned deposits the above-named security as a proposal guarantee and agrees that it shall be forfeited to the OWNER in case this proposal is accepted by the OWNER and the undersigned fails to execute a contract with the OWNER as specified in the Contract Documents or fails to furnish the required payment and performance bonds, or substitute, and insurance certificates and endorsements. Should the OWNER be required to engage the services of an attorney in connection with the enforcement of this bid, Bidder promises to pay OWNER's reasonable attorneys' fees, incurred with or without suit.

The names of all persons interested in the foregoing proposals as principals are as follows: (NOTICE - If Bidder or other interested person is a corporation, state legal name of corporation, also names of the president, secretary, treasurer, and manager thereof; if a general partnership, state true name of firm, also names of all individual partners composing firm; if a limited partnership, the names of all general partners and limited partners; if Bidder or other interested person is an individual, state first and last names in full; if the Bidder is a joint venture, state the complete name of each venturer).

Bidder hereby confirms that it has all licenses and permits required by federal, state, and local statutes, regulations, and ordinances. The following are the CONTRACTOR's applicable license numbers (add pages if needed):

CONTRACTOR's License No.

Expiration Date

<hr/>	<hr/>
<hr/>	<hr/>
<hr/>	<hr/>

Pursuant to the requirements of California Business and Professions Code Section 7028.15(e), a bid submitted to the OWNER by a contractor who is not licensed pursuant to Chapter 9 of Division 3 of the Business and Professions Code shall be considered nonresponsive and shall be rejected as provided for by law.

Pursuant to California law, Public Contract Code Section 1055.1 et seq., the participation goal for minority business enterprises is 15 percent; for women business enterprises, 5 percent; and for disabled veteran business enterprises, 3 percent. Each Bidder is required to meet, or make a good faith effort to meet, specified goals to be eligible.

CERTIFICATION OF MINORITY AND WOMEN BUSINESS ENTERPRISE PARTICIPATION REQUIREMENTS

- 1) Compliance with goals as set forth above.
- 2) The following information shall be provided by the Bidder on supplemental pages to its Bid, for each minority and women enterprise who is a subcontractor on the subject Project, and it is hereby certified by the Bidder, under penalty of perjury that such information will be provided accurately and completely:
 - a) Name of minority firm and address.
 - b) Name of person to contact at minority firm.
 - c) Business telephone of minority firm.
 - d) Type of ownership.
 - e) Controlling interest (ethnicity and citizenship).
 - f) Documentation or evidence of minority ethnicity.
 - g) Name of owners, general partners, and officers of firm and their percent of ownership in the firm. If a corporation, total outstanding stock and a percentage breakdown of ownership.
 - h) Management control of firm in the following areas:
 - (i) Financial decisions.
 - (ii) Estimating.
 - (iii) Marketing and sales.
 - (iv) Hiring and dismissal of management.
 - (v) Purchasing of major equipment and supplies.

- i) Documentation of identify of owner or management official who is, or has been, within the last three years, an owner, manager, or employee of another firm that has an ownership interest or a present business relationship with the firm. Present business relationships include shared space, employees, equipment, or financing. An explanation of any such relationship shall be provided.
- j) Bonding capabilities.
- k) Whether the firm has been denied certification, or any of the individuals listed in g) above have been involved with a firm that has been denied certification, as a minority, women, or disadvantaged business enterprise by a participating state or local agency.
- l) Type of business (for example, service, goods, construction).
- m) Attachment of a copy of an active business and contractor's license, or any other pertinent license or permit.
- n) Location area of state to be considered for work.
- o) Other documentation required to verify ownership and control of a certification applicant in accordance with Sections 23.51 and 23.53 of Title 49 of the Code of Federal Regulations.

DISABLED VETERAN BUSINESS ENTERPRISE PARTICIPATION PROGRAM REQUIREMENTS

- 1) Compliance with goals set forth above.
- 2) In accordance with Public Contract Code Section 10115, et seq., the Real Estate Services Division has established criteria to implement the Disabled Veterans Business Enterprise Participation Program goals as set forth above.
- 3) The Bidder shall properly complete the Program Requirement Document as included in this Bid package to have this Proposal considered.

REQUEST FOR SMALL BUSINESS PREFERENCE AND CERTIFICATION

- 1) Small Business Preference Request: The undersigned hereby requires preference as a "Small Business" and further certifies under penalty of perjury, that the firm still meets the requirements of Section 1896(L) Title 2, of the California Code of Regulations and has been approved by the Office of Small Business Certification and Resources (OSBCR).
- 2) Certification Approval Letter: If the License Classification for this project is "A" or "B" and the Bid is over \$100,000 and the successful contractor claims "Small Business" preference, and is certified as "Small Business," then at least 50 percent of the subcontractors shall also be certified "Small Business." Submit one copy of the Office of

Small Business Certification and Resources (OSBCR) certification approval letter with Bid for each "Small Business" claim. This requirement also pertains to subcontractors.

- 3) Execution: The "Request for Small Business Preference and Certification" shall be executed in the same name in which the Bidder is licensed and prequalified. Bidder bidding jointly or as a combination of several business organizations shall be jointly licensed and prequalified in the same name in which the Bid is executed.

Legal Name of Bidder(s):

Signature of Chief Executive
Officer Authorized to Sign as Bidder

Date

Bonding Assistance: In the event Bidder has received assistance in obtaining bonding for this project, Bidder shall set forth name and nature of firm providing such assistance. Should firm be listed as a subcontractor, Bidder shall set forth the percentage of the Contract to be performed by the subcontractor.

Firm Providing Assistance and Nature of Assistance

Subcontractor: Yes _____ No _____ Percentage: _____

Penalties: Penalties for furnishing incorrect supporting information in obtaining preference are defined in Section 1896.12.

STATEMENT OF COMPLIANCE -- NONDISCRIMINATION

In submitting this Bid, the Bidder hereby certifies, unless specifically exempted, compliance with Public Contract Code, Section 12990, and CCR, Title 2, Division 4, Chapter 5, in matters relating to the development, implementation, and maintenance of a nondiscrimination program. Bidder agrees not to unlawfully discriminate against any employee or applications for employment because of race, religion, color, national origin, ancestry, physical handicap, medical condition, marital status, sex, or age (over 40).

QUESTIONNAIRE

- 1) In accordance with Public Contract Code, Section 10162, the Bidder shall complete the following questionnaire:
 - a) Has the Bidder, any officer of the Bidder, or any employee of the Bidder who has a proprietary interest in the Bidder, ever been disqualified, removed, or

otherwise prevented from bidding on, or completing a federal, state, or local government project because of a violation of law or a safety regulation?

Yes _____ No _____

b) Has the Bidder, any officer of the Bidder, or any employee of the Bidder who has a proprietary interest in the Bidder, ever received a safety violation or failed to file notifications to the CAL/OSHA, Federal OSHA, or EPA agencies for employee records as required by CCR, Title 8, Section 5208, and CFR 40, Part 61?

Yes _____ No _____

If the answer to either a) or b) above is "Yes," then give the date(s) of the citation(s) or failure to make notifications, and explain the circumstances by attachment to this Bid Proposal.

CERTIFICATION OF A DRUG-FREE WORKPLACE

The certification of a drug-free workplace form is attached as a part of these Bid documents and shall be completed and returned with the Bid Form, fully completed and executed.

Signature of Bidder:

Dated: _____, 20__.

NOTE: If Bidder is a corporation, the legal name of the corporation shall be set forth above, together with the signature of the officer or officers authorized to sign contracts on behalf of the corporation and the corporate seal; if Bidder is a partnership, the true name of the firm shall be set forth above, together with the signature of the partner or partners authorized to sign contracts on behalf of the partnership; if the Bidder is an individual, his signature shall be placed above; if the Bidder is a joint venture, the name of the joint venture shall be set forth above with the signature of an authorized representative of each venturer.

NONCOLLUSION AFFIDAVIT

_____, being first duly sworn,
deposes and says that he/she is
_____ of _____ the party
making the foregoing bid, that the bid is not made in the interest of, or on behalf of, any
undisclosed person, partnership, company, association, organization, or corporation; that
the bid is genuine and not collusive or sham; that the Bidder has not directly or indirectly
induced or solicited any other bidder to put in a false or sham bid, and has not directly or
indirectly colluded, conspired, connived, or agreed with any Bidder or anyone else to put
in a sham bid, or that anyone shall refrain from bidding; that the Bidder has not in any
manner, directly or indirectly, sought by agreement, communication, or conference with
anyone to fix the bid price of the Bidder or any other bidder, or to fix any overhead,
profit, or cost element of the bid price, or of that of any other bidder, or to secure any
advantage against the public body awarding the contract of anyone interested in the
proposed contract; that all statements contained in the bid are true; and, further, that the
Bidder has not, directly or indirectly, submitted his or her bid price or any breakdown
thereof, or the contents thereof, or divulged information or data relative thereto, or paid,
and will not pay, any fee to any corporation, partnership, company association,
organization, bid depository or to any member or agent thereof to effectuate a collusive
or sham bid.

Bidder

State of California)
) ss.
County of _____)

On this _____ day of _____ 20____, before me personally came
_____ to me known, or proven to be on the basis of
satisfactory evidence, who being duly sworn, did depose and say: that
_____ is an authorized representative of the
_____ and acknowledged to me that
_____ executed the within instrument on behalf of
said Bidder.

In witness whereof, I have signed and affixed my official seal on the date first above
written.

Notary Public

END OF SECTION

SECTION 005200
AGREEMENT

THIS AGREEMENT, made and entered into by and between the
WESTER HILLS WATER DISTRICT

hereinafter referred to as "OWNER" and

_____;
a corporation under the laws of the state of _____;

a partnership composed of _____;

a joint venture composed of _____;

an individual doing business as _____;
hereinafter referred to as "CONTRACTOR."

OWNER and CONTRACTOR agree as follows:

- (1) SCOPE OF WORK: CONTRACTOR will furnish all materials and will perform all of the work for the construction of
**WESTERN HILLS WATER DISTRICT
2012 SYSTEM MODIFICATIONS AND IMPROVEMENTS**
in accordance with the plans and specifications and other contract documents therefore.
- (2) TIME FOR COMPLETION: The work shall be completed within the times set forth in Section 007300 (G). Time is of the essence and forfeiture due to delay will be assessed as provided for in the General Provisions.
- (3) CONTRACT SUM: OWNER will pay CONTRACTOR in accordance with the prices shown in the Bid Form.
- (4) PAYMENTS: Monthly progress payments and the final payment will be made in accordance with the General Provisions as modified by the Special Provisions. The filing of the notice of completion by OWNER shall be preceded by acceptance of the work made only by an action of the Governing Body of OWNER in session.
- (5) COMPLIANCE WITH PUBLIC CONTRACTS LAW: OWNER is a public agency in the State of

provisions of law applicable to public contracts are a part of this contract to the same extent as though set forth herein and will be complied with by CONTRACTOR.

- (6) CONTRACTOR'S REPRESENTATIONS: In order to induce OWNER to enter into this Agreement, CONTRACTOR makes the following representations:
- (a) CONTRACTOR has examined and carefully studied the Contract Documents and the other related data identified in the Bidding Documents;
 - (b) CONTRACTOR has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;
 - (c) CONTRACTOR is familiar with and is satisfied as to all federal, state, and local laws and regulations that may affect cost, progress, and performance of the Work;
 - (d) CONTRACTOR has carefully studied all reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface and subsurface structures at or contiguous to the Site (except underground facilities) which have been identified in the Supplementary Conditions as provided in the General Provisions;
 - (e) CONTRACTOR has obtained and carefully studied (or assumes responsibility for having done so) any additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and underground facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods techniques, sequences, and procedures of construction to be employed by CONTRACTOR, including applying the specific means, methods, techniques, sequences, and procedures of construction, if any, expressly required by the Contract Documents to be employed by CONTRACTOR, and safety precautions and programs incident thereof;
 - (f) CONTRACTOR does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract times, and in accordance with the other terms and conditions of the Contract Documents;
 - (g) CONTRACTOR is aware of the general nature of work to be performed by OWNER and others at the Site that relates to the Work as indicated in the Contract Documents;
 - (h) CONTRACTOR has correlated the information known to CONTRACTOR, information and observations obtained from visits to the Site, reports and drawings identified in the Contract Documents, and all additional examinations, investigations, explorations, tests, studies, and data within the Contract Documents;
 - (i) CONTRACTOR has given ENGINEER written notice of all conflicts, errors, ambiguities, or discrepancies that CONTRACTOR has discovered in the Contract Documents, and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR; and

- (j) The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
- (7) ACCOUNTING RECORDS: CONTRACTOR shall check all materials, equipment, and labor entering into the Work and shall keep such full and detailed accounts as may be necessary for proper financial management under this Agreement, and the accounting methods shall be satisfactory to OWNER. OWNER shall be afforded access to all Contractor's records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to the cost of the Work and CONTRACTOR's fee. CONTRACTOR shall preserve all such documents for a period of three years after the final payment by OWNER.
- (8) CONTRACT DOCUMENTS: The complete contract includes all the Contract Documents set forth herein, to wit: Notice Inviting Sealed Proposals (Bids), Bid Form, Agreement, Bid Bond, Performance Bond, Payment Bond, CONTRACTOR's Certificate Regarding Workers' Compensation, Certificate of Insurance (Workers' Compensation and Employers' Liability), Insurance Endorsement (Workers' Compensation and Employers' Liability), Certificate of Insurance (Liability), Insurance Endorsement (Liability), Certificate of Insurance (Builders' Risk "All Risk"), Insurance Endorsement (Builders' Risk "All Risk"), Certificate of Insurance (Earthquake and Flood), Insurance Endorsement (Earthquake and Flood), Certificate of Insurance (CONTRACTOR's Pollution Liability), Insurance Endorsement (CONTRACTOR's Pollution Liability), General Provisions, Special Provisions, Standard Specifications, Drawings, Plans, and also addenda thereto and supplemental agreements.
- (9) SUCCESSOR AND ASSIGNS: OWNER and CONTRACTOR each binds itself, its partners, successors, assigns, and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.
- (10) PROMPT PAYMENT: As required by California law, the provisions of California Public Contract Code Section 20104.50, regarding prompt payment to contractors, are hereby incorporated in their entirety.
- (11) AIR POLLUTION: The CONTRACTOR shall comply with all air pollution control rules, regulations, ordinances, and statutes which apply to any work performed pursuant to the Contract, including any air pollution control rules, regulations, ordinances, and statutes specified in Section 11017 of the Government Code.

This Agreement is executed by the OWNER pursuant to an action of its Governing Body in session on _____, 20___, authorizing the same, and CONTRACTOR has caused this Agreement to be duly executed. The effective date will be the last date of execution by the parties.

Dated: _____, 20___ By _____
(Authorized Representative of OWNER)

Title: _____

Dated: _____, 20__

(CONTRACTOR)

By _____
(Authorized Representative of CONTRACTOR)

Title _____

(If Bidder is a Corporation, attached Seal)

(Attach Acknowledgment for Authorized Representative of CONTRACTOR)

APPROVED:

(Attorney for OWNER)

CERTIFICATE OF CONTRACTOR

I, _____, certify that I am a/the _____ [designate sole proprietor, partner in partnership, or specify corporate office, e.g., secretary] in the entity named as CONTRACTOR in the foregoing contract.

I hereby expressly certify that the name of the entity to which I am associated is _____; that this entity is in good standing and has complied with all applicable laws and regulations, and that I have been expressly authorized by the proper parties in this entity to execute this contract on behalf of the above-named entity.

ATTEST:

Name _____
(Please Type)

Title _____

On this _____ day of _____, 20__, before me personally came _____ to me known, or proven to me on the basis of satisfactory evidence, who being duly sworn, did depose and say: that (he/she) is an authorized representative of the CONTRACTOR and acknowledged to me that (he/she) executed the within instrument on behalf of said CONTRACTOR, _____.

In witness whereof, I have signed and affixed my official seal on the date in this certificate first above written.

NOTARY PUBLIC

END OF SECTION

SECTION 006110
BID BOND

We, _____

as Principal, and _____
as Surety, jointly and severally, bind ourselves, our heirs, representatives, successors and assigns,
as set forth herein, to the

WESTER HILLS WATER DISTRICT

(herein called OWNER) for payment of the penal sum of _____

_____ Dollars (\$ _____), lawful money of the United States. Principal has submitted the accompanying bid for the construction of

**WESTERN HILLS WATER DISTRICT
2012 SYSTEM MODIFICATIONS AND IMPROVEMENTS**

If the Principal is awarded the contract and enters into a written contract, in the form prescribed by the OWNER, at the price designated by his bid, and files two bonds with the OWNER, or substitute security in lieu thereof, one to guarantee payment for labor and materials and the other to guarantee faithful performance, in the time and manner specified by the OWNER, and carries all insurance in type and amount which conforms to the Contract Documents and furnishes required certificates and endorsements thereof **within 15 calendar days after notice of award by the Owner in writing**, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

Forfeiture of this bond, or any deposit made in lieu thereof, shall not preclude the OWNER from seeking all other remedies provided by law to cover losses sustained as a result of the Principal's failure to do any of the foregoing.

Principal and Surety agree that if the OWNER is required to engage the services of an attorney in connection with the enforcement of this bond, each shall pay OWNER's reasonable attorney's fees incurred with or without suit.

Executed on _____, 20____

PRINCIPAL

(Seal if Corporation)

By _____

Title _____

(Attach Acknowledgment of Authorized Representative of Principal)

Any claims under this bond may be addressed to:

(name and address of Surety)

(name and address of Surety's agent for service of process in California, if different from above)

(telephone number of Surety's agent in California)

(Attach Acknowledgment)

SURETY

By _____
(Attorney-in-Fact)

NOTICE:

No substitution or revision to this bond form will be accepted. Sureties must be authorized to do business in and have an agent for service of process in California. Certified copy of Power of Attorney must be attached.

END OF SECTION

SECTION 006111
PERFORMANCE BOND

We, _____
as Principal, and _____
as Surety, jointly and severally, bind ourselves, our heirs, representatives, successors and assigns,
as set forth herein, to the

WESTERN HILLS WATER DISTRICT

(herein called OWNER) for payment of the penal sum of _____

_____ Dollars (\$ _____), lawful money of the United States. OWNER has awarded
Principal a contract for the construction of

**WESTERN HILLS WATER DISTRICT
2012 SYSTEM MODIFICATIONS AND IMPROVEMENTS**

THE CONDITION OF THIS OBLIGATION IS SUCH that if the Principal shall in all things abide by and well and truly keep and perform the covenants, and agreements in the said contract, and any alteration thereof made as therein provided, on his part to be kept and performed at the time and in the manner therein specified, and shall faithfully fulfill the one-year guarantee of all materials and workmanship, and shall indemnify and save harmless the OWNER, the DISTRICT ENGINEER, the OWNER'S REPRESENTATIVE, and their consultants, and each of their directors, officers, employees and agents, as therein stipulated, this obligation shall become null and void, otherwise, it shall be and remain in full force and effect.

Surety agrees that no change, extension of time, alteration, or addition to the terms of the contract, or the work to be performed thereunder, or the plans and specifications shall in any way affect its obligation on this bond, and it does hereby waive notice thereof.

Principal and Surety agree that if the OWNER is required to engage the services of an attorney in connection with the enforcement of this bond, each shall pay OWNER's reasonable attorney's fees incurred, with or without suit, in addition to the above sum.

Executed in four original counterparts on

_____, 20____

PRINCIPAL

(Seal if Corporation)

By _____

Title _____

(Attach Acknowledgment of Authorized Representative of Principal)

Any claims under this bond may be addressed to:

_____ (name and address of Surety)

_____ (name and address of Surety's agent for service of process in California, if different from above)

_____ (telephone number of Surety's agent in California)

(Attach Acknowledgment)

_____ SURETY

By _____

APPROVED:

(Attorney-in-Fact)

(Attorney for OWNER)

NOTICE:

No substitution or revision to this bond form will be accepted. Sureties must be authorized to do business in and have an agent for service of process in California. Certified copy of Power of Attorney must be attached.

END OF SECTION

SECTION 006112
PAYMENT BOND

We, _____
as Principal, and _____
as Surety, jointly and severally, bind ourselves, our heirs, representatives, successors and assigns,
as set forth herein, to the

WESTERN HILLS WATER DISTRICT

(herein called OWNER) for payment of the penal sum of _____

_____ Dollars (\$ _____), lawful money of the United States. OWNER has awarded Principal a contract for the construction of

**WESTERN HILLS WATER DISTRICT
2012 SYSTEM MODIFICATIONS AND IMPROVEMENTS**

If Principal or any of his subcontractors fails to pay any of the persons named in Section 3181 of the California Civil Code, or amounts due under the Unemployment Insurance Code with respect to work or labor performed under the contract or during the one-year guarantee period, or for any amounts required to be deducted, withheld, and paid over to the Franchise Tax Board from the wages of employees of the contractor and his subcontractors pursuant to Section 13020 of the Unemployment Insurance Code, with respect to such work and labor, then Surety will pay the same in an amount not exceeding the sum specified above, and also will pay, in case suit is brought upon this bond, such reasonable attorney's fees as shall be fixed by the court.

This bond shall inure to the benefit of any of the persons named in Section 3181 of the California Civil Code, so as to give a right of action to them or their assigns in any suit brought upon this bond.

Surety agrees that no change, extension of time, alteration, or addition to the terms of the contract, or the work to be performed thereunder, or the drawings and specifications shall in any way affect its obligation on this bond, and it does hereby waive notice thereof.

Principal and Surety agree that should OWNER become a party to any action on this bond that, each will also pay OWNER's reasonable attorney's fees incurred therein in addition to the sum above set forth.

Executed in four original counterparts on

_____, 20____

(Seal if Corporation)

PRINCIPAL

By _____

Title _____

(Attach Acknowledgment of Authorized Representative of Principal)

Any claims under this bond may be addressed to:

(name and address of Surety)

(name and address of Surety's agent for service of process in California, if different from above)

(telephone number of Surety's agent in California)

(Attach Acknowledgment)

SURETY

By _____

(Attorney-in-Fact)

APPROVED:

(Attorney for OWNER)

NOTICE:

No substitution or revision to this bond form will be accepted. Sureties must be authorized to do business in and have an agent for service of process in California. Certified copy of Power of Attorney must be attached.

END OF SECTION

SECTION 006220
CONTRACTOR'S CERTIFICATE REGARDING WORKERS' COMPENSATION

Description of Contract:

**WESTERN HILLS WATER DISTRICT
2012 SYSTEM MODIFICATIONS AND
IMPROVEMENTS**

Labor Code Section 3700 provides (in part):

“Every employer except the State shall secure the payment of compensation in one or more of the following ways:

(a) By being insured against liability to pay compensation in one or more insurers duly authorized to write compensation insurance in this State.

(b) By securing from the Director of Industrial Relations a certificate of consent to self-insure, which may be given upon furnishing proof satisfactory to the Director of Industrial Relations of ability to self-insure and to pay any compensation that may become due to his employees.”

I am aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the work of this contract.

Dated: _____, 20__

(CONTRACTOR)

By _____

(Official Title)

(SEAL)

(Labor Code Section 1861 provides that the above certificate must be signed and filed by the CONTRACTOR with the OWNER prior to performing any work under this contract.)

END OF SECTION

SECTION 006223
LIABILITY INSURANCE CERTIFICATE OF INSURANCE

Description of Contract: **WESTERN HILLS WATER DISTRICT
2012 SYSTEM MODIFICATIONS AND IMPROVEMENTS**

Type of Insurance: **Liability Insurance**

THIS IS TO CERTIFY that the following policies have been issued by the below-stated company in conformance with the requirements of Article 3-4 of the General Provisions and Section 007300(H) and are in force at this time:

Type of Insurance	Policy Number	Effective Date	Expiration Date	Limits	
General Liability				General Aggregate	
				Products—Comp/Ops Agg.	
				Personal & Adv. Injury	
				Each Occurrence	
				Fire Damage (Any one fire)	
				Med. Expense (Any one person)	
Automobile Liability				Combined Single Limit	
				Bodily Injury (Per person)	
				Bodily Injury (Per Accident)	
				Property Damage	
Excess Liability				Each Occurrence	
				Aggregate	

This certificate is issued as a matter of information only and confers no rights upon the certificate holder. This certificate does not amend, extend, or alter the coverage afforded by the policies listed herein.

This is to certify that the policy has been issued to the named insured for the policy period indicated, notwithstanding any requirement, term, or condition of any contract or other document with respect to which this certificate may be issued or may pertain, the insurance afforded by the policies described herein is subject to all the terms, exclusions, and conditions of such policies.

The Company will give at least ten (10) days' written notice to the OWNER prior to cancellation of said policy for nonpayment of premium and thirty (30) days' written notice to the OWNER prior to cancellation of said policy for any other reason.

Named Insured (CONTRACTOR)

Insurance Company

Street Number

Street Number

City and State

City and State

By _____
(Company Representative)

Insurance Company Agent for Service
of Process in California:

Name

Agency

Street Number

City and State

Telephone Number

NOTICE:

No substitution or revision to the above certificate form will be accepted. If the insurance called for is provided by more than one insurance company, a separate certificate in the exact above form shall be provided for each insurance company.

Insurers must be authorized to do business and have an agent for service of process in California and have at least a B+ VIII rating in accordance with the most current Best's Rating Guide.

END OF SECTION

SECTION 006224
LIABILITY INSURANCE ENDORSEMENT

Description of Contract: **WESTERN HILLS WATER DISTRICT
2012 SYSTEM MODIFICATIONS AND
IMPROVEMENTS**

Type of Insurance: Liability Insurance

This endorsement forms a part of Policy No. _____.

ENDORSEMENT

The OWNER, the ENGINEER, the OWNER'S REPRESENTATIVE, and their consultants, and each of their directors, officers, and employees are included as additional insured's under said policy but only while acting in their capacity as such and only as respects operations of the named insured. This insurance shall not apply to an additional insured to the degree that the loss or damage is ultimately determined to be the result of the additional insured's negligence (including any connected with the preparation or approval of maps, drawings, opinions, reports, surveys, designs, or specifications). The insurance afforded to these additional insured's is primary insurance. If the additional insured's have other insurance which might be applicable to any loss, the amount of this insurance shall not be reduced or prorated by the existence of such other insurance.

This endorsement does not increase the Company's total limits of liability.

Named Insured (CONTRACTOR)	Insurance Company
Street Number	Street Number
City and State	City and State
	By _____ (Company Representative)

NOTICE:

No substitution or revision to the above endorsement form will be accepted. If the insurance called for is provided by more than one policy, a separate endorsement in the exact above form shall be provided for each policy.

END OF SECTION

RELEASE FORM

OWNER: _____

NAME OF CONTRACTOR: _____

PROJECT DESCRIPTION: _____

PERIOD WORK PERFORMED: _____

The above-named Contractor hereby acknowledges payment in full for all compensation of whatever nature due the Contractor for all labor and materials furnished and for all work performed on the above-referenced project for the period specified above with the exception of Contract retention amounts and disputed claims specifically shown below.

RETENTION AMOUNT FOR THIS PERIOD: \$ _____

DISPUTED CLAIMS

<u>DESCRIPTION OF CLAIM</u>	<u>AMOUNT CLAIMED</u>
-----------------------------	-----------------------

The Contractor further expressly waives and releases any claim the Contractor may have, of whatever type or nature, for the period specified which is not shown as a retention amount or a disputed claim on this form. This release and waiver has been made voluntarily by Contractor without any fraud, duress, or undue influence by any person or entity.

Contractor further certifies, warrants, and represents that all bills for labor, materials and work due subcontractors for the specified period have been paid in full and that the parties signing below on behalf of Contractor have express authority to execute this release.

DATED: _____

PRINT NAME OF CONTRACTOR

DESCRIBE ENTITY (Partnership, Corporate, etc.)

By _____

By _____

SECTION 007000
GENERAL PROVISIONS

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ARTICLE 1 DEFINITIONS, TERMS, AND ABBREVIATIONS

1-1 DEFINITIONS

Whenever the following terms occur in the Contract Documents, the meaning shall be interpreted as follows:

ACCEPTANCE, FINAL ACCEPTANCE. The formal action by the Owner accepting the work as being complete.

ACCEPTED BID. The bid (proposal) accepted by the Owner.

ADDENDA. Written or graphic instruments issued prior to the opening of bids which clarify, correct, or change the bidding requirements and the Contract Documents.

AGREEMENT. The written instrument which is evidence of the agreement between Owner and Contractor covering the work.

BIDDER. Any individual, partnership, corporation, joint venture, or other combination thereof submitting a proposal for the work contemplated, acting directly or through an authorized representative.

CONTRACT. The entire and integrated written agreement executed between the Owner and the Contractor concerning the work. The Contract supersedes prior negotiations, representations or agreements, whether written or oral.

CONTRACTOR. The individual, partnership, corporation, joint venture, or other combination thereof that has entered into the Contract with the Owner for the performance of the work. The term "Contractor" means the Contractor or its authorized representative.

CONTRACT DOCUMENTS. The Contract Documents set forth in the Agreement; also any and all supplemental agreements amending or extending the work contemplated. Supplemental agreements are written agreements covering alterations, amendments, or extensions to the Contract and include Contract change orders.

DAYS. Unless otherwise specified, days shall mean calendar days.

ENGINEER or DISTRICT ENGINEER. The Western Hills Water District - District Engineer. Patrick Garvey. The term "Engineer" or "District Engineer" means the District Engineer, its authorized representative, its consultant, Benchmark Engineering Inc. or its approved subconsultants.

OWNER. The Western Hills Water District identified as such in the Agreement. The term "Owner" means the Owner or its authorized representative.

OWNER'S REPRESENTATIVE. The person or firm authorized in writing by the Owner to represent it during the performance of the work by the Contractor. The Owner's Representative means the Owner's Representative or its assistants.

PLANS, DRAWINGS. The plans (drawings), or reproductions thereof, which show the location, character, dimensions, and scope of the work to be done.

SPECIAL PROVISIONS. Additions, deletions, and changes to the General Provisions and Standard Specifications.

SPECIFICATIONS. The written provisions and requirements contained in the General Provisions and Standard Specifications as supplemented by the Special Provisions.

STANDARD SPECIFICATIONS. The Contract Documents identified or referenced as such.

SUBCONTRACTOR. An individual, partnership, corporation, joint venture, or other combination thereof that has a contract with the Contractor to perform any of the work at the site. Subcontractor also means an individual, partnership, corporation, joint venture, or other combination thereof that has a contract with another subcontractor to perform any of the work at the site.

STANDARD DRAWINGS, STANDARD PLANS. That portion of the plans identified or referenced as such.

UTILITY. Public or private fixed works for the transportation of fluids, gases, power, signals, or communications.

WORK. Any and all obligations, duties, and responsibilities necessary to complete the construction assigned to, or undertaken by, the Contractor pursuant to the Contract Documents including all labor necessary to produce such construction and all materials, equipment, and supplies incorporated or to be incorporated in the construction. Also, the completed construction or parts thereof required to be provided under the Contract Documents.

1-2 TERMS

Wherever the terms "required," "permitted," "ordered," "designated," "directed," "prescribed," or terms of like import are used, it shall be understood that the requirements, permission, order, designation, prescription, or direction of the Owner's Representative is intended. Similarly, the terms "acceptable," "satisfactory," "or equal," or terms of like import shall mean acceptable to or satisfactory to the Owner's Representative, unless otherwise expressly stated. The word "provide" shall be understood to mean furnish and install. Whenever the context so requires, the singular shall include the plural, and the masculine and neuter genders shall each include the other.

1-3 ABBREVIATIONS

Wherever the following abbreviations are used, they shall have the meanings indicated:

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AGA	American Gas Association
AI	The Asphalt Institute
AIA	American Institute of Architects
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron & Steel Institute
ANSI	American National Standards Institute (formerly USASI, USAS, ASA)
API	American Petroleum Institute
APWA	American Public Works Association
AREA	American Railway Engineering Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
CRSI	Concrete Reinforcing Steel Institute
IEEE	Institute of Electrical and Electronics Engineers
NBFU	National Board of Fire Underwriters
NEMA	National Electrical Manufacturers Association
PCA	Portland Cement Association
State Specifications	California Standard Specifications, State of California, Department of Transportation, Division of Highways
SSPC	Steel Structures Painting Council
UBC	Uniform Building Code, Pacific Coast Building Officials Conference of the International Conference of Building Officials
U/L or UL	Underwriters' Laboratories, Inc.
USGS	United States Geological Survey

ARTICLE 2 PROPOSAL REQUIREMENTS AND CONDITIONS

2-1 CONTRACT DOCUMENTS

The Contract Documents are set forth in the agreement form and the definition of "Contract Documents" in the article on DEFINITIONS, TERMS, AND ABBREVIATIONS.

2-2 LICENSE

No bid will be accepted from a Bidder who is not licensed to conduct business in the state of California and licensed to perform the class of work defined by the Contract Documents.

2-3 PROPOSALS

Bids shall be made upon the bid form furnished by the Owner and a part of the Contract Documents. All bids shall be properly executed and with all items filled in; the signatures of all persons signing shall be in longhand. Erasures, interlineations, or other corrections shall be authenticated by affixing in the margin immediately opposite the correction the initials of a person signing the bid. If the unit price and the total amount named by a Bidder for any item are not in agreement, the unit price alone shall be considered as representing the Bidder's intention, and the totals shall be corrected to conform thereto.

Bids shall not contain any recapitulation of the work to be done. Alternative proposals will not be considered, except as called for. No oral, telegraphic, or telephonic proposals or modifications will be considered.

Bids shall be accompanied by a "**Bid Bond**" in the form of a cashier's or a certified check, or bidder's bond or substitute security, in an amount not less than 10 percent of the amount of bid, made payable to or for the benefit of the Owner. Said check or bond or substitute shall be given as a guarantee that the Bidder will enter into a Contract and furnish the required bonds or substitutes and insurance certificates and endorsements if awarded the Contract, and in case of refusal or failure to enter into said Contract and furnish the required bonds or substitutes and insurance certificates and endorsements within 15 calendar days after notice of award by the Owner in writing, the check and the money represented by said check shall be forfeited to the Owner, or in the event that a bond or other security is deposited, said security shall be forfeited. Forfeiture does not preclude the Owner from seeking all other remedies provided by law to recover losses sustained as a result of the Contractor's failure to enter into the Contract or to furnish the required bonds or substitutes, or insurance certificates and endorsements, including without limitation, attorneys' fees and other costs reasonably incurred by the Owner, with or without legal proceedings.

Bids shall be sealed in an envelope marked and addressed as set forth in the Special Provisions. Bids shall be delivered to the addressee at the location designated in the Notice Inviting Sealed Proposals on or before the day and hour set for the opening of bids in the Notice Inviting Sealed Proposals, and shall bear the name of the Bidder. A bid will not be accepted after the date and time designated in the Notice Inviting Sealed Proposals. It is the sole responsibility of the Bidder to see that its bid is delivered and received in proper time. Any bid received after said designated date and time shall be returned to the Bidder unopened.

2-4 WITHDRAWAL OF BID

A Bidder may withdraw its bid by a signed written request any time prior to the date and time for receiving bids designated in the Notice Inviting Sealed Proposals.

The withdrawal of a bid does not prejudice the right of a Bidder to file a new bid so long as the new bid is delivered as set forth in the article on PROPOSALS prior to the closing time specified for all bids.

2-5 BIDDERS INTERESTED IN MORE THAN ONE BID

No person, partnership, or corporation shall be allowed to make or file, or be interested in more than one bid for the work, unless alternative bids are called for. A person, partnership, or corporation submitting a subproposal to a Bidder, or who has quoted prices on material to a Bidder, is not thereby disqualified from submitting a subproposal or quoting prices to other Bidders.

2-6 INTERPRETATION OF PLANS AND OTHER CONTRACT DOCUMENTS

If any person or entity contemplating submitting a bid for the proposed Contract is in doubt as to the true meaning of any part of the plans, specifications, or other contract documents, or finds discrepancies in, or omissions from the plans and specifications or other contract documents, it may submit to the Engineer a written request for an interpretation or correction thereof. The person submitting the request will be responsible for its prompt delivery. An interpretation or correction of the Contract Documents will be made only by Addendum duly issued by the Engineer. A copy of such Addendum will be mailed or delivered to each person or entity that has received a set of such documents. The Owner and the District Engineer will not be responsible for any other explanation or interpretation of the documents.

2-7 ADDENDA

Addenda issued before the time in which to submit bids expires shall be included in the bid and shall be made a part of the Contract.

2-8 EXISTING CONDITIONS AND EXAMINATION OF CONTRACT DOCUMENTS

The Bidder represents that it has carefully examined the Contract Documents and the site where the work is to be performed and that it has familiarized itself with all local conditions and federal, state and local laws, ordinances, rules, and regulations that may affect in any manner the performance of the work. The Bidder further represents that it has studied all surveys and investigation reports about subsurface and latent physical conditions pertaining to the jobsite, that it has performed such additional surveys and investigations as it deems necessary to complete the work at its bid price, and that it has correlated the results of all such data with the requirements of the Contract Documents. The submittal of a bid shall be conclusive evidence that the Bidder has investigated and is satisfied as to the conditions to be encountered, including locality, uncertainty of weather and all other contingencies, and as to the character, quality, quantities, and scope of the work.

The plans and specifications for the work show subsurface conditions or otherwise hidden conditions as they are supposed or believed by the Engineer to exist; but it is not intended or to be inferred that the conditions as shown thereon constitute a representation that such conditions are actually existent. Except as otherwise specifically provided in the Contract Documents, the Owner, the Engineer, and their consultants shall not be liable for any loss sustained by the Contractor as a result of any variance of such conditions as shown on the plans and the actual conditions revealed during the progress of the work or otherwise.

Where the Owner or the Engineer or their consultants have made investigations of subsurface conditions in areas where the work is to be performed, such investigations were made only for the purpose of study and design. The conditions indicated by such investigations apply only at the specific location of each boring or excavation at the time the borings or excavations were made. Where such investigations have been made, Bidders or Contractors may inspect the records as to such investigations subject to and upon the conditions hereinafter set forth. The inspection of the records shall be made at the office of the Engineer.

The records of such investigations are not a part of the Contract and are shown solely for the convenience of the Bidder or Contractor. It is expressly understood and agreed that the Owner, the Engineer, and their consultants assume no responsibility whatsoever in respect to the sufficiency or accuracy of the investigations; the records thereof; or of the interpretations set forth therein or made by the Owner's consultants, the Engineer or its consultants in the use thereof by the Engineer, and there is no warranty or guarantee, either express or implied, that the conditions indicated by such investigations or records thereof are representative of those existing throughout such areas, or any part thereof, or that unlooked-for developments may not occur, or that materials other than, or in proportions, densities, or other characteristics different from, those indicated may not be encountered.

When a log of test borings showing a record of the data obtained by the investigation of subsurface conditions by the Owner, the Engineer, or their consultants is included with the plans or other documents, it is expressly understood and agreed that said log of test borings does not constitute a part of the Contract, represents only the opinion of the Owner or the Engineer or their consultants as to the character of the materials encountered by them in the test borings, is included in the plans or other documents only for the convenience of Bidders, and its use is subject to all of the conditions and limitations set forth in this article.

The availability or use of information described in this article is not to be construed in any way as a waiver of the provisions of the first paragraph in this article and a Bidder or Contractor is cautioned to make such independent investigations and examination as it deems necessary to satisfy itself as to conditions to be encountered in the performance of the work.

No information derived from such inspection of records of investigations or compilation thereof made by the Owner, the Engineer, or their consultants will in any way relieve the Bidder or Contractor from any risk or from properly fulfilling the terms of the Contract nor entitle the Contractor to any additional compensation.

ARTICLE 3 AWARD AND EXECUTION OF CONTRACT

3-1 AWARD OF CONTRACT OR REJECTION OF BIDS

The award of the Contract, if it be awarded, will be to the lowest responsible responsive Bidder complying with the instructions contained in the Contract Documents. The Owner, however, reserves the right to select the schedules under which the bids are to be compared, to reject any and all bids, and to waive any irregularity in bids received. If, in the judgment of the Owner, a bid is unbalanced or if the Bidder is not responsible, it shall be considered sufficient grounds for rejection of the entire bid.

The Owner shall have the period of time set forth in the Special Provisions after the opening of bids within which to accept or reject the bids. No Bidder may withdraw its bid during said period. The Owner will return the proposal guarantees, except any guarantees which have been forfeited, and except bidders' bonds, to the respective Bidders whose proposals they accompanied within ten days after the execution of the Contract by the successful Bidder or rejection of all bids or upon receipt of a written request therefor received after said period of time set forth in the Special Provisions.

Before award of the Contract, any Bidder shall furnish upon request a recent statement of its financial condition and previous construction experience or such other evidence of its qualifications as may be requested by the Owner. If a Bidder fails to furnish in a timely manner the information requested, it shall be considered sufficient grounds for rejection of such Bidder's entire bid.

3-2 EXECUTION OF CONTRACT

The form of agreement, bonds, and other documents which the successful Bidder, as Contractor, will be required to execute are included as a part of the Contract Documents.

The Contract shall be signed by the successful Bidder and returned to the Owner, together with the bonds and certificates of insurance and endorsements, within 15 calendar days or such additional time as may be allowed by the Owner from the date of the mailing of notice from the Owner to the Bidder or from the date of personal delivery of notice from the Owner to the Bidder that the agreement is ready for signature. The agreement, bonds, certificates of insurance and endorsements, and other documents to be executed by the Contractor shall be executed in original-quadruplicate, one each of which shall be filed with the Owner and one each with the Attorney for the Owner and the Engineer for the Owner.

3-3 BONDS

The successful Bidder, simultaneously with the execution of the Agreement, shall furnish a payment bond and a performance bond each in an amount equal to 100 percent of the Contract amount, or equivalent cash or security in lieu of bonds pursuant to Section 995.710 of the Code of Civil Procedure. Bonds shall be furnished by surety companies satisfactory to the Owner on the forms furnished as part of the Contract Documents. Surety companies, to be acceptable to the Owner, must be authorized to do business and have an agent for service of process in California.

3-4 INSURANCE REQUIREMENTS

The successful Bidder will be required to furnish the Owner proof of full compliance with all insurance requirements as specified in the article on CONTRACTOR'S INSURANCE. The forms of certificate of insurance and endorsement which the successful Bidder, as Contractor, will be required to furnish are included as a part of the Contract Documents.

3-5 FAILURE TO EXECUTE CONTRACT

Failure by a Bidder to whom the Contract is awarded to execute the Contract or to furnish the required bonds or insurance certificates and endorsements shall be just cause for the annulment of the award and the forfeiture of the proposal guarantee.

A Bidder who is awarded the Contract and fails to execute the Contract or furnish the required bonds or insurance certificates and endorsements shall be liable to the Owner for all damages resulting therefrom including reasonable attorneys' fees. The proposal guarantee forfeited shall not be a limitation thereon.

ARTICLE 4 SCOPE OF WORK

4-1 WORK TO BE DONE

The work to be done consists of furnishing all transportation, labor, materials, tools, equipment, services, permits, utilities and all other items which are necessary or appurtenant to construct and complete the entire project and construct the project designated in the Contract Documents, and to leave the grounds in a neat and presentable condition. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be provided whether or not specifically called for at no additional cost to Owner.

4-2 CHANGES IN THE WORK

The Owner may require changes in, additions to, or deductions from the work, including complete termination thereof. Adjustment, if any, in the amounts to be paid to the Contractor by reason of any such change, addition, or deduction shall be determined as set forth in Article 9 of the General Provisions.

The Owner's Representative may order minor changes in the work not involving an increase or decrease in the Contract amount, not involving a change in the time for completion, and not inconsistent with the purposes for which the work is being constructed. If the Contractor believes that any order for minor changes in the work involves changes in the Contract amount or time for completion, it shall not proceed with the minor changes so ordered and shall within seven days of the receipt of such order notify the Owner's Representative in writing of its estimate of the changes in the Contract amount and time for completion it believes to be appropriate.

No payment for changes in the work will be made, and no changes in the time for completion by reason of changes in the work will be made, unless the changes are covered by a written change order approved by the Owner in advance of the Contractor's proceeding with the changed work.

4-3 OBSTRUCTIONS

The Contractor shall remove and dispose of all structures, debris, or other obstructions of any character necessary to accommodate the work. Where such obstructions consist of improvements not required by law to be removed by the owner thereof, all such improvements shall be removed, maintained, and permanently replaced by the Contractor at its expense except as otherwise specifically provided in the Contract Documents.

4-4 UTILITIES

The Engineer has endeavored to determine the existence of utilities at the site of the work from the records provided by the owners of known utilities in the vicinity of the work. The positions of these utilities as derived from such records are shown on the plans. The service connections to these utilities may not be shown on the plans.

The Contractor shall make its own investigations, including exploratory excavations, to determine the locations and type of existing service laterals or appurtenances when their presence can be inferred from the presence of other visible facilities, such as buildings, meter and junction boxes, on or adjacent to the site of the work. If the Contractor discovers utility facilities not identified in the plans or specifications or in a position different from that shown in the plans and specifications, it shall immediately notify in writing the Owner's Representative and the owner of the utility facility.

As provided in Section 4216 of the California Government Code, at least two working days prior to commencing any excavation, the Contractor shall contact the regional notification center (Underground Service Alert of Southern California) and obtain an inquiry identification number as set forth in paragraph 4216.2.

Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data; and
2. The cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for: (a) reviewing and checking all such information and data; (b) locating all underground facilities shown or indicated in the Contract Documents; (c) coordination of the work with the owners of such underground facilities, including Owner, during construction, and (d) the safety and protection of all such underground facilities and repairing any damage thereto resulting from the work.

If an underground facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any work in connection therewith (except in an emergency) as required by Contractor, in its obligation to prevent threatened damages, injury or loss in emergencies affecting the safety or protection of persons or the work or property at the site or adjacent thereto, identify the owner of such underground facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the underground facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the underground facility. During such time, Contractor shall be responsible for the safety and protection of such underground facility.

If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract times, or both, to the extent that they are attributable to the existence or location of any underground facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated.

The right is reserved to governmental agencies and to owners of utilities to enter at any time upon any street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the work and for the purpose of maintaining and making repairs to their property.

4-5 PLANS AND SPECIFICATIONS FURNISHED BY THE OWNER

The Owner will furnish to the Contractor free of charge all copies of plans and specifications reasonably necessary for the execution of the work. The Contractor shall keep one set of plans and specifications in good order available to the Owner's Representative at the site of the work. The contractor shall keep an up to date set of clean red-lined marked up record drawings, showing all changes and As Built conditions. These records shall be kept current by the contractor for the duration of the project.

4-6 FINAL CLEANUP

Upon completion and before making application for acceptance of the work, the Contractor shall clean all rights-of-way, streets, borrow pits, and all other grounds occupied by it in connection with the work of all rubbish, excess materials, temporary structures, and equipment, and all parts of the work and grounds occupied by it shall be left in a neat and presentable condition.

4-7 AS BUILTS

The Contractor shall maintain a neatly red-lined marked up set of full size record drawings, showing all changes and the final locations and layouts of all mechanical; electrical and instrumentation equipment; piping and conduits; structures and other pertinent information depicting the 'As Built' conditions. These records shall be kept current by the contractor for the duration of the project.

Upon completion and before making application for acceptance of the work, the Contractor shall provide all As Built information to the Engineer. As Built information shall include, but will not be limited to, the most current red-lined marked up record drawings along with all horizontal, vertical changes or additions or deletions to any of the facilities, appurtenances and the specifications. Any and all known changes, whether included in contract change orders or not, shall be provided. The Engineer or his consultant will field review this information and prepare the "As Built" or "Record" drawings from this information. Final payment will not be released until adequate As Built information is provided to the Engineer.

ARTICLE 5 QUALITY OF THE WORK

5-1 AUTHORITY OF THE OWNER'S REPRESENTATIVE

The Owner's Representative shall decide any and all questions which may arise as to the interpretation of the plans and specifications and shall have authority to disapprove or reject materials and equipment furnished and work performed which, in the Owner's Representative's opinion, is not in accordance with the Contract Documents.

5-2 SUPPLEMENTAL DRAWINGS

The plans may be supplemented by such drawings as are necessary to better define the work. All such drawings delivered to the Contractor by the Owner's Representative shall be deemed written instructions to the Contractor. If the Contractor believes that any supplemental drawings call for changes in the work for which the Contract amount or time for completion should be changed, it shall not proceed with the changes in the work so called for and shall within seven days of the receipt of the supplemental drawings notify the Owner's Representative in writing of its estimate of the changes in the Contract amount and time for completion it believes to be appropriate.

No payment for changes in the work will be made and no change in the time for completion by reason of changes in the work will be made, unless the changes are covered by a written change order approved by the Owner in advance of the Contractor's proceeding with the changed work.

5-3 CONFORMITY WITH CONTRACT DOCUMENTS AND ALLOWABLE DEVIATIONS

The work shall conform to the lines, grades, dimensions, tolerances, and material and equipment requirements shown on the plans or set forth in the specifications. Although measurement, sampling, and testing may be considered evidence as to such conformity, the Owner's Representative shall be the sole judge as to whether the work or materials deviate from the plans and specifications, and its decision as to any allowable deviations therefrom shall be final.

If specific lines, grades, and dimensions are not shown on plans, those furnished by the Owner's Representative shall govern.

5-4 MANUFACTURER'S INSTRUCTIONS

All materials and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned in accordance with the instructions of the applicable manufacturer, fabricator, supplier, or distributor, except as otherwise specifically provided in the Contract Documents.

5-5 COORDINATION OF PLANS AND SPECIFICATIONS

The specifications, plans, and other contract documents are essential parts of the Contract, and a requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for the complete work. In the event of an apparent difference between plans and specifications, reference shall be made to the Owner's Representative whose decision thereon shall be final.

Special Provisions shall govern over General Provisions and Standard Specifications.

5-6 INTERPRETATION OF PLANS AND SPECIFICATIONS

Figured dimensions on drawings shall govern, but work not dimensioned shall be as directed. Work not particularly shown or specified shall be the same as similar parts that are shown or specified. Large-scale details shall take precedence over smaller scale drawings as to shape and details of construction. Specifications shall govern as to materials and workmanship. Drawings and specifications are intended to be fully complementary and to agree. The specification calling for the higher quality material or workmanship shall prevail. Materials or work described in words which so applied have a well-known technical or trade meaning shall be deemed to refer to such recognized standards. Before undertaking each part of the work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Owner's Representatives any conflict, error, ambiguity, or discrepancy which Contractor may discover and shall obtain a written interpretation or clarification from Owner's Representative before proceeding with any work affected thereby. The Owner's Representative's decision thereon shall be final.

5-7 ERRORS OR DISCREPANCIES NOTED BY CONTRACTOR

It is the duty of the Contractor to promptly notify the Owner's Representative in writing of any design, materials, or specified method that the Contractor believes may prove defective or insufficient. If the Contractor believes that a defect or insufficiency exists in design, materials, or specified method and fails to promptly notify the Owner's Representative in writing of this belief, the Contractor waives any right to assert that defect or insufficiency in design, materials, or specified method at any later date in any legal or equitable proceeding against Owner, or in any subsequent arbitration or settlement conference between the Owner and the Contractor. The Owner's Representative, on receipt of any such notice, will promptly investigate the circumstances and give appropriate instructions to the Contractor. Until such instructions are given, any work done by the Contractor after it comes to the belief that a defect or insufficiency exists in design, materials, or specified method which is directly or indirectly affected by such alleged defect or insufficiency in design, materials, or specified method will be at its own risk and it shall bear all cost arising therefrom.

If the Contractor, either before commencing work or in the course of the work, finds any discrepancy between the specifications and the plans or between either of them and the physical conditions at the site of the work or finds any error or omission in any of the plans or in any survey, it shall promptly notify the Owner's Representative of such discrepancy, error, or omission. If the Contractor observes that any plans or specifications are at variance with any applicable law, ordinance, regulation, order, or decree, it shall promptly notify the Owner's Representative in writing of such conflict. The Owner's Representative, on receipt of any such notice, will promptly investigate the circumstances and give appropriate instructions to the Contractor. Until such instructions are given, any work done by the Contractor after its discovery of such error, discrepancy, or conflict which is directly or indirectly affected by such error, discrepancy, or conflict will be at its own risk and it shall bear all cost arising therefrom.

5-8 SUPERVISION AND SUPERINTENDENCE

The Contractor shall supervise and direct the work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the work in accordance with the Contract Documents. The Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction but the Contractor shall not be solely responsible for the negligence of others in the design or selection of a specific means, method, technique, sequence, or procedure of construction that is indicated in and required by the construction documents.

The Contractor shall be responsible to see that the completed work complies with the Contract Documents.

The Contractor shall designate and keep on the work at all times during its progress a competent superintendent who shall not be replaced without written notice to the Owner's Representative. The superintendent will be the Contractor's representative at the site and shall have authority to act on behalf of the Contractor. All communications given to the superintendent shall be as binding as if given to the Contractor. During periods when the work is suspended, the Contractor shall make appropriate arrangements for any emergency work which may be required.

Whenever the superintendent is not present on any particular part of the work where the Owner's Representative may desire to inform the Contractor relative to interpretation of the plans and specifications or to disapproval or rejection of materials or work performed, the Owner's Representative may so inform the foreman or other worker in charge of the particular part of the work in reference to which the information is given. Information so given shall be as binding as if given to the superintendent.

5-9 SHOP DRAWINGS

Shop Drawings are drawings, diagrams, illustrations, schedules, performance charts, brochures, and other data which are prepared by the Contractor or any subcontractor, manufacturer, supplier, or distributor and which illustrate some portion of the work.

The Contractor shall review, mark with its approval, and submit for review by the Owner's Representative Shop Drawings as called for in the Special Provisions and Standard Specifications or requested by the Owner's Representative. Drawings shall be submitted in sextuplet to the Owner's Representative and be accompanied by a letter of transmittal listing the drawings submitted. Drawings shall show the name of the project, the name of the Contractor, and, if any, the names of suppliers, manufacturers, and subcontractors. If the Shop Drawings incorporate any documents prepared by the Engineer, such Shop Drawings shall not reproduce the registration stamp or company logo of the Engineer. Shop Drawings shall be submitted with promptness and in orderly sequence so as to cause no delay in prosecution of the work.

Shop Drawings shall be complete in all respects. If the Shop Drawings show any deviations from the requirements of the plans and specifications because of standard shop practices or other reasons, the deviations and the reasons therefor shall be set forth in the letter of transmittal.

By submitting Shop Drawings, the Contractor represents that material, equipment, and other work shown thereon conforms to the plans and specifications, except for any deviations set forth in the letter of transmittal.

Within 10 working days after receipt of said drawings, the Owner's Representative will return two of the copies of the drawings to the Contractor with any comments noted thereon. If so noted by the Owner's Representative, the Contractor shall correct the drawings and resubmit them in the same manner as specified for the original submittal. The Contractor in the letter of transmittal accompanying resubmitted Shop Drawings shall direct specific attention to revisions other than the corrections requested by the Owner's Representative on previous submittals.

The review by the Owner's Representative is only for general conformance with the design concept of the project and general compliance with the plans and specifications and shall not be construed as relieving the Contractor of the full responsibility for: providing materials, equipment, and work required by the Contract; the proper fitting and construction of the work; the accuracy and completeness of the Shop Drawings; selecting fabrication processes and techniques of construction; and performing the work in a safe manner.

No portion of the work requiring a Shop Drawing submittal shall be commenced until the submittal has been reviewed by the Owner's Representative and returned to the Contractor with a notation indicating that resubmittal is not required.

If the Contractor believes that any Shop Drawing or communication relative thereto calls for changes in the work for which the contract amount or time for completion should be changed, it shall not proceed with the changes in the work so called for and shall promptly notify the Owner's Representative in writing of its estimate of the changes in the Contract amount and time for completion it believes to be appropriate. No payment for changes in the work will be made and no change in the time for completion by reason of changes in the work will be made, unless the changes are covered by a written change order approved by the Owner in advance of the Contractor's proceeding with the changed work.

5-10 QUALITY AND SAFETY OF MATERIALS AND EQUIPMENT

All equipment, materials, and supplies to be incorporated in the work shall be new, unless otherwise specified. All equipment, materials, and supplies shall be produced in a good and workmanlike manner. When the quality of a material, process, or article is not specifically set forth in the plans and specifications, the best available quality of the material, process, or article shall be provided.

Whenever any material, process, or article is indicated or specified by grade, patent or proprietary name, or by name of manufacturer, such specification shall be deemed to be used for the purpose of facilitating description of the materials, process, or articles desired and shall be deemed to be followed by the words "or (approved) equal," and the Contractor may offer any material, process, or article which shall be substantially equal or better in every respect to that so indicated or specified; provided, however, that if the material, process, or article offered by the Contractor is not, in the opinion of the Owner's Representative, equal or better in every respect to that specified, then the Contractor must furnish the material, process, or article specified or one

that in the opinion of the Owner's Representative is the substantial equal or better in every respect. In the event that the Contractor furnishes material, process, or article more expensive than specified, the difference in cost of such material, process, or article so furnished shall be borne by the Contractor.

In accordance with Section 3400 of the Public Contract Code, the Contractor shall submit data substantiating requests for substitution of "equal" items within 35 days after award of the Contract. This 35-day period of time is included in the number of days allowed for the completion of the work.

All materials, equipment, and supplies provided shall, without additional charge to Owner, fully conform with all applicable state and federal safety laws, rules, regulations, and orders, and it shall be Contractor's responsibility to provide only such materials, equipment, and supplies notwithstanding any omission in the Contract Documents therefor or that a particular material, equipment, or supply was specified.

5-11 STANDARDS, CODES, SAMPLES, AND TESTS

Whenever reference is made to a standard, code, specification, or test and the designation representing the date of adoption or latest revision thereof is omitted, it shall mean the latest revision of such standard, code, specification, or test in effect on the day the Notice Inviting Sealed Proposals (Bids) is dated.

Tests shall be made in accordance with commonly recognized procedures of technical organizations and such special procedures as may be prescribed elsewhere in the plans and specifications. The Contractor shall furnish without charge such samples for testing as may be required by the Owner's Representative.

5-12 OBSERVATION OF WORK BY OWNER'S REPRESENTATIVE

The Owner's Representative shall at all times have access to the work during construction and shall be furnished with every reasonable facility for ascertaining full knowledge respecting the progress, workmanship, and character of materials and equipment used and employed in the work.

Whenever the Contractor varies the normal period during which work or any portion of it is carried on each day, it shall give timely notice to the Owner's Representative so that the Owner's Representative may, if the Owner's Representative wishes, be present to observe the work in progress. If the Contractor fails to give such timely notice, any work done in the absence of the Owner's Representative will be subject to rejection.

The Contractor shall give timely notice to the Owner's Representative in advance of backfilling or otherwise covering any part of the work so that the Owner's Representative may, if it wishes, observe such part of the work before it is concealed.

The observation, if any, by the Owner's Representative of the work shall not relieve the Contractor of any of its obligations to fulfill the Contract as prescribed. Defective work shall be

accordance with the Contract Documents may be rejected notwithstanding the fact that such materials, equipment, and work have been previously observed by the Owner's Representative or that payment therefor has been included in an estimate for payment.

5-13 REMOVAL OF DEFECTIVE AND UNAUTHORIZED WORK

Any work which does not conform to the requirements of the Contract Documents shall be remedied or removed and replaced by the Contractor, together with any other work which may be displaced in so doing, and no compensation will be allowed the Contractor for such removal, replacement, or remedial work. All nonconforming materials shall be immediately removed from the site.

Any work done beyond the lines and grades shown on the plans or established by the Owner's Representative or any changes in, additions to, or deductions from the work done without written authority will be considered as unauthorized and will not be paid for. Work so done may be ordered remedied, removed, or replaced at the Contractor's expense.

Upon failure on the part of the Contractor to comply promptly with any order of the Owner's Representative made under the provisions of this article, the Owner's Representative shall have authority to cause nonconforming materials, rejected work, or unauthorized work to be remedied, removed, or replaced at the Contractor's expense and to deduct the costs from any moneys due or to become due the Contractor.

5-14 ONE-YEAR GUARANTEE

Besides guarantees required elsewhere, the Contractor shall and hereby does guarantee the work for a period of one year after the date of acceptance of the work by the Owner, except for any portion of the work that is utilized or placed into service by the Owner in accordance with the provisions of Article 6-6. The guarantee period for portions of the work so utilized or placed into service shall be one year commencing on the date of the written notification to the Contractor described in Article 6-6. The Contractor shall repair or remove and replace any and all work, together with any other work which may be displaced in so doing, that is found to be defective in workmanship and/or materials within said one-year periods, without expense whatsoever to the Owner, ordinary wear and tear and unusual abuse or neglect excepted. In the event of failure to comply with the above-mentioned conditions within one week after being notified in writing, the Owner is hereby authorized to proceed to have the defects remedied and made good at the expense of the Contractor, who hereby agrees to pay the cost and charges therefor immediately on demand. Such action by the Owner will not relieve the Contractor of the guarantees required by this article or elsewhere in the Contract Documents.

The performance bond and the payment bond shall continue in full force and effect for the guarantee period.

If, in the opinion of the Owner, defective work creates a dangerous condition or requires immediate correction or attention to prevent further loss to the Owner or to prevent interruption of operation of the Owner, the Owner will attempt to give the notice required by this article. If the Contractor cannot be contacted or does not comply with the Owner's request for correction within a reasonable time as determined by the Owner, the Owner may, notwithstanding the

provisions of this article, proceed to make such correction or provide such attention; and the costs of such correction or attention shall be charged against the Contractor. Such action by the Owner will not relieve the Contractor of the guarantees required by this article or elsewhere in the Contract Documents.

This article does not in any way limit the guarantee on any items for which a longer guarantee is specified or on any items for which a manufacturer or supplier gives a guarantee for a longer period. The Contractor agrees to act as a co-guarantor with such manufacturer or supplier and shall furnish the Owner all appropriate guarantee or warranty certificates upon completion of the project. No guarantee period, whether provided for in this article or elsewhere, shall in any way limit the liability of Contractor or its sureties or insurers under the indemnity or insurance provisions of these General Provisions.

ARTICLE 6 PROSECUTION AND PROGRESS

6-1 SUBCONTRACTING

If the Contractor shall subcontract any part of this Contract, the Contractor shall be as fully responsible to the Owner for the acts and omissions of its subcontractor and of the persons either directly or indirectly employed by its subcontractor as it is for the acts and omissions of persons directly employed by the Contractor. Nothing contained in the Contract Documents shall create any contractual relationship between any subcontractor and the Owner. The Contractor shall cause every subcontractor to be bound by the terms of the Contract Documents.

The divisions and sections of the specifications and the identifications of any drawings shall not control the Contractor in dividing the work among subcontractors.

6-2 ASSIGNMENT

The performance of the Contract may not be assigned, except upon the written consent of the Owner. Consent will not be given to any proposed assignment which would relieve the original Contractor or its surety of their responsibilities under the Contract, nor will the Owner consent to any assignment of a part of the work under the Contract.

Upon obtaining a prior written consent of the Owner, the Contractor may assign moneys due or to become due it under the Contract, to the extent permitted by law, but any assignment of moneys shall be subject to all proper setoffs in favor of the Owner and to all deductions provided for in the Contract, and particularly all money withheld, whether assigned or not, shall be subject to being used by the Owner for the completion of the work in the event that the Contractor should be in default therein.

No assignment of this Contract will be approved unless it shall contain a provision that the funds to be paid to the assignee under the assignment are subject to a prior lien for services rendered or materials supplied for performance of the work called for under the Contract in favor of all persons, firms, or corporations rendering such services or supplying such materials and that the Owner may withhold funds due until all work required by the Contract Documents is completed to the Owner's satisfaction.

6-3 CONTRACTOR'S CONSTRUCTION SCHEDULE AND COST BREAKDOWN

Within ten days after execution of the Contract, the Contractor shall deliver to the Owner's Representative a construction progress schedule and cost breakdown in bar chart form showing the proposed dates of commencement and completion and cost of each of the various parts of the work and the anticipated amount of each monthly payment that will become due the Contractor in accordance therewith.

6-4 TIME FOR COMPLETION AND FORFEITURE DUE TO DELAY

The Contractor shall complete all or any designated portion of the work called for under the Contract within the time set forth in the Special Provisions. Time is of the essence in this Contract.

Failure of the Contractor to perform any covenant or condition contained in the Contract Documents within the time period specified shall constitute a material breach of this Contract entitling the Owner to terminate the Contract unless the Contractor applies for, and receives, an extension of time in accordance with the procedures set forth in this article and Article 6-5 on EXTENSION OF TIME.

Failure of the Owner to insist upon the performance of any covenant or condition within the time period specified in the Contract Documents shall not constitute a waiver of the Contractor's duty to complete performance within the designated periods unless the waiver is in writing.

The Owner's agreement to waive a specific time provision or to extend the time for performance shall not constitute a waiver of any other time provisions contained in the Contract Documents. Failure of the Contractor to complete performance promptly within the additional time authorized in the waiver or extension of time agreement shall constitute a material breach of this Contract entitling the Owner to terminate.

In accordance with Government Code 53069.85, Contractor agrees to forfeit and pay Owner the amount per day set forth in the Special Provisions for each and every day of delay which shall be deducted from any payments due or to become due the Contractor.

The Contractor shall not be deemed in breach of this Contract and no forfeiture due to delay shall be made because of any delays in the completion of the work due to unforeseeable causes beyond the control and without the fault or negligence of the Contractor, provided the Contractor requests an extension of time in accordance with the procedures set forth in this article and Article 6-5 on EXTENSION OF TIME. Unforeseeable causes of delay beyond the control of Contractor shall include acts of God, acts of a public enemy, acts of the government, acts of the Owner, or acts of another contractor in the performance of a contract with the Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and weather, or delays of subcontractors due to such causes, or delays caused by failure of the Owner or the owner of a utility to provide for removal or relocation of existing utility facilities. Delays caused by actions or neglect of Contractor or its agents, servants, employees, officers, subcontractors, directors, or of any party contracting to perform part or all of the work or to supply any equipment or materials shall not be excusable delays. Excusable delays (those beyond Contractor's control) shall not entitle the Contractor to any additional compensation except as noted below. The sole remedy of the Contractor shall be to seek an extension of time.

The Contractor will be compensated for damages incurred due to delays for which the Owner is responsible if such delays are unreasonable in the circumstances involved and were not within the contemplation of the parties when the Contract was awarded to the Contractor. Such actual costs will be determined by the Owner's Representative. The Owner will not be liable for, and in making this determination the Owner's Representative will exclude, all damages which the Owner's Representative determines the Contractor could have avoided by any reasonable means including, without limitation, the judicious handling of forces, equipment, or plant.

6-5 EXTENSION OF TIME

The time specified for completion of all of the work or any part of the work may be extended only by a written change order executed by the Owner or other written form executed by the Owner.

Requests for an extension of time must be delivered to the Owner's Representative within ten consecutive calendar days following the date of the occurrence which caused the delay. The request must be submitted in writing and must state the cause of the delay, the date of the occurrence causing the delay, and the amount of additional time requested. Requests for extensions of time shall be supported by all evidence reasonably available or known to the Contractor which would support the extension of time requested. Requests for extensions of time failing to include the information specified in this article and requests for extensions of time which are not received within the time specified above shall result in the forfeiture of the Contractor's right to receive any extension of time requested.

If the Contractor is requesting an extension of time because of weather, it shall supply daily written reports to the Owner's Representative describing such weather and the work which could not be performed that day because of such weather or conditions resulting therefrom and which it otherwise would have performed.

The Owner's acceptance of the daily reports shall not be deemed an admission of the Contractor's right to receive an extension of time or a waiver of the Owner's right to strictly enforce the time provisions contained in the Contract Documents.

When the Contractor has submitted a request for an extension of time in accordance with the procedures of this article and Article 6-4 on TIME FOR COMPLETION AND FORFEITURE DUE TO DELAY, the Owner will ascertain the facts and extent of the delay and extend the time for completing the work if, in its judgment, the findings of fact justify such an extension, and its findings of facts thereon shall be final and conclusive. An extension of time may be granted by the Owner after the expiration of the time originally fixed in the Contract or as previously extended, and the extension so granted shall be deemed to commence and be effective from the date of such expiration.

Any extension of time shall not release the sureties upon any bond required under the Contract.

6-6 USE OF COMPLETED PORTIONS

When the work or any portion of it is sufficiently complete to be utilized or placed into service, the Owner shall have the right upon written notification to the Contractor to utilize such portions of the work and to place the operable portions into service and to operate same.

Upon said notice and commencement of utilization or operation by the Owner, the Contractor shall be relieved of the duty of maintaining the portions so utilized or placed into operation; provided, however, that nothing in this article shall be construed as relieving the Contractor of the full responsibility for completing the work in its entirety, for making good defective work and materials, for protecting the work from damage, and for being responsible for damage and for the work as set forth in the General Provisions and other contract documents nor shall such

action by the Owner be deemed completion and acceptance, and such action shall not relieve the Contractor, its sureties, or insurers of the provisions of Articles 5-14, 7-12, and 8.

ARTICLE 7 LEGAL RELATIONS AND RESPONSIBILITIES

7-1 OBSERVING LAWS AND ORDINANCES

The Contractor shall keep itself fully informed of all laws, ordinances, and regulations which in any manner affect those engaged or employed in the work or the materials used in the work or which in any way affect the conduct of the work and of all such orders and decrees of bodies or tribunals having any jurisdiction or authority over same. If any discrepancy or inconsistency is discovered in the plans, specifications, or Contract for the work in relation to any such law, ordinance, regulation, order, or decree, the Contractor shall forthwith report the same to the Owner's Representative in writing and cease operations on that part of the work until the Owner's Representative has given the Contractor appropriate instructions as provided for in Article 5-7 on ERRORS OR DISCREPANCIES NOTED BY CONTRACTOR.

The Contractor shall at all times observe and comply with and shall cause all its agents, employees, subcontractors, and suppliers to observe and comply with all laws, ordinances, regulations, orders, and decrees, and shall, to the fullest extent allowed by law, hold harmless, indemnify, and defend the Owner, the Engineer, the Owner's Representative, and their consultants, and each of their directors, officers, employees, and agents from and against all claims, damages, losses, expenses, and other costs, including costs of defense and attorneys' fees, arising out of or resulting from the violation of any such law, ordinance, regulation, order, or decree by the Contractor, its employees, agents, subcontractors, or suppliers.

7-2 PERMITS AND LICENSES

The Contractor shall procure all permits and licenses, pay all charges and fees, and give all notices necessary and incidental to the due and lawful prosecution of the work.

7-3 INVENTIONS, PATENTS, AND COPYRIGHTS

The Contractor shall pay all royalties and assume all costs arising from the use of any invention, design, process, materials, equipment, product, or device which is the subject of patent rights or copyrights.

The Contractor shall, to the fullest extent allowed by law, hold harmless, indemnify, and defend the Owner, the Engineer, the Owner's Representative, and their consultants, and each of their directors, officers, employees, and agents from and against all claims, damages, losses, expenses, and other costs, including costs of defense and attorneys' fees, arising out of any infringement of patent rights or copyrights incident to the use in the performance of the work or resulting from the incorporation in the work of any invention, design, process, materials, equipment, product or device, and shall defend all such claims in connection with any alleged infringement of such rights.

7-4 PUBLIC CONVENIENCE AND SAFETY

The Contractor shall so conduct its operations as to offer the least possible obstruction and inconvenience to the public, and it shall have under construction no greater length or amount of work than it can prosecute properly with due regard to the rights and safety of the public.

Convenient access to driveways, houses, and buildings along the line of work shall be maintained and temporary crossings shall be provided and maintained in good condition. Not more than one crossing or intersecting street or road shall be closed at any one time.

The Contractor shall provide and maintain such fences, barriers, directional signs, lights, and flagmen as are necessary to give adequate warning to the public at all times of any dangerous conditions to be encountered as a result of the construction work and to give directions to the public.

7-5 RESPONSIBILITY FOR LOSS, DAMAGE, OR INJURIES

The Contractor shall be responsible for all claims, demands, or liability from any cause arising out of or resulting from or in connection with the performance of the work, excepting only those as may be caused solely and exclusively by the negligence of the Owner, the Engineer, the Owner's Representative, or their consultants, or their directors, officers, employees, and agents. Such responsibility shall extend to claims, demands, or liability for loss, damage, or injuries occurring after completion of the work as well as during the progress of the work.

In the event any hazardous materials, including but not limited to asbestos, are utilized in construction or hazardous materials are otherwise encountered during construction, the Contractor shall take all appropriate precautions to protect persons and property and shall comply with all applicable regulations for the installation and handling of such hazardous materials. The Contractor is solely responsible for protection of persons and property that could be affected by construction and the Contractor's handling of such materials.

7-6 CONTRACTOR'S RESPONSIBILITY FOR THE WORK

Until the final acceptance of the work by Owner, the Contractor shall have the responsible charge and care of the work and of the materials to be used therein (including materials for which it has received partial payment or materials which have been furnished by the Owner) and shall bear the risk of injury, loss, or damage to any part thereof by the action of the elements or from any other cause, whether arising from the execution or from the nonexecution of the work.

The Contractor shall rebuild, repair, restore, and make good all injuries, losses, or damages to any portion of the work or the materials occasioned by any cause before its completion and final acceptance and shall bear the expense thereof. Where necessary to protect the work or materials from damage, the Contractor shall at its expense provide suitable drainage and erect such temporary structures as are necessary to protect the work or materials from damage. The suspension of the work or the granting of an extension of time from any cause whatever shall not relieve the Contractor of its responsibility for the work and materials as herein specified.

In an emergency affecting the safety of life or property, including adjoining property, the Contractor, without special instructions or authorizations, shall act at its discretion to prevent such threatened loss or injury.

Notwithstanding the foregoing provisions of this article, the Contractor shall not be responsible for the cost of repairing or restoring damage to the work, which damage is determined to have been proximately caused by an Act of God, in excess of 5 percent of the contracted amount,

provided that the work damaged is built in accordance with accepted and applicable building standards and the plans and specifications. For the purposes of this paragraph, "Acts of God" shall include only the following occurrences or conditions and effect: earthquakes in excess of a magnitude of 3.5 on the Richter Scale and tidal waves.

7-7 PRESERVATION OF PROPERTY

The Contractor shall exercise due care to avoid injury to existing improvements or facilities, utility facilities, adjacent property, and trees and shrubbery that are not to be removed.

All trees, shrubbery, and landscaping that are not to be removed, and pole lines, fences, signs, survey markers and monuments, buildings and structures, conduits, pipelines under or above ground, sewer and waterlines, all highway or street facilities, and any other improvements or facilities within or adjacent to the work shall be protected from injury or damage, and the Contractor shall provide and install suitable safeguards to protect such objects from injury or damage. If such objects are injured or damaged by reason of the Contractor's operation, they shall be replaced or restored at the Contractor's expense to a condition as good as when the Contractor entered upon the work or as good as required by the plans and specifications if any such objects are a part of the work being performed.

The fact that any such pipe or other underground facility is not shown on the plans shall not relieve the Contractor of its responsibility under this article.

In addition to any requirements imposed by law, the Contractor shall shore up, brace, underpin, and protect as may be necessary, all foundations and other parts of all existing structures adjacent to and adjoining the site of the work which are in any way affected by the excavations or other operations connected with the performance of the work. Whenever any notice is required to be given by the Owner or the Contractor to any adjacent or adjoining landowner or other party before commencement of any work, such notice shall be given by the Contractor.

In an emergency affecting the safety of life or property, including adjoining property, the Contractor, without special instructions or authorizations, shall act at its discretion to prevent such threatened loss or injury.

7-8 REGIONAL NOTIFICATION CENTER CONTACT

Contractor, except in an emergency, shall contact the appropriate regional notification center at least two working days prior to commencing any excavation if the excavation will be conducted in an area or in a private easement which is known, or reasonably should be known, to contain subsurface installations other than the underground facilities owned or operated by the Owner, and obtain an inquiry identification number from that notification center. No excavation shall be commenced and carried out by the Contractor unless such an inquiry identification number has been assigned to the Contractor or any subcontractor of the Contractor and the Owner has been given the identification number by the Contractor.

Emergency shall be defined as a sudden, unexpected occurrence, involving a clear and imminent danger, demanding immediate action to prevent or mitigate loss of, or damage to, life, health, property, or essential public services. Emergency includes such occurrences as fire, flood,

earthquake, or other soil or geologic movements, as well as such occurrences as riot, accident, damage to a subsurface installation requiring immediate repair, or sabotage (Government Code Section 4216).

Subsurface installation means any underground pipeline, conduit, duct, wire, or other structure, except nonpressurized sewer lines, nonpressurized storm drains, or other nonpressurized drain lines (Government Code Section 4216).

7-9 EXCAVATION

7-9.1 EXCAVATION PLANS FOR WORKER PROTECTION REQUIRED BY LABOR CODE SECTION 6705

If the total amount of the Contract is in excess of \$25,000, the Contractor shall submit to the Owner for acceptance, in advance of excavation, a detailed plan showing the design of shoring, bracing, sloping, or other provisions to be made for worker protection from the hazard of caving ground during the excavation of any trench or trenches 5 feet or more in depth. The plan shall be prepared by a registered civil or structural engineer. As a part of the plan, a note shall be included stating that the registered civil or structural engineer certifies that the plan complies with the CAL/OSHA Construction Safety Orders, or that the registered civil or structural engineer certifies that the plan is not less effective than the shoring, bracing, sloping, or other provisions of the Safety Orders.

The Owner or the Engineer or their consultants may have made investigations of subsurface conditions in areas where the work is to be performed. If so, these investigations are identified in the Special Provisions and the records of such investigations are available for inspection at the office of the Engineer. The detailed plan showing the design of shoring, etc., which the Contractor is required to submit to the Owner for acceptance in advance of excavation will not be accepted by the Owner if the plan is based on subsurface conditions which are more favorable than those revealed by the investigations made by the Owner or the Engineer or their consultants; nor will the plan be accepted if it is based on soils-related design criteria which is less restrictive than the criteria set forth in the report on the aforesaid investigations of subsurface conditions.

The detailed plan showing the design of shoring, etc., shall include surcharge loads for nearby embankments and structures, for spoil banks, and for construction equipment and other construction loadings. The plan shall indicate for all trench conditions the minimum horizontal distances from the side of the trench at its top to the near side of the surcharge loads.

Nothing contained in this article shall be construed as relieving the Contractor of the full responsibility for providing shoring, bracing, sloping, or other provisions which are adequate for worker protection.

7-9.2 EXCAVATIONS BELOW 4 FEET

If any work required by this Contract includes digging trenches or other excavations that extend deeper than 4 feet below the surface, the Contractor shall promptly, and before the following conditions are disturbed, notify the Owner in writing of any:

1. Material that the Contractor believes may be material that is hazardous waste, as defined in Section 25117 of the Health and Safety Code, that is required to be removed to a Class I, Class II, or Class III disposal site in accordance with the provisions of existing law;
2. Subsurface or latent physical conditions at the site differing from those indicated;
3. Unknown physical conditions at the site of any unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract.

Nothing in this section is intended to relieve the Contractor of its responsibility to carefully examine the Contract Documents and the site where the work is to be performed in accordance with Article 2-8 of the General Provisions; to familiarize itself with all local conditions and federal, state, and local laws, ordinances, rules, and regulations that may affect the performance of any work; to study all surveys and investigation reports about subsurface and latent physical conditions pertaining to the jobsite; to perform such additional surveys and investigations as the Contractor deems necessary to complete the work at its bid price; and to correlate the results of all such data with the requirements of the Contract Documents.

If the Owner determines that hazardous waste exists and that conditions exist which Contractor could not discover through the investigations required by the preceding paragraph, the Owner shall notify the Contractor and the Contractor may request a change order in accordance with the Contract Documents. Nothing in this section shall relieve the Contractor of the obligation to pay all fees and costs associated with removal and cleanup of any hazardous waste used at, or brought to, the jobsite by the Contractor. Nor shall this section relieve the Contractor of responsibility for site conditions discoverable by any investigation required by the preceding paragraph.

In the event that a dispute arises between the Owner and the Contractor involving hazardous waste and whether site conditions differ materially from those the Contractor could or should have discovered by the investigations required by this Contract, the Contractor shall not be excused from the scheduled completion date provided in the Contract Documents and shall proceed with all work in the manner and in the time required by the Contract Documents.

7-10 SAFETY

Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the work. Contractor shall take all necessary precautions for the safety of and shall provide the necessary protection to prevent damages, injury, or loss to: (1) all persons on the Site or who may be affected by the work; (2) all the work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and (3) other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and underground facilities not designated for removal, relocation, or replacement in the course of construction. Contractor shall comply with all applicable laws and regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary

safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of underground facilities and other utility owners when prosecution of the work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

The right of the Engineer or the Owner's Representative to conduct construction review or observation of the Contractor's performance will not include review or observation of the adequacy of the Contractor's safety measures in, on, or near the construction site.

Contractor's duties and responsibilities for safety and for protection of the work shall continue until such time as all the work is completed and final payment in accordance with Article 9-3 has been paid.

7-11 PERSONAL LIABILITY

No director, officer, employee, or agent of the Owner, the Engineer, the Owner's Representative, or their consultants shall be personally responsible for any liability arising under or by virtue of the Contract.

7-12 INDEMNITY

To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, the Engineer, the Owner's Representative, and their consultants, and each of their directors, officers, agents, and employees from and against all claims, damages, losses, expenses, and other costs, including costs of defense and attorneys' fees, arising out of or resulting from or in connection with the performance of the work, both on and off the jobsite, provided that any of the foregoing (1) is attributable to personal injury, bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the work itself), including the loss of use resulting therefrom, and (2) is caused in whole or in part by any act or omission of the Contractor, any subcontractor, any supplier, anyone directly or indirectly employed by any of them or anyone for whose acts or omissions any of them may be liable, regardless of whether or not caused in part by any act or omission (active, passive, or comparative negligence included) excepting only the indemnitee's sole negligence or willful misconduct.

In any and all claims against the indemnified parties by any employee of the Contractor, any subcontractor, any supplier, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the indemnification obligation under the first and fourth paragraphs in this article on INDEMNITY shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable, by or for the Contractor, or any subcontractor, or any supplier, or other persons under workers' compensation acts, disability benefit acts, or other employee acts.

The obligations of the Contractor under the first and fourth paragraphs in this article on INDEMNITY shall not extend to the liability of the Engineer, the Owner's Representative, and their consultants, and each of their directors, officers, employees, and agents, arising out of or resulting from or in connection with the preparation or approval of maps, drawings, opinions, reports, surveys, designs or specifications, providing that the foregoing was the sole and exclusive cause of the loss, damage, or injury.

The Contractor shall also indemnify and hold harmless the Owner, the Engineer, the Owner's Representative, and their consultants, and each of their directors, officers, employees, and agents, to the fullest extent allowed by law from and against all losses, expenses, damages (including damages to the work itself), attorneys' fees, and other costs, including all costs of defense, which any of them may incur with respect to the failure, neglect, or refusal of Contractor to faithfully perform the work and all of the Contractor's obligations under the Contract. Such costs, expenses, and damages shall include all cost, including attorneys' fees, incurred by the indemnified parties in any lawsuit to which they are a party.

7-13 HOURS OF LABOR

The Contractor shall forfeit as a penalty to the Owner \$25 for each worker employed in the execution of the Contract by the Contractor or any subcontractor under it for each calendar day during which such worker is required or permitted to work more than 8 hours in any one calendar day and 40 hours in any one calendar week in violation of the provisions of the Labor Code and, in particular, Section 1810 to Section 1815 thereof, inclusive, except that work performed by employees of Contractors in excess of 8 hours per day and 40 hours during any one week shall be permitted upon compensation for all hours worked in excess of 8 hours per day at not less than one and one-half times the basic rate of pay as provided in said Section 1815.

7-14 PREVAILING WAGE

The Contractor shall comply with Labor Code Section 1775. In accordance with said Section 1775, the Contractor shall forfeit as a penalty to the Owner up to \$50 for each calendar day or portion thereof for each worker paid less than the stipulated prevailing rates for such work or craft in which such worker is employed for any work done under the Contract by the Contractor or by any subcontractor under it in violation of the provisions of the Labor Code and in particular, Labor Code Sections 1770 to 1780, inclusive. The amount of the forfeiture will be determined by the Labor Commissioner based on the considerations specified in Labor Code Section 1775. In addition to said penalty and pursuant to said Section 1775, the difference between such stipulated prevailing wage rates and the amount paid to each worker for each calendar day or portion thereof for which each worker was paid less than the stipulated prevailing wage rate shall be paid to each worker by the Contractor. Pursuant to Labor Code Section 1775, to the extent there is insufficient money due a Contractor to cover all penalties forfeited and amounts due, the Division of Labor Standards Enforcement shall be notified of the violation and the Division of Labor Standards Enforcement may maintain an action in any court of competent jurisdiction to recover the penalties and amounts due pursuant to Labor Code Section 1775.

Section 1776 of the Labor Code requires each contractor and its subcontractors to keep accurate payroll records and make such available for inspection by persons and entities identified in that section, in the manner stated therein. Section 1776(g), places the responsibility for compliance with Section 1776 on the prime contractor.

Whenever any contractor or subcontractor performing a public works project is found by the Labor Commission to be in willful violation of Labor Code provisions, as set forth in Labor Code Section 1777.1, except Section 1777.5, the contractor or subcontractor or any firm,

corporation, partnership, or association in which the contractor or subcontractor has a substantial interest shall be ineligible to bid on or to receive any public works contract for a period up to three years for each second and subsequent violation occurring within three years of a separate and previous willful violation of this chapter. These periods of debarment shall run from the date the determination of the violation is made by the Labor Commissioner.

A willful violation occurs when the contractor or subcontractor knew or reasonably should have known of its obligations under the public works law and deliberately fails or refuses to comply with its provisions.

7-15 APPRENTICES

Attention is directed to the provisions in Sections 1777.5, 1777.6 and 1777.7 of the Labor Code concerning the employment of apprentices by the Contractor or any subcontractor under it.

The Contractor and any subcontractor under it shall comply with the requirements of Sections 1777.5 and 1777.6 of the Labor Code in the employment of apprentices.

Information relative to apprenticeship standards, wage schedules, and other requirements may be obtained from the Director of Industrial Relations, ex officio the Administrator of Apprenticeship, San Francisco, California, or from the Division of Apprenticeship Standards and its branch offices.

Willful violations of Section 1777.5 may result in the Contractor, and the business entity under which the Contractor is doing business, being denied the right to bid on, or to receive, any public works contract for a period of up to one year for the first violation and for a period of up to three years for the second and subsequent violations commencing from the date the determination of noncompliance by the Chief of the Division of Apprenticeship Standards. In addition, if the Contractor violates Section 1777.5, it may be required to forfeit as a civil penalty an amount not exceeding the sum of one hundred (\$100.00) for each calendar day of noncompliance which shall be withheld from progress payments by Owner upon notice from the Department of Industrial Relations. (Labor Code Section 1777.7.)

7-16 WARRANTY OF TITLE

No materials, supplies, or equipment for the work under this Contract shall be purchased subject to any chattel mortgage or under a conditional sale contract or other agreement by which an interest therein or any part thereof is retained by the seller or supplier. The Contractor warrants clear and good title to all materials, supplies, and equipment installed and incorporated in the work and agrees upon completion of all work to deliver the premises, together with all improvements and appurtenances constructed or placed thereon by it, to the Owner free from any claims, liens, encumbrances, or charges and further agrees that neither it nor any person, firm, or corporation furnishing any material or labor for any work covered by the Contract shall have any right to a lien upon the premises or any improvement or appurtenance thereon, provided that this shall not preclude the Contractor from installing metering devices or other equipment of utility companies or of municipalities, the title of which is commonly retained by the utility company or the municipality. Nothing contained in this article, however, shall defeat or impair the right of such persons furnishing materials or labor under any bond given by the Contractor for their

protection or any right under any law permitting such persons to look to funds due the Contractor in the hands of the Owner. The provisions of this article shall be inserted in all subcontracts and material contracts, and notices of its provision shall be given to all persons furnishing materials for the work when no formal contract is entered into for such materials.

7-17 PROPERTY RIGHTS IN MATERIALS

Nothing in the Contract shall be construed as vesting in the Contractor any right of property in the materials used after they have been attached or affixed to the work or the soil, or after payment has been made for materials delivered to the site of the work, or stored subject to or under the control of the Owner. All such materials shall become the property of the Owner upon being so attached or affixed or upon payment for materials delivered to the site of the work or stored subject to or under the control of the Owner.

Soil, stone, gravel, and other materials found at the site of the work and which conform to the plans and specifications for incorporation into the work may be used in the work. No other use shall be made of such materials except as may be otherwise described in the plans and specifications.

7-18 MUTUAL RESPONSIBILITY OF CONTRACTORS

Nothing in the Contract shall be interpreted as granting to the Contractor exclusive occupancy of the site of the project. The Contractor must ascertain to its own satisfaction the scope of the project and the nature of any other contracts that have been or may be awarded by the Owner in the construction of the project, to the end that the Contractor will perform this Contract in the light of such other contracts, if any.

The Contractor shall not cause any unnecessary hindrance or delay to any other contractor working on the project. If the performance of any contract for the project is likely to be interfered with by the simultaneous performance of some other contract or contracts, the Owner's Representative shall decide which contractor shall cease work temporarily and which contractor shall continue or whether the work under the contracts can be coordinated so that the contractors may proceed simultaneously. On all questions concerning conflicting interest of contractors performing related work, the decision of the Owner's Representative shall be binding upon all contractors concerned and the Owner, the Engineer, the Owner's Representative, and their consultants shall not be responsible for any damages suffered or extra costs incurred by the Contractor resulting directly or indirectly from the award or performance or attempted performance of any other contract or contracts on the project or caused by a decision or omission of the Owner's Representative respecting the order of precedence in the performance of the contracts.

If through acts of neglect on the part of the Contractor, any other contractor or any subcontractor shall suffer loss or damage on the work, the Contractor agrees to settle with such other contractor or subcontractor by agreement or arbitration, if such other contractor or subcontractor will so settle. If such other contractor or subcontractor shall assert any claim against the Owner, the Engineer, the Owner's Representative, or their consultants or any of their directors, officers, employees, or agents on account of any damage alleged to have been so sustained, the Owner

shall notify the Contractor who shall hold harmless, indemnify, and defend the Owner, the Engineer, the Owner's Representative, and their consultants, and each of their directors, officers, employees, and agents against any such claim, including all attorneys' fees and any other costs incurred by the indemnified parties relative to any such claim, to the fullest extent allowed by law.

7-19 TERMINATION FOR BREACH

If the Contractor refuses or fails to prosecute the work or any separable part thereof with such diligence as will ensure its completion within the time specified herein, or any extension thereof, or fails to complete such work within such time, or if the Contractor should be adjudged a bankrupt, or if it should make a general assignment for the benefit of its creditors, or if a receiver should be appointed on account of its insolvency, or if it files a petition to take advantage of any debtor's act, or if it or any of its subcontractors should violate any of the provisions of the contract, or if it should persistently or repeatedly refuse or should fail, except in cases for which extension of time is provided, to supply enough properly skilled workers or proper materials to complete the work in the time specified, or if it should fail to make prompt payment to subcontractors or for material or labor, or if it should persistently disregard laws, ordinances, or instructions given by the Owner or Owner's Representative, the Owner may, without prejudice to any other right or remedy, serve written notice upon the Contractor and its surety of its intention to terminate the contract, said notice to contain the reasons for such intention to terminate the contract, and unless within ten days after the service of such notice such violations shall cease and satisfactory arrangements for the corrections thereof be made, the contract shall upon the expiration of said ten days cease and terminate. In such case, the Contractor shall not be entitled to receive any further payment until the work is finished.

In the event of any such termination, the Owner shall immediately serve written notice thereof upon the surety and the Contractor, and the surety shall have the right to take over and perform the Contract; provided, however, that if the surety within 15 days after the serving upon it of a notice of termination does not give the Owner written notice of its intention to take over and perform the Contract or does not commence performance thereof within 30 days from the date of serving said notice, the Owner may take over the work and prosecute the same to completion, by Contract or by any other method it may deem advisable, for the account and at the expense of the Contractor, and its surety shall be liable to the Owner for any excess cost or other damage occasioned the Owner thereby, and in such event the Owner may, without liability for so doing, take possession of and utilize in completing the work such materials, appliances, plants, and other property belonging to the Contractor that may be on the site of the work and be necessary therefor. For any portion of such work that the Owner elects to complete by furnishing its own employees, materials, tools, and equipment, the Owner shall be compensated for such in accordance with the schedule of compensation for force account work in Article 9-1 on PAYMENT FOR CHANGES IN THE WORK.

If the unpaid balance of the Contract price exceeds the direct and indirect costs of completing the work, including, but not limited to, all costs to Owner arising from professional services and attorneys' fees and all costs generated to insure or bond the work of substituted contractors or subcontractors utilized to complete the work, such excess shall be paid to Contractor. If such costs exceed the unpaid balance, Contractor shall pay the difference to Owner promptly upon

demand; on failure of Contractor to pay, the Surety shall pay on demand by Owner. Any portion of such difference not paid by Contractor or surety within 30 days following the mailing of a demand for such costs by Owner shall earn interest at the rate of 10 percent per annum or the maximum rate authorized by California law, whichever is lower.

The foregoing provisions are in addition to and not in limitation of any other rights or remedies available to the Owner.

7-20 TERMINATION FOR GRIEVANCE

Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. Completed and acceptable work executed in accordance with the Contract Documents prior to the effective date of the termination, including fair and reasonable sums for overhead and profit on such work;
2. Expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted work, plus fair and reasonable sums for overhead and profit on such expenses; and
3. Reasonable expenses directly attributable to termination.

Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

7-21 NOTICE AND SERVICE THEREOF

Any notice required or given under the Contract shall be in writing, be dated, and signed by the party giving such notice or its duly authorized representative, and be served as follows:

If to the Owner, by personal delivery or by deposit in the United States mail or by fax with confirming receipt.

If to the Contractor, by personal delivery to the Contractor or to its authorized representative at the site of the project or by deposit in the United States mail or by fax with confirming receipt.

If to the surety or any other person, by personal delivery to said surety or other person or by deposit in the United States mail or by fax with confirming receipt.

All mailed notices shall be in sealed envelopes, shall be sent by certified mail with postage prepaid, and shall be addressed to the addresses in the Contract Documents or such substitute addresses which a party designates in writing and serves as set forth herein.

7-22 PROVISION INTEGRITY

If any provision of this Contract is held by a court of competent jurisdiction to be invalid, void, or unenforceable, the remaining provisions shall nevertheless continue in full force without being impaired or invalidated in any way. In the event that this Agreement is for any reason terminated, then its indemnity, liability, and waiver provisions shall remain in full force and effect. In the event that any such provisions shall be prohibited by law, then the subject provision shall not be void, but rather shall be interpreted as applying only to the fullest extent allowable by law.

7-23 ATTORNEYS' FEES

Should either party to the Contract bring an arbitration or mediation proceeding or other action to enforce any provision of the Contract, including an action pursuant to Public Contract Code Section 20104.4, the prevailing party shall be entitled to recover its reasonable attorneys' fees and costs in connection therewith. The term "prevail" as used in this section shall include any action at law, in equity, or pursuant to arbitration in which either party has been successful.

7-24 LANDS AND RIGHTS-OF-WAY

The lands and rights-of-way for the facility to be constructed will be provided by the Owner. The Contractor shall make its own arrangements and pay all expenses for additional area required by it outside the limits of the Owner's lands and rights-of-way.

Work in public right-of-way shall be done in accordance with the requirements of the permit issued by the public agency in whose right-of-way the work is located in addition to conforming to the plans and specifications. If a permit is not required, the work shall conform to the standards of the public agency involved in addition to conforming to the plans and specifications.

7-25 WAIVER OF RIGHTS

Except as otherwise specifically provided in the Contract Documents, no action or failure to act by the Owner, Engineer, Owner's Representative, or Contractor shall constitute a waiver of any right or duty afforded any of them under the Contract Documents, nor shall any such action or failure to act constitute an approval of or acquiescence in any breach thereunder.

7-26 TAXES

The Contractor shall pay all sales, consumer, use, and other taxes.

NOTICE OF TAXABLE POSSESSORY INTEREST - The terms of this document may result in the creation of a possessory interest. If such a possessory interest is vested in a private party to this document, the private party may be subjected to the payment of personal property taxes levied on such interest.

7-27 ASSIGNMENT OF ANTI-TRUST ACTIONS

In entering into a public works contract or subcontract to supply goods, services, or materials pursuant to a public works contract, the Contractor or subcontractor offers and agrees to assign to

the awarding body all rights, title, and interest in and to all causes of action it may have under Section 4 of the Clayton Act (15 U.S.C. Section 15) or under the Cartwright Act (Chapter 2 [commencing with Section 16700] of Part 2 of Division 7 of the Business and Professions Code), arising from purchases of goods, services, or materials pursuant to the public works contract or the subcontract. This assignment shall be made and become effective at the time the awarding body tenders final payment to the Contractor, without further acknowledgment by the parties.

In submitting a bid to a public purchasing body, the Bidder offers and agrees that if the bid is accepted, it will assign to the purchasing body all rights, title, and interest in and to all causes of action it may have under Section 4 of the Clayton Act (15 U.S.C. Section 15) or under the Cartwright Act (Chapter 2 [commencing with Section 16700] of Part 2 of Division 7 of the Business and Professions Code), arising from purchases of goods, materials, or services by the Bidder for sale to the purchasing body pursuant to the bid. Such assignment shall be made and become effective at the time the purchasing body tenders final payment to the Bidder.

7-28 PAYROLL RECORDS

It shall be the responsibility of the Contractor to maintain an accurate payroll record showing the name, address, social security number, work classification, straight time and overtime hours worked each day and week, and the actual per diem wages paid to each employee in accordance with Labor Code Section 1776, and to ensure that each subcontractor also complies with all provisions of Labor Code Section 1776 and this Contract provision.

All payroll records shall be certified as accurate by the applicable contractor or subcontractor or its agent having authority over such matters.

The Contractor shall ensure that all payroll records are available for inspection at the Contractor's principal office during normal business hours and shall notify the Owner, in writing, of the place where all payroll records are located from time to time.

The Contractor shall furnish a copy of all payroll records, upon request, to employees or their authorized agents, to the Owner, to the Division of Labor Standards Enforcement, and to the Division of Apprenticeship Standards of the Department of Industrial Relations. The Contractor shall also furnish a copy of payroll records to the general public upon request provided the public request is made through the Owner, the Division of Apprenticeship Standards, or the Division of Labor Standards Enforcement of the Department of Industrial Relations. Members of the general public shall not be given access to payroll records at the Contractor's principal office.

Records made available to the general public in accordance with the prior paragraph shall be marked or obliterated in such a manner that the name and address of the Contractor and/or subcontractor and the name, address, and telephone number of all employees does not appear on the modified record.

The Contractor shall file a certified copy of any requested payroll records with the entity that requested such records within ten days of the date a written request for payroll records has been received.

Failure of the Contractor to comply with any provision of this article or Labor Code Section 1776 within ten days of the date a written request for compliance is received shall result in a forfeiture of \$25 per calendar day or portion thereof, for each worker, until strict compliance is obtained. Upon notification by the Division of Apprenticeship Standards or the Division of Labor Standards Enforcement of the Department of Industrial Relations, the Owner shall withhold penalties under this article or Labor Code Section 1776 from the Contractor's payments then due.

7-29 RESOLUTION OF CLAIMS

All public works claims between the Contractor and Owner relating to this Contract where the total claims of both parties are equal to or less than \$375,000 shall be resolved in accordance with Public Contract Code Sections 20104 et seq., which are incorporated herein by reference. Where the total claim of the Contractor and Owner exceeds a total of \$375,000, this section shall not apply.

7-30 CONTROLLING LAW

This Contract is to be governed by the laws of the state of California.

7-31 HEADINGS

Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Provisions.

ARTICLE 8 CONTRACTOR'S INSURANCE

8-1 GENERAL

The Contractor shall not commence or continue to perform any work unless it, at its own expense, has in full force and effect all required insurance. The Contractor shall not permit any subcontractor to perform work on this project unless all of the required insurance has also been complied with by such subcontractor.

The types of insurance the Contractor shall obtain and maintain are Workers' Compensation and Employers' Liability Insurance, General and Automobile Liability Insurance, Builders' Risk "All Risk" or Installation Floater Insurance, Contractor's Pollution Liability Insurance and, if so determined by the Owner at the time of award of the Contract, Earthquake and Flood Insurance, all as set forth herein.

Workers' Compensation and Employers' Liability Insurance and Liability Insurance shall be maintained in effect for the full guarantee period.

Insurers must be authorized to do business and have an agent for service of process in California and must have at least an "B VIII" rating in accordance with the most current Best's Rating Guide.

As evidence of specified insurance coverage, the Contractor shall provide certificates of insurance and endorsements on the forms provided as a part of the Contract Documents. No alteration or substitution of said forms will be allowed.

8-2 WORKERS' COMPENSATION AND EMPLOYERS' LIABILITY INSURANCE

Upon execution of the Agreement, the Contractor shall provide a certificate(s) of insurance certifying that it has obtained full Workers' Compensation Insurance coverage for no less than the statutory limits and Employers' Liability Insurance coverage in limits not less than the amounts set forth in the Special Provisions, for all persons whom it employs or may employ in carrying out the work under the Contract. At the same time, the Contractor shall provide the insurance endorsement(s) on the forms provided as part of the Contract Documents. This insurance shall be in strict accordance with the requirements of the most current and applicable state Workers' Compensation Insurance laws.

8-3 GENERAL AND AUTOMOBILE LIABILITY INSURANCE

Upon execution of the Agreement, the Contractor shall provide a certificate(s) of insurance showing that it has Liability Insurance coverage in limits not less than the amounts set forth in the Special Provisions. At the same time, the Contractor shall provide the insurance endorsement(s) on the forms provided as a part of the Contract Documents.

Included in such insurance shall be a "Cross Liability" or "Severability of Interest" clause.

The Liability Insurance coverage shall include each of the following types of insurance or coverage for exposures, as applicable:

A. General Liability

- (1) Commercial Form.
- (2) Premises-Operations.
- (3) Explosion and Collapse Hazard.
- (4) Underground Hazard.
- (5) Products/Completed Operations.
- (6) Blanket Contractual Insurance.
- (7) Broad Form Property Damage.
- (8) Independent Contractors.
- (9) Personal Injury and Advertising Injury.

B. Automobile Liability

- (1) Business Auto Form Including Loading and Unloading.
- (2) Owned.
- (3) Hired.
- (4) Non-Owned.

Included with the Certificate(s) of Insurance shall be endorsements which name as additional insured's the Owner, the District Engineer, the Owner's Representative, and their consultants, and each of their directors, officers, and employees and state that the insurance afforded to these additional insured's shall be primary insurance and if the additional insured's have other insurance which might be applicable to any loss, the amount of the insurance provided under this article on GENERAL AND AUTOMOBILE LIABILITY INSURANCE shall not be reduced or prorated by the existence of such other insurance.

8-4 BUILDERS' RISK "ALL RISK" AND
INSTALLATION FLOATER INSURANCE

Upon execution of the Agreement, the Contractor shall provide a certificate(s) of insurance showing that it has obtained for the period of the Contract Builders' Risk "All Risk" completed value insurance coverage (including flood but excluding earthquake and tidal wave) upon the entire project which is the subject of the Contract and including completed work and work in progress and an Installation Floater to cover machinery and equipment of all kinds during transit, installation, and testing at the Owner's premises. At the same time, the Contractor shall provide the insurance endorsement(s) on the forms provided as a part of the Contract Documents. Such insurance shall include as additional insured's: the Owner, the Engineer, the Owner's Representative, and their consultants, and each of their directors, officers, and employees, as their interest may appear.

8-6 CONTRACTOR'S POLLUTION LIABILITY INSURANCE

Upon execution of the Agreement, the Contractor shall provide a certificate(s) of insurance showing that it has Pollution Liability Insurance coverage in limits not less than the amounts set forth in the Special Provisions. At the same time, the Contractor shall provide the insurance endorsement(s) on the forms provided as a part of the Contract Documents.

8-7 CONTRACTOR'S LIABILITY NOT LIMITED BY INSURANCE

Nothing contained in these insurance requirements is to be construed as limiting the liability of the Contractor or the Contractor's insurers.

ARTICLE 9 ESTIMATES AND PAYMENTS

9-1 PAYMENT FOR CHANGES IN THE WORK

Changes in, additions to, or deductions from the work, including increases or decreases in the quantity of any item or portion of the work, shall be set forth in a written change order executed by the Owner and by the Contractor which shall specify:

The changes, additions, and deductions to be made.

The increase or decrease in compensation due the Contractor, if any.

Adjustment in the time of completion, if any.

Adjustment in the compensation due the Contractor shall be determined by one or more of the following methods in the order of precedence listed below:

Unit prices contained in the Contract.

Mutually agreeable lump-sum or unit prices. If requested by the Owner's Representative, the Contractor shall furnish an itemized breakdown of the quantities and prices used in computing proposed lump-sum and unit prices.

Force account whereby the Contractor is compensated for furnishing labor, materials, tools, and equipment as follows:

Cost of labor plus 15 percent for workers directly engaged in the performance of the work. Cost of labor shall include actual wages paid including employer payments to or on behalf of the workers for health and welfare, pension, vacation, and similar purposes plus payments imposed on payroll amounts by state and federal laws plus subsistence and travel allowance payments to workers.

Cost of material plus 15 percent. Cost of material shall include sales tax, freight, and delivery charges. The Owner reserves the right to furnish such materials as it deems advisable and the Contractor shall not be paid the 15 percent markup on such materials.

For tools and equipment actually engaged in the performance of the work, rental rates plus 15 percent. The rental rates shall be those prevailing in the area where the work is performed. No rental charge shall be made for the use of tools or equipment having a replacement value of \$500 or less.

Subcontractor invoices to the Contractor plus 5 percent. Subcontractor invoices shall be based on the above-described cost of labor plus 15 percent, cost of material plus 15 percent, and tool and equipment rental rates plus 15 percent.

No payment shall be made for any item not set forth above, including without limitation, Contractor's overhead, general administrative expense, supervision, or damages claimed for delay in prosecuting the remainder of the work.

For force account work, the Contractor shall submit to the Owner's Representative for its verification daily work sheets showing an itemized breakdown of labor, materials, tools, and equipment used in performing the work. No payment will be made for work not verified by the Owner's Representative.

9-2 PROGRESS PAYMENTS

The Owner shall, on or before the tenth day of each calendar month after actual construction work is started, cause an estimate in writing to be made by the Owner's Representative of the value of the work completed by the Contractor and of materials delivered on the ground at the site of the work or stored subject to or under the control of the Owner to the first of the month in which the estimate is made. In estimating such value, the Owner's Representative may take into consideration, along with other facts and conditions deemed by it to be proper, the ratio of the difficulty or cost of the work done to the probable difficulty or cost of the work remaining to be done. The Owner shall retain 10 percent of such estimated value as part security for the fulfillment of the Contract by the Contractor, unless the Contractor has substituted equivalent securities as defined by Article 9-5 of these General Provisions, and shall by the end of each month in which the estimate is made pay to the Contractor the balance of such estimated value after deducting therefrom all previous payments and all sums to be kept or retained under the terms of the Contract.

9-3 FINAL ESTIMATE AND PAYMENT

When the work has been substantially completed, the Owner's Representative will make a final estimate of the total amount of work done thereunder and the amount to be paid therefor under the terms of the Contract. If the Owner finds the work has been substantially completed according to the Contract, it shall accept the work, shall file a notice of completion, and shall pay the entire sum so found to be due after deducting therefrom all previous payments and all amounts to be retained under the provisions of the Contract. All prior progress estimates and payments shall be subject to correction in the final estimate and payment. The final payment shall not be due and payable until the expiration of 40 days from the date of filing a notice of completion of the work by the Owner.

It is mutually agreed between the parties to the Contract that no certificate given or payment made under the Contract shall be conclusive evidence of performance of the Contract and no payment shall be construed to be an acceptance of any defective work or improper materials.

9-4 OWNER'S RIGHT TO WITHHOLD CERTAIN AMOUNTS AND MAKE APPLICATION THEREOF

In addition to the amount which the Owner may retain under the above article on PROGRESS PAYMENTS, the Owner may withhold a sufficient amount or amounts from any payment otherwise due to the Contractor as in Owner's judgment may be necessary to cover:

Payments which may be past due and payable for properly filed claims against the Contractor or any subcontractors for labor or materials furnished in or about the performance of the work under this Contract.

Estimated or actual costs for correcting defective work not remedied.

Amounts claimed by the Owner as forfeiture due to delay or other offsets.

The Owner may apply such withheld amount or amounts to the payment of such claims in its discretion. In so doing, the Owner shall be deemed the agent of the Contractor and any payments so made by the Owner shall be considered as a payment made under the Contract by the Owner to the Contractor, and the Owner shall not be liable to the Contractor for such payment made in good faith. Such payments may be made without prior judicial determination of the claim or claims. The Owner will render to the Contractor a proper account of such funds disbursed in behalf of the Contractor.

9-5 WITHHELD CONTRACT FUNDS

Pursuant to Public Contract Code Section 22300, equivalent securities may be substituted for monies withheld to ensure performance of the Contract, except contracts for which there will be financing provided by the Farmers Home Administration of the United States Department of Agriculture pursuant to the Consolidated Farm and Rural Development Act (7 U.S.C. Sec. 1921 et seq.), or where federal regulations and/or policies do not allow such substitution. The Owner reserves the right to solely determine the adequacy of the securities being proposed by the Contractor and the value of those securities. The Owner shall also be entitled to charge an administrative fee, as determined by Owner in its sole discretion, for substituting equivalent securities for retention amounts. The Owner's decisions with respect to the administration of the provisions of Section 22300 shall be final and shall include, but not be limited to, determinations of what securities are equivalent, the value of the securities, the negotiability of the securities, the costs of administration and the determination of whether or not the administration should be accomplished by an independent agency or by the Owner. The Owner shall be entitled, at any time, to request the deposit of additional securities of a value designated by Owner, in Owner's sole discretion, to satisfy this requirement. If the Owner does not receive satisfactory securities within twelve (12) consecutive days of the date of the written request, Owner shall be entitled to withhold amounts due Contractor until securities of satisfactory value to Owner have been received.

9-6 REQUIRED RELEASES

The Contractor shall not be entitled to any payment specified in its Contract which is undisputed until such time as the Contractor has executed a release, in the following form, releasing the Owner from all claims relating to the work for which the Contractor is being paid. The release form contains space for the Contractor to claim any disputed amount and to designate the retention amount for each period associated with the release. Contractor hereby expressly agrees that failure on its part to designate any disputed amount or to designate the correct retention amount for each release period on the release form shall constitute an express waiver of the right of the Contractor to claim any disputed amount or any retention amount at any later date. The

Owner shall have no obligation to pay the Contractor for any work done until the release form attached to these Contract Documents has been executed by the Contractor and submitted to the Owner.

SECTION 007300

SUPPLEMENT TO GENERAL PROVISIONS

A. Definitions

Whenever the following terms occur in the contract documents, their meaning is as follows:

OWNER	WESTERN HILLS WATER DISTRICT 9501 Morton Davis Drive Patterson, CA 95363
DISTRICT ENGINEER	WESTERN HILLS WATER DISTRICT District Engineer, Patrick Garvey 9501 Morton Davis Drive Patterson, CA 95363
ENGINEER	DISTRICT ENGINEER or BENCHMARK ENGINEERING, INC. 1121 Oakdale Road, Suite 1 Modesto, CA 95355
SECTION 007300	SUPPLEMENT TO GENERAL PROVISIONS

B. Terms

Command-type sentences used in the contract documents refer to and are directed to the Contractor.

C. Authority for the Work

The drawings, specifications, and other contract documents for the Work were approved by the OWNER on _____, 2012.

D. Marking and Addressing Bid Envelope

Bids shall be sealed in envelope marked and addressed to:

**WESTERN HILLS WATER DISTRICT
DISTRICT ENGINEER
9501 Morton Davis Drive
Patterson, CA 95363**

And shall clearly be marked:

PROPOSAL: 2012 SYSTEM MODIFICATIONS

Bids shall be delivered to the addressee on or before the day and hour set for the opening of bids in the Notice Inviting Sealed Proposals, and shall bear the name of the Bidder.

A bid will not be accepted after the date and time designated in the Notice Inviting Sealed Proposals. It is the sole responsibility of the Bidder to see that its bid is delivered and received in proper time. Any bid received after said designated date and time shall be returned to the Bidder unopened.

E. Investigations and Reports

At the Owner's expense, the Contractor shall provide a geotechnical investigation, report and recommendations from a geotechnical firm, satisfactory to the District Engineer, at the time of excavation of the two areas of street repairs (Morton Davis Drive at 10+00 to 11+00 and Diablo Grande Parkway at Tee Box Court) as noted on the plans. These 2 reports will be reviewed by the District Engineer and any/all applicable recommendations shall become part of the work.

F. Award of Contract or Rejection of Bids

Within a period **30 calendar days** after the opening of the bids, the Owner will accept or reject the bids.

G. Time for Completion and Forfeiture Due to Delay

1. Work will be substantially completed within **160 consecutive calendar days**, from and after the date of award of the contract.
2. As allowed by Government Code 53069.85, forfeiture for each day completion is delayed beyond the time allowed will be at the rate of **\$1,000.00 per calendar day**.

H. Amount of Liability Insurance

General Liability:	Bodily Injury and Property Damage coverage shall be for not less than	
	\$2,000,000	General Aggregate.
	\$2,000,000	Products/Completed Operations Aggregate.
	\$2,000,000	Personal and Advertising Injury.
	\$2,000,000	Each Occurrence.
	OR	
	Bodily Injury and Property Damage coverage shall be in a Combined Single Limit of not less than	
\$2,000,000	Each Occurrence and Aggregate.	
Automobile Liability:	Bodily Injury coverage shall be for not less than	
	\$2,000,000	Each Person.
	\$2,000,000	Each Accident.
	\$2,000,000	Property Damage coverage shall be for not less than
	OR	
	\$2,000,000	Bodily Injury and Property Damage coverage shall be in a Combined Single Limit of not less than
Employers' Liability:	Bodily Injury coverage shall be for not less than	
	\$2,000,000	Each Accident.
	\$2,000,000	Each Disease-Policy Limit.
	\$2,000,000	Each Disease-Each Employee.

I. Contractor's Insurance

1. General:

- a. In conformance with Article 8 of Section 007000, the types of insurance the Contractor shall obtain and maintain are Worker's Compensation and Employer's Liability Insurance, Liability Insurance, General and Automotive Liability Insurance, Builders' Risk "All Risk" Insurance, and Contractor's Pollution Liability Insurance. No Earthquake, flood, or Tidal Wave Insurance will be required for this contract.
- b. Section 007000, Article 8-1 is hereby modified to read:
Insurers must be authorized to do business and have an agent for service of process in California. Excepting only the State Compensation Insurance Fund in reference to Worker's Compensation Insurance, insurers must have an "A" policyholder's rating and a financial rating of at least Class VI in accordance with the most current Best's Rating.

SECTION 011100
COORDINATION OF WORK, PERMITS, AND REGULATIONS

A. Description

This section generally describes the project and includes, work sequence and schedule, Contractor's use of premises, maintenance and operation of existing facilities, construction survey staking, and regulations.

B. General Nature of Work

The work generally involves construction of:

Various piping improvements and modifications at and between the Clearwater Tank, the Solids Storage Tank, the Equalization Tank,

Approximately 2550 L.F. of 4" low pressure drain line from the Solids Storage Tank to the Sanitary Sewer at Morton Davis Dr.,

Various piping improvements and modifications at the Zone 3 Reservoir and

Street reconstructions at Diablo Grande Pkwy./Tee Box Ct. and at Morton Davis Dr./Sta. 10+00 to Sta. 11+00.

C. Location of Project Site

The project site is located in the general area of the Diablo Grande Water Treatment Plant.

D. Work Sequence and Schedule

1. The Contractor shall provide a Construction and Sequencing Schedule and obtain approval from the District Engineer prior to commencing any work.
2. In order to minimize operational shutdowns, the Contractor is encouraged to work and to make connections of new system to existing system when the water plant is not producing water.

E. Contractor's Use of Premises

Contractor will have access to the work site during the hours of 6:30 AM to 5:30 PM, Monday through Friday. After hours or weekend work will need to be coordinated with the District Engineer of the Western Hills Water District.

F. Owner Occupancy

Operations staff will be using the water treatment plant during construction. Access to all WHWD facilities shall be maintained by the Contractor at all times.

The Contractor shall provide a Detour Plan when working in any Diablo Grande street areas, 24 hr. comfortable public access shall be provided and safely maintained by the contractor.

G. Maintenance and Operation of Existing Facilities

The water treatment plant will be in use during construction. Connections of new equipment to the existing facilities will be coordinated with the District Engineer and operations staff at the water treatment plant.

The streets and roads within the Diablo Grande subdivision will be in use during construction. Comfortable vehicular access shall be maintained at all times. Streets shall be kept clean and free of excessive dust for the duration of the work. Any vehicular delays or detours will be coordinated with the District Engineer and the Home Owners' Association and operations staffs.

H. Construction Survey Staking

See Section 015100.

I. Permits

Obtain and pay the fees for the following permits when required: .

Name or Type of Permit	Name, Address, Telephone Number of Permitting Agency
Hazardous Materials Permit	Department of Environmental Division Hazardous Material Division Stanislaus County 3800 Cornucopia Way, Suite C Modesto, CA 95358 (209) 525 6725
CAL/OSHA Form 750 Scaffolding and Trenching Single Project Permit	1209 Woodrow, Ste. C-4 Modesto 95350 (209) 576-6260 Fax (209) 576-6191
CAL/OSHA Pressure Vessel Permit (obtain after installation)	1209 Woodrow, Ste. C-4 Modesto 95350 (209) 576-6260 Fax (209) 576-6191
State Water Resources Control Board (SWRCB) – Construction Activities Storm Water General Permit (99-08-DWQ) (SWPPP)	State Water Resources Control Board Sacramento, CA (916) 341-5536

Contact the permitting agencies listed above for current fees associated with each permit.

The permits contain requirements that affect the cost of project work and some permanent permits require supplementary work permits and fees to execute construction. Comply with the permit requirements and obtain and pay the fees involved with the supplementary work permits.

END OF SECTION

SECTION 012000
MEASUREMENT AND PAYMENT

A. Work Listed in the Schedule of Work Items

1. Work under this contract will be paid on a unit price or lump-sum basis as outlined on the Bid Form for the quantity of work installed.
2. The unit prices and lump-sum prices include full compensation for furnishing the labor, materials, tools, and equipment and doing all the work involved to complete the work included in the contract documents.
3. The application for payment will be for a specific item based on the percentage completed or quantity installed. The percentage complete will be based on the value of the partially completed work relative to the value of the item when entirely completed and ready for service.

B. Work Not Listed in the Schedule of Work Items

1. The General Conditions and items in the Special Provisions, general requirements, and specifications which are not listed in the schedule of work items of the Bid Form are, in general, applicable to more than one listed work item, and no separate work item is provided therefor. Include the cost of work not listed but necessary to complete the project designated in the contract documents in the various listed work items of the Bid Form.
2. The bids for the work are intended to establish a total cost for the work in its entirety. Should the Contractor feel that the cost for the work has not been established by specific items in the Bid Form, include the cost for that work in some related bid item so that the Proposal for the project reflects the total cost for completing the work in its entirety.

C. Mobilization

Payment for mobilization shall be made at the time of the first progress payment after the Contractor has purchased bonds and insurance and established a Contractor's site office with telephone service and a temporary field office for the Resident Project Representative.

D. Demobilization

Payment for demobilization shall be made with the final payment estimate and shall be equal to 20% of the bid amount shown for mobilization.

E. Storm Water Pollution Control

Payment for storm water pollution control shall be made at the contract lump-sum bid price and shall be divided equally throughout the length of the contract.

END OF SECTION

SECTION 013300
SUBMITTALS

A. Related Work Specified Elsewhere

1. Operation and Maintenance Manuals: 019310.

B. Shop Drawings

1. Submit shop drawings in accordance with the General Conditions and Section 013300.
2. The use of contract drawing reproductions for shop drawings is subject to rejection.
3. Submit six copies of shop drawings. The Owner's Representative will keep four copies and return two copies. If the Contractor desires more than two copies, he shall transfer the Owner's Representative's comments onto additional copies at his own expense. Clearly indicate the equipment tag or identification number, specification section, and drawing number to which each shop drawing is referenced.
4. If the Contractor submits shop drawings of equipment by manufacturers other than those listed in the specifications, provide the following information with the submittal:
 - a. The name and address of at least three companies or agencies that are currently using the equipment.
 - b. The name and telephone number of at least one person at each of the above companies or agencies whom the Owner's Representative may contact.
 - c. A description of the equipment that was installed at the above locations. The description shall be in sufficient detail to allow the Owner's Representative to compare it with the equipment that is proposed to be installed in this project.
5. For materials originating outside of the United States for which tests are required, provide recertification and retesting by an independent domestic testing laboratory.

C. Samples

1. Furnish samples of the various materials, together with the finish thereon, as specified for and intended to be used on or in the work. Send samples to the office of the Owner's Representative, carriage prepaid.
2. Submit samples before purchasing, fabricating, applying, or installing such materials and finishes.
3. Submit samples, other than field samples, in duplicate. A cover letter shall accompany the sample and shall list all items being transmitted, designating their particular usage and location in the project. One sample marked "Resubmittal Not Required" will be returned to the Contractor; rejected samples will not be returned.

4. Samples shall be submitted and resubmitted until acceptable. Materials, finishes, and workmanship in the completed project shall be equal in every respect to that of the samples so submitted and accepted.
5. Samples shall conform to materials, fixtures, equipment, surface textures, colors, etc., as required by drawings and specifications or as requested by the Owner's Representative.
6. Identify sample as to product, color, manufacturer, trade name, lot, style, model, etc., location of use, and contract document reference, as well as the names of the Contractor, supplier, project, and Owner's Representative.
7. Samples shall be 8 inches by 10 inches in size and shall be limited in thickness to a minimum consistent with sample presentation. In lieu thereof, submit the actual full-size item.
8. Samples of value may be returned to the Contractor for use in the project after review, analysis, comparison, and/or testing as may be required by the Owner's Representative.
9. Furnish one 8-inch by 10-inch sample of the finally reviewed materials, colors, or textures to the Owner's Representative for final record. Such material samples shall carry on the back all identification as previously described including, if paint sample, manufacturer, mix, proportion, name of color, building, Contractor, subcontractor, and surfaces to which applied.

D. Submittal Register

Designate in a submittal register/schedule, coordinated with the construction schedule, the date for submission and the date the reviewed shop drawings, product data, and samples will be needed. The submittal register shall be on 8-1/2-inch by 11-inch or 11-inch by 17-inch sheets in a format acceptable to the Owner's Representative. The submittal register shall include the submittal description, specification section, date to be submitted, date reviewed, and date acceptable submittal is required.

E. Submittal Requirements

1. Make submittals promptly in accordance with the submittal register/schedule and in such sequence as to cause no delay in the work. Schedule submission a minimum of 10 calendar days before reviewed submittals will be needed.
2. Submittals shall contain:
 - a. The date of submission and the dates of any previous submissions.
 - b. The project title and number.
 - c. Contract identification.
 - d. The names of:

1. Contractor.
 2. Supplier.
 3. Manufacturer.
- e. Identification of the product, with the specification section number.
 - f. Field dimensions, clearly identified as such.
 - g. Relationship to adjacent or critical features of the work or materials.
 - h. Identification of deviations from contract documents.
 - i. Identification of revisions on resubmittals.
 - j. A 5-inch by 5-inch blank space for Engineer's stamps.
 - k. Contractor's stamp, initialed or signed, shall certify Contractor's review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal that the product meets the requirements of the work and of the contract documents.

F. Submittal Format

1. Each submittal shall have a transmittal form. A sample transmittal form is included at the end of this section. Every page in a submittal shall be numbered in sequence. Each copy of a submittal shall be collated and stapled or bound, as appropriate. Copies not collated will be rejected.
2. Where product data from a manufacturer is submitted, clearly mark which model is proposed, with all pertinent data, capacities, dimensions, clearances, diagrams, controls, connections, anchorage, and supports. Present a sufficient level of detail for assessment of compliance with the contract documents.
3. Each submittal shall be assigned a unique number. Submittals shall be numbered sequentially. The submittal numbers shall be clearly noted on the transmittal. Original submittals shall be assigned a numeric submittal number. Resubmittals shall bear an alphanumeric system which consists of the specification section number assigned to the original submittal for that item followed by a letter of the alphabet to represent that it is a subsequent submittal of the original. For example, if Submittal 030500 requires a resubmittal, the first resubmittal will bear the designation "030500A" and the second resubmittal will bear the designation "030500B" and so on.
4. Disorganized submittals that do not meet the requirements above will be returned without review.

G. Resubmittals

Resubmittal of submittals will be reviewed and returned in the same review period as for the original submittal. It is considered reasonable that the Contractor shall make a complete and acceptable submittal by the second submission of a submittal item. The Owner's Representative reserves the right to withhold monies due to the Contractor to cover additional costs of any review beyond the second submittal.

H. Contractor's Jobsite Drawings

Provide and maintain on the jobsite one complete set of prints of all drawings which form a part of the contract. Immediately after each portion of the work is installed, indicate all deviations from the original design shown in the drawings either by additional sketches or ink thereon. Upon completion of the job, deliver this record set to the Owner's Representative.

SHOP DRAWING SUBMITTAL NO. _____

AECOM					
ATTN: _____			ATTN: _____		
PROJECT					
<u>AECOM PROJECT NO.</u>		<u>OWNER PROJECT NO.</u>		<u>CONTRACTOR PROJECT NO.</u>	
ITEM NO.	COPIES	DESCRIPTION	PREVIOUS SUBMITTAL NO.	SPEC. SECTION NO.	PLAN SHEET NO.

SUBMITTED BY: _____ DATE _____
CONTRACTOR

SUBMITTAL RETURN (TO BE COMPLETED BY ENGINEER)				
ITEM NO.	COPIES	RESUBMIT		COMMENTS
		YES	NO	

COPY: _____ RETURNED BY: _____ DATE _____
ENGINEER

END OF SECTION

SECTION 014210
GENERAL ABBREVIATIONS

A. General

Interpret abbreviations used in the drawings and in the specifications as tabulated below. If an abbreviation on a drawing is not explained below, it shall be as explained in ANSI Y1.1. The interpretation of abbreviations shall consider the context or discipline in which they are used, for example:

1. FF usually means "finish floor" when referring to a floor slab.
2. FF usually means "flat face" when referring to a pipe flange.

B. List of General Abbreviations

Abbreviation	Term
A	
A	Ampere/Area
AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturer's Association
AAS	Airport Advisory Service
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
AB	Anchor Bolt/Aggregate Base
ABAN	Abandoned
ABC	Asphalt Base Course
ABS	Acrylonitrile-Butadiene-Styrene
ABT	About
AC	Acre/Asphaltic Concrete/Alternating Current/Air Conditioning
ACCU	Air Cooled Condensing Unit
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
ACP	Asbestos-Cement Pipe
ACU	Air Conditioning Unit
AD	Access Door
ADA	Americans with Disabilities Act
ADDL	Additional

Abbreviation	Term
ADJ	Adjacent
AE	Architect-Engineer
AF	Air Filter/Ampere Frame
AFB	Air Force Base
AFBMA	Anti-Friction Bearing Manufacturer's Association
AGA	American Gas Association
AGMA	American Gear Manufacturer's Association
AHD	Ahead
AHU	Air Handling Unit
AI	The Asphalt Institute
AIA	American Institute of Architects
AICS	Amperes Interrupting Capacity, Symmetrical
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AL	Aluminum
ALIGN	Alignment
ALM	Alarm
ALTN	Alternate
AMB	Ambient
AMCA	Air Movement and Control Association
AMP	Ampere
ANCH	Anchor
ANG	Angle
ANSI	American National Standards Institute
API	American Petroleum Institute
APPROX	Approximate
APWA	American Public Works Association
ARCH	Architecture/Architectural
AREA	American Railway Engineering Association
ARI	Air Conditioning and Refrigeration Institute
ARV	Air-Release Valve
ARVV	Air-Release/Vacuum Valve
ASCE	American Society of Civil Engineers

Abbreviation	Term
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASPH	Asphalt
ASSY	Assembly
ASTM	American Society of Testing and Materials
ATS	Automatic Transfer Switch
AVE	Avenue
AVG	Average
AWG	American Wire Gauge
AWPA	American Wood Preservers Association
AWPB	American Wood Preservers Bureau
AWS	American Welding Society
AWWA	American Water Works Association
B	
BB	Back-to-Back
BC	Beginning of Curve/Back of Curve/Bolt Circle
BCR	Begin Curb Return
BEG	Begin
BEP	Best Efficiency Point
BETW	Between
BF	Blind Flange
BHP	Brake Horsepower
BK	Back/Brake
BKR	Breaker
BL	Base Line
BLDG	Building
BLK	Block
BM	Bench Mark/Beam
BO	Blowoff
BOCA	Building Officials Code Administration International, Inc.
BOD	Biochemical Oxygen Demand
BOT	Bottom
BP	Baseplate

Abbreviation	Term
BR	Bronze/Branch
BRG	Bearing
BTN	Button
BTU	British Thermal Unit
BUR CBL	Buried Cable
BV	Butterfly Valve
BVC	Begin Vertical Curve
BW	Block Wall
C	
C	Conduit/Celsius
CAB	Crushed Aggregate Base
CALTRANS	California Department of Transportation
CANTIL	Cantilevered
CAP	Capacity
CATV	Cable Television
CB	Catch Basin/Circuit Breaker
CBC	California Building Code
CC	Cooling Coil
C-C	Center-to-Center
CCB	Concrete Block
CCP	Concrete Cylinder Pipe
CCS	Central Control Station
CCTV	Closed-Circuit Television
CD	Cross Drain/Condensate Drain/Ceiling Diffuser
CEC	California Electrical Code
CEM	Cement
CF	Cubic Feet/Curb Face
CFH	Cubic Feet Per Hour
CFM	Cubic Feet Per Minute
CFS	Cubic Feet Per Second
CG	Ceiling Grill
C & G	Curb and Gutter
CGA	Compressed Gas Association
CH	Chiller

Abbreviation	Term
CHG	Change
CHKD PL	Checkered Plate
CI	Cast Iron
CIP	Cast in Place/Cast-Iron Pipe
CIPP	Cured-in-Place Pipe
CISP	Cast-Iron Soil Pipe
CISPI	Cast-Iron Soil Pipe Institute
CJ	Construction Joint
CL	Centerline/Class/Clearance
CLR	Clear
CMAA	Crane Manufacturer's Association of America
CMC	Cement-Mortar Coated or Coating
CML	Cement-Mortar Lined or Lining
CMLCSP	Cement-Mortar Lined and Coated Steel Pipe
CMP	Corrugated Metal Pipe
CMPA	Corrugated Metal Pipe Arch
CMU	Concrete Masonry Unit
CO	Cleanout/Conduit Only
COL	Column
COMM	Communication
COMP	Composite
COMPL	Complete
CONC	Concrete
CONN	Connection
CONST	Construct or Construction
CONT	Continuous
CONTR	Contractor
COORD	Coordinate/Coordinated
COP	Copper
COR	Corner
CPLG	Coupling
CPU	Central Processing Unit
CRES	Corrosion-Resistant Steel
CRSI	Concrete Reinforcing Steel Institute

Abbreviation	Term
CS	Carbon Steel/Commercial Standard
CSP	Corrugated Steel Pipe
CT	Center Top/Current Transformer
CTG	Coating
CTR	Center
CTV	Cable Television
CULV	Culvert
CU YD, CY	Cubic Yard
CYL	Cylinder
D	
D	Degree of Curvature
DB	Direct Buried/Decibel
DBL	Double
DC	Direct Current
DEPT	Department
DET	Detail/Detour
DG	Decomposed Granite
DI	Drop Inlet/Ductile Iron
DIA	Diameter
DIAG	Diagonal
DIM	Dimension
DIMJ	Ductile-Iron Mechanical Joint
DIP	Ductile-Iron Pipe
DIPRA	Ductile-Iron Pipe Research Association
DISCH	Discharge
DIST	Distance
DIV	Divide/Division
DO	Dissolved Oxygen
DMH	Drop Manhole
DN	Down
DP	Differential Pressure
DPI	Differential Pressure Indicator
DPNL	Distribution Panel
DR	Drain/Door

Abbreviation	Term
DSL	Diesel
DWG	Drawing
DWY	Driveway
E	
E	East
EA	Each
EC	End of Curve
ECC	Eccentric
ECR	End of Curb Return
ED	External Distance
EDUC	Eductor
EE	Each End
EF	Each Face/Exhaust Fan
EFF	Efficiency
EFL	Effluent
EG	Exhaust Grill
EGL	Energy Grade Line
EL	Elevation/Each Layer
E/L	Easement Line
ELEC	Electric
ELEV	Elevation
ELL	Elbow
ELP	Elliptical
EMB	Embankment
ENC	Encasement
ENCL	Enclosure
ENG	Engine
ENGR	Engineer
EOP	Edge of Pavement
EOS	Equivalent Opening Size
EOTW	Edge of Traveled Way
EP	Explosion Proof/Edge of Pavement
EPA	Environmental Protection Agency (Federal)
EPDM	Ethylene Propylene Diene Monomer

Abbreviation	Term
EPR	Ethylene-Propylene Rubber
EQ	Equation
EQL	Equal
ESMT	Easement
EST	Estimate or Estimated
ETC	And so Forth
ETM	Elapsed Time Meter
EVAP	Evaporator
EVC	End Vertical Curve
EW	Each Way
EWC	Electric Water Cooler
EXC	Excavate or Excavation
EXP	Expansion
EXST	Existing
EXT	Exterior/Extension
F	
F	Fahrenheit/Floor
FAA	Federal Aviation Administration
FAB	Fabricate
FBRBD	Fiberboard
FC	Foot-Candle
FCC	Filter Control Console
FCO	Floor Cleanout
FCV	Flow Control Valve
FD	Floor Drain
FDN	Foundation
FE	Flanged End
FF	Finished Floor/Flat Face
FG	Finished Grade
FHY	Fire Hydrant
F&I	Furnish and Install
FIG	Figure
FIN	Final
FIT	Fitting

Abbreviation	Term
FL	Floor/Flow Line
FLEX	Flexible/Flexure
FLG	Flange
FLT	Float
FLUOR	Fluorescent
FM	Force Main/Factory Mutual
FMH	Flexible Metal Hose
FNSH	Finish
FOC	Face of Concrete
FOS	Face of Stud
FPC	Flexible Pipe Coupling
FPM	Feet Per Minute
FPS	Feet Per Second
FPT	Female Pipe Thread
FRP	Fiberglass-Reinforced Plastic
FS	Finished Surface/Floor Sink/Federal Specifications
FSTNR	Fastener
FT	Feet or Foot
FTG	Footing
FUT	Future
FWY	Freeway
FX	Fire Extinguisher
G	
G	Gas
GA	Gauge
GAL	Gallon
GALV	Galvanized
GAS	Gasoline
GB	Grade Break
GDR	Guard Rail
GE	Grooved End
GEN	Generator
GENL	General
GFI	Ground Fault Interrupter

Abbreviation	Term
GM	Gas Main
GMAW	Gas Metal Arc Welding
GMT	Greenwich Mean Time
GND	Ground
GPD	Gallons Per Day
GPM	Gallons Per Minute
GR	Grade
GRTG	Grating
GSKT	Gasket
GUT	Gutter
GV	Gate Valve
GWB	Gypsum Wallboard
GWBX	Gypsum Wallboard, Fire Rated
GYP	Gypsum
H	
H	Humidistat
HARN	Harness
HB	Hose Bibb
HC	Heating Coil
HD	Heavy Duty
HDPE	High Density Polyethylene
HEPA	High Efficiency Particulate Air
HGL	Hydraulic Grade Line
HID	High Intensity Discharge
HOA	Hand-Off-Automatic
HOR	Hand-Off-Remote
HORIZ	Horizontal
HP	Horsepower/High Pressure
HPS	High Pressure Sodium
HPT	High Point
HR	Hour/Handrail
HS	High Strength
HT	Height
HTG	Heating

Abbreviation	Term
HTR	Heater
HV	Hose Valve
HVAC	Heating, Ventilating, and Air Conditioning
HVY	Heavy
HW	Headwall/Hot Water
HWL	High Water Level
HWY	Highway
HYDR	Hydraulic
HZ	Hertz (cycles per second)
I	
I	Intersection Angle
ICBO	International Conference of Building Officials
ID	Inside Diameter
IE	Invert Elevation
IEEE	Institute of Electrical and Electronics Engineers
IN	Inches
INCAND	Incandescent
INCL	Include
INL	Inlet
INS	Insulating
INSL	Install or Installation
INTR	Interior/Intersection
INV	Invert
IP	Iron Pipe
IPS	Iron Pipe Size
IPT	Iron Pipe Thread
IRR	Irrigation
ISA	Instrument Society of America
J	
J	Joist
JB	Junction Box
JCT	Junction
JIC	Joint Industrial Council
JN	Join

Abbreviation	Term
JT	Joint
K	
KG	Kilogram
KM	Kilometer
KIPS	Thousands of Pounds
KV	Kilovolt
KVA	Kilovolt-Ampere
KW	Kilowatt
KWH	Kilowatt-Hour
KWHM	Kilowatt-Hour Meter
L	
L	Length of Curve/Long/Left
LATL	Lateral
LAV	Lavatory
LB	Pound
LBR	Lumber
LCL	Local
LF	Linear Foot
LG	Long
LGTH	Length
LI	Level Indicator
LLO	Long Leg Outstanding
LOC	Location/Locate
LONGIT	Longitudinal
LOS	Lockout Stop
LP	Light Pole
LPT	Low Point
LR	Long Radius
LS	Lift Station
LT	Left/Light
LTG	Lighting
LWC	Lightweight Concrete
LWIC	Lightweight Insulating Concrete
LWL	Low Water Level

Abbreviation	Term
M	
MA	Milliampere
MAG	Magnet/Magnetic
MATL	Material
MAX	Maximum
MB	Machine Bolt/Megabyte/Millibars
MBH	Thousand BTU Per Hour
MECH	Mechanical
MC	Metal Channel
MCC	Motor Control Center
MCM	Thousand Circular Mils
MCP	Motor Circuit Protector
MD	Motorized Damper
MFR	Manufacturer
MG	Million Gallons/Milligram
MGD	Million Gallons Per Day
MG/L	Milligrams Per Liter
MH	Manhole
MHZ	Megahertz
MI	Malleable Iron/Mile
MIL	Military Specifications
MIN	Minimum
MISC	Miscellaneous
MLSS	Mixed Liquor Suspended Solids
MLVSS	Mixed Liquor Volatile Suspended Solids
MJ	Mechanical Joint
MMA	Monorail Manufacturer's Association
MO	Motor Operator/Motor Operated/Masonry Opening
MOD	Modification
MON	Monument
MOT	Motor
MPT	Male Pipe Thread
MSL	Mean Sea Level
MSS	Manufacturer's Standardization Society

Abbreviation	Term
MTD	Mounted
N	
N	North/Neutral/Nitrogen
NA	Not Applicable
NAAMM	National Association of Architectural Metal Manufacturers
NBFU	National Board of Fire Underwriters
NBS	National Bureau of Standards
N & C	Nail and Cap
NC	Normally Closed
NDT	Nondestructive Testing
NE	Northeast
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFC	National Fire Code
NH	National Hose
NIC	Not in Contract
NIP	Nipple
NMTBA	National Machine Tool Builders Association
NO	Number/Normally Open
NOM	Nominal
NPT	National Pipe Taper
NRS	Nonrising Stem
NSF	National Sanitation Foundation
NTS	Not to Scale
NTU	Nephelometric Turbidity Unit
NW	Northwest
NWL	Normal Water Level
O	
OA	Overall/Outside Air
OC	On Center/Overcurrent
OD	Outside Diameter
ODP	Open Dripproof
OE	Or Equal
OF	Outside Face

Abbreviation	Term
OPER	Operator
OPNG	Opening
OPP	Opposite
ORIG	Original
OSA	Outside Air
OSHA	Occupational Safety and Health Administration
O TO O	Out to Out
OVFL	Overflow
OVHD	Overhead
P	
P	Pole
PARA	Paragraph
PB	Push Button/Pull Box
PC	Point of Curvature/Programmable Controller
PCA	Portland Cement Association
PCC	Point of Compound Curvature/Portland Cement Concrete
PDI	Plumbing and Drainage Institute
PE	Plain End/Polyethylene/Professional Engineer
PEN	Penetration
PERF	Perforated
PF	Power Factor
PG	Pressure Gauge
PI	Point of Intersection
PJTN	Projection
PKWY	Parkway
PL	Plate/Property Line
PLATF	Platform
PLC	Programmable Logic Controller
PLF	Pounds Per Lineal Foot
PNL	Panel
POB	Point of Beginning
POC	Point of Connection
POJ	Push-On Joint
PP	Power Pole/Polypropylene

Abbreviation	Term
PPB	Parts Per Billion
PPM	Parts Per Million
PR	Pair
PRC	Point of Reverse Curve
PRESS	Pressure
PRL	Parallel
PROV	Provisions
PRPSD	Proposed
PRVC	Point of Reverse Vertical Curve
PSI	Pounds Per Square Inch
PSIG	Pounds Per Square Inch Gauge
PSF	Pounds Per Square Foot
PSHL	Pressure Switch (High/Low)
PSL	Pressure Switch (Low)
PT	Point of Tangency
PV	Plug Valve
PVC	Polyvinyl Chloride
PVMT	Pavement
PWR	Power
Q	
Q	Flow Rate
QTY	Quantity
R	
R	Right/Radius
RAD	Radius/Radial
RAF	Return Air Fan
RAG	Return Air Grille
RC	Reinforced Concrete
RCB	Reinforced Concrete Box
RCP	Reinforced Concrete Pipe
RCPA	Reinforced Concrete Pipe Arch
RD	Road
RDC	Reduce
RDCR	Reducer

Abbreviation	Term
RDWY	Roadway
REF	Reference
REINF	Reinforce or Reinforced
RELOC	Relocated
REQ	Required/Requirement
REQD	Required
REV	Revise/Revision
RF	Raised Face
RH	Relative Humidity
RND	Round
RJ	Restrained Joint
RLG	Railing
RPM	Revolutions Per Minute
RR	Railroad
RST	Reinforcing Steel
RT	Right
RTD	Resistance Temperature Detector
RTU	Remote Terminal Unit
R/W	Right-of-Way
S	
S	South/Slope in Feet Per Foot/Sewer
SAE	Society of Automotive Engineers
SAN	Sanitary
SAR	Supply Air Register
SBCCI	Southern Building Codes Congress International
SC	Seal Coat
SCFM	Standard Cubic Feet Per Minute
SCHED	Schedule
SCR	Silicon-Controlled Rectifier/Selective Catalytic Reduction
SCRN	Screen
SD	Storm Drain
SDG	Siding
SDI	Steel Deck Institute
SDWK	Sidewalk

Abbreviation	Term
SE	Southeast
SECT	Section
SF	Square Feet
SGL	Single
SH	Sheet/Sheeting/Shielded
SIM	Similar
SLP	Slope
SLV	Sleeve
SM	Sheet Metal
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SMAW	Shielded Metal Arc Welding
SOL	Solenoid
SOV	Solenoid-Operated Valve
SP	Space/Steel Pipe/Static Pressure/Spare
SPCG	Spacing
SPEC	Specification
SPLC	Splice
SPRT	Support
SQ	Square
SQ FT	Square Feet
SR	Short Radius
SS	Sanitary Sewer
SSPC	Steel Structures Painting Council
SST	Stainless Steel
ST	Street
STA	Station
STBY	Standby
STC	Sound Transmission Class
STD	Standard
STK	Stake
STL	Steel
STR	Straight
STRL	Structural
STRUCT	Structure

Abbreviation	Term
STS	Storm Sewer
STGR	Stringer
STWY	Stairway
SURF	Surface
SW	Southwest
SWG	Swing
SWI	Steel Window Institute
SYMM	Symmetrical
SYS	System
T	
T	Ton/Tangent Length of Curve/Telephone
TAN	Tangent
T/B	Top of Beam
TB	Top of Bank/Terminal Board
T & B	Top and Bottom
TBG	Tubing
TBM	Temporary Bench Mark
TC	Top of Curb
TD	Time Delay
TDH	Total Dynamic Head
TDS	Total Dissolved Solids
TEFC	Totally Enclosed Fan Cooled
TEL	Telephone
TEMP	Temperature/Temporary
TENV	Totally Enclosed Nonventilated
THB	Thrust Block
THD	Thread or Threaded
THH	Thrust Harness
THK	Thick
TIG	Tungsten Inert Gas
TIR	Total Indicator Reading
TO	Turnout
T/O	Top of
TOC	Top of Concrete

Abbreviation	Term
TOS	Top of Slab/Top of Steel
TOT	Total
TP	Telephone Pole
TRD	Tread
TRA	Tie Rod Assembly
TS	Tube Steel
TYP	Typical
U	
UBC	Uniform Building Code, Pacific Coast Building Officials Conference of the International Conference of Building Officials
UD	Underdrain
UG	Underground
UH	Unit Heater
UL	Underwriters' Laboratories, Inc.
ULT	Ultimate
UNO	Unless Noted Otherwise
UPS	Uninterruptible Power Supply
UR	Urinal
USGS	United States Geological Survey
UTC	Underground Telephone Cable
UTR	Up Through Roof
UV	Ultraviolet
V	
V	Vent/Valve/Volt
VAC	Vacuum/Volts, Alternating Current
VC	Vertical Curve
VCP	Vitrified Clay Pipe
VEL	Velocity
VERT	Vertical
VFD	Variable Frequency Drive
VOL	Volume
VPC	Vertical Point of Curve
VPI	Vertical Point of Intersection
VPT	Vertical Point of Tangency

Abbreviation	Term
VTR	Vent Through Roof
W	
W	West/Watt/Wide/Water
W/	With
WC	Water Closet
WCO	Wall Cleanout
WG	Water Gauge
WH	Wall Hydrant
WL	Waterline
WLD	Welded
WM	Water Meter/Water Main
W/O	Without
WP	Waterproof/Working Point
WRGWB	Water-Resistant Gypsum Wallboard
WSE	Water Surface Elevation
WSP	Water Stop
WT	Weight
WTR	Water
WWF	Welded Wire Fabric (same as WWR)
WWM	Woven Wire Mesh (same as WWR)
WWR	Welded Wire Reinforcement
X	
XFMR	Transformer
XFR	Transfer
Y	
YCO	Yard Cleanout
YD	Yard
YP	Yield Point
YR	Year
YS	Yield Strength
Z	

END OF SECTION

SECTION 015100
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

A. Construction Water

1. Related Work Specified Elsewhere:

- a. Earthwork: 312300.
- b. Trenching, Backfilling, and Compacting: 312316.
- c. General Concrete Construction: 030500.
- d. Pressure Testing of Piping: 400515.

2. The Contractor shall make his own arrangements for developing water sources and supply labor and equipment to collect, load, transport, and apply water as necessary for compaction of materials, testing, pipeline disinfection, dust control, and other construction use.

B. Electrical Power--Construction Phase

Provide for the purchase of power or provide portable power for the construction of the project where existing outlets are not available. Provide for the extension of utility lines to the point of usage. The cost of power shall be included in the appropriate bid items to which it is appurtenant and shall include full compensation for furnishing all labor, materials, tools, and equipment required to obtain and distribute power for construction purposes.

C. Dust Control

Perform dust control operations to prevent construction operations from producing dust in amounts harmful to persons or causing a nuisance to persons living nearby or occupying buildings in the vicinity of the work. Use water or dust preventative to control dust.

D. Fire Danger

Minimize fire danger in the vicinity of and adjacent to the construction site. Provide labor and equipment to protect the surrounding private property from fire damage resulting from construction operations.

E. Construction Staking

1. The Engineer, through its consultant, Benchmark Engineering Inc., shall furnish all construction surveying and staking required for the work at the Owner's expense. The work shall be done under the direction of a licensed surveyor.
2. The contractor shall notify the Engineer's consultant a minimum of 48 hours in advance of the need for any staking.

3. Any staking requested by the contractor or their subcontractor that is above and beyond standard staking needs and all re-staking will be subject to an extra work back charge to the contractor.
4. The contractor shall assume all responsibility for the protection and preservation of all benchmarks, control points, reference points and all survey stakes and shall bear all expenses for their replacement and/or errors caused by their loss or disturbance.
5. The contractor shall bear the cost to reset any section corners, monuments, and property corners unnecessarily or negligently distributed by construction in accordance with California Law

F. Access Roads and Parking Areas

1. Obtain access to project site through the existing Diablo Grande H.O.A. public roads accessible at all times between the hours of 6:30 a.m. and 5:30 p.m.
2. The Contractor and his employees will be permitted to park their vehicles outside the fenced boundary of the Water Treatment Plant.

END OF SECTION

SECTION 017410
CLEANING DURING CONSTRUCTION AND FINAL CLEANING

A. General

1. This section includes cleaning during construction and final cleaning on completion of the work.
2. At all times maintain areas covered by the contract and adjacent properties and public access roads free from accumulations of waste, debris, and rubbish caused by construction operations.
3. Conduct cleaning and disposal operations to comply with local ordinances and antipollution laws. Do not burn or bury rubbish or waste materials on project site. Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in storm or sanitary drains. Do not dispose of wastes into streams or waterways.
4. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

B. Cleaning During Construction

1. During execution of work, clean site, adjacent properties, and public access roads and dispose of waste materials, debris, and rubbish to assure that buildings, grounds, and public properties are maintained free from accumulations of waste materials and rubbish.
2. Wet down dry materials and rubbish to lay dust and prevent all blowing dust.
3. Provide containers for collection and disposal of waste materials, debris, and rubbish.
4. Cover or wet excavated material leaving and arriving at the site to prevent blowing dust. Clean the public access roads to the site of any material falling from the haul trucks.

C. Final Cleaning

1. At the completion of work and immediately prior to final inspection, clean the entire project site as follows.
2. Clean, sweep, wash, and polish all work and equipment including finishes.
3. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces; polish surfaces.
4. Repair, patch, and touch up marred surfaces to match adjacent surfaces.
5. Broom clean paved surfaces; rake clean landscaped areas.
6. Remove from the site temporary structures and materials, equipment, and appurtenances not required as a part of, or appurtenant to, the completed work.

SECTION 019310
OPERATION AND MAINTENANCE MANUALS

A. General

Submit six copies of all manufacturer's operation and maintenance manuals and data pertinent to equipment supplied for the project. Prepare and organize the material in three-ring binders with divider tabs and labels. Include a table of contents.

B. Submittals

1. Submittals shall include:

- a. List of equipment furnished for project with name, address, and telephone number of each vendor.
- b. List of serial numbers of equipment furnished.
- c. A copy of shop drawings for mechanical, electrical, and instrument equipment in final form.
- d. Manufacturer's operation and maintenance instructions and parts lists.
- e. Tabulation of motor nameplate horsepower, nameplate current, field-measured current, overload relay setting, and catalog number for polyphase motors.
- f. List of fuses, lamps, seals, and other expendable equipment and devices. Specify size, type, and ordering description. List name, address, e-mail address, fax number, and telephone number of vendor.

2. Provide manuals for each piece of equipment including individual components and subsystems of complete assemblies. Line out nonapplicable text and illustrations. The section of the manual on operation shall describe the functions and limitations of each component and its relationship to the system of which it is a part. Where several models, options, or styles are described, the manual shall identify the items actually provided.

3. Each manual shall contain the following:

- a. Manufacturer's identification, including order number, model, and serial number.
- b. Blue line prints or reviewed shop drawings and diagrams of all systems.
- c. Certified equipment drawings or reviewed shop drawing data clearly marked for equipment furnished.
- d. Complete operating and maintenance instructions for each and every item of equipment, setting forth in detail and step-by-step the procedure for starting, stopping, operating, and maintaining the entire system as installed. Include a schedule of recommended maintenance intervals.

- e. Complete parts list of replaceable parts, their part numbers, and the name and address of their nearest vendor.
 - f. Any special emergency operating instruction and a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to the various parts of the system.
 - g. Copy of manufacturer's equipment guarantees and warranties.
4. Brochures shall be loose leaf with durable plastic or fiberboard covers. Each sheet shall be reinforced to prevent tearing from continued use, and each brochure shall have the following information clearly printed on its cover:
- a. Project name, name of Owner, and address.
 - b. Name and address of Owner's Representative.
 - c. Name and addresses of contractors and subcontractors and department to contact.
 - d. Telephone number of contractors, including night and emergency numbers.
 - e. Major equipment vendors' names and telephone numbers.
5. Submit complete manuals at least two weeks before the date of the instructions required by the subsections on "Manufacturer's Services" in the various specification sections.
6. Operation and maintenance manuals specified herein are in addition to any operation, maintenance, or installation instructions required by the Contractor to install, test, and start up equipment.

C. Equipment Data Sheets

Provide six sets of equipment data sheets, bound in three-ring binders, summarizing the equipment manufacturer's maintenance instructions and recommendations. A blank data sheet and a sample data sheet are attached.

Preventive Maintenance and Operating Requirement Sheets

Preventive Maintenance Program	Equipment Record Number	
EQUIPMENT DESCRIPTION	ELECTRICAL OR MECHANICAL DATA	
Name:	Size:	
Serial No.:	Model:	
Vendor:		
Vendor Address:	Type:	
	Mfr.:	
Vendor Rep:	Voltage:	Amps:
Phone:	Phase:	rpm:
Maintenance Work to be Done	Frequency*	
OPERATING REQUIREMENTS AND REFERENCE		

*D - Daily; W - Weekly; B - Biweekly; M - Monthly; Q - Quarterly;
S - Semiannually; A - Annually.

SAMPLE

Preventive Maintenance and Operating Requirement Sheets

Preventive Maintenance Program		Equipment Record Number	
EQUIPMENT DESCRIPTION		ELECTRICAL OR MECHANICAL DATA	
Name: Influent Pump No. 1 Tag No.: P01-1	Size: 15 hp		
Serial No.: 123456ABC	Model: 140T Frame Serial No. 987654ZY Class F Insulation W/Space Heater		
Vendor: ABC Pump Co.			
Vendor Address: 1111 Pump Circle Newport Beach, CA 92663		Type:	
		Mfr.: DEF Motors, Inc.	
Vendor Rep: XYZ Equipment, Inc.		Voltage: 460	Amps: 20
Phone: 714/752-0505		Phase: 3	rpm: 1,800
Maintenance Work to be Done			Frequency*
1. Operate all valves and check such things as a) bearing temperature, b) changes in running sound, c) suction and discharge gauge readings, d) pump discharge rate, and e) general condition of the drive equipment.			D
2. Check packing.			D
3. Checking pumping unit for any dust, dirt, or debris.			W
(Continued on attached sheet)			
OPERATING REQUIREMENTS AND REFERENCE			
For manufacturer's instructions regarding installation, operation, maintenance, and trouble shooting of this equipment, see Volume _____, Section _____.			

*D - Daily; W - Weekly; B - Biweekly; M - Monthly; Q - Quarterly;
S - Semiannually; A - Annually.

SAMPLE

Preventive Maintenance and Operating Requirement Sheets

Preventive Maintenance Program		Equipment Record Number	
EQUIPMENT DESCRIPTION		ELECTRICAL OR MECHANICAL DATA	
Name:		Size:	
Serial No.:		Model:	
Vendor:			
Vendor Address:		Type:	
		Mfr.:	
Vendor Rep:		Voltage:	Amps:
Phone:		Phase:	rpm:
Maintenance Work to be Done			Frequency*
4. Lubricate bearing frame and motor bearings (consult manufacturer's instructions for type of grease or oil).			Q
5. Disassemble and change or repair the following: a) impeller, b) shafts, c) shaft sleeve, d) rotary seals, and e) sleeve bearings.			A
OPERATING REQUIREMENTS AND REFERENCE			

*D - Daily; W - Weekly; B - Biweekly; M - Monthly; Q - Quarterly;
S - Semiannually; A - Annually.

END OF SECTION

SECTION 020120
PROTECTING EXISTING UNDERGROUND UTILITIES

PART 1 - GENERAL

A. Description

This section includes materials and procedures for protecting existing underground utilities.

B. Related Work Specified Elsewhere

1. Connections to Existing Buried Pipelines: 020130.
2. Trenching, Backfilling, and Compacting: 312316.

PART 2 - MATERIALS

A. Replacement in Kind

Except as indicated below or as specifically authorized by the Owner's Representative, reconstruct utilities with new material of the same size, type, and quality as that removed.

B. Vitrified Clay Sewer Pipe and Couplings

For sewer pipe 8 inches and less in diameter, replacement shall consist of plain-end pipe conforming to ASTM C700. Compression couplings shall conform to ASTM C594, band seal couplings or equal. Use at least two lengths of pipe in crossing the trench section.

PART 3 - EXECUTION

A. General

1. Replace in kind roadway improvements, such as curbs and gutters, barricades, traffic islands, signalization, fences, signs, etc., that are cut, removed, damaged, or otherwise disturbed by the construction.
2. Where utilities are parallel to or cross the construction but do not conflict with the permanent work to be constructed, follow the procedures given below. Notify the utility owner 48 hours in advance of the crossing construction and coordinate the construction schedule with the utility owner's requirements. For utility crossings not shown in the drawings, refer to the General Conditions and the instructions of the Owner's Representative for guidance.
3. Determine the true location and depth of utilities and service connections which may be affected by or affect the work. Determine the type, material, and condition of these

utilities. In order to provide sufficient lead time to resolve unforeseen conflicts, order materials and take appropriate measures to ensure that there is no delay in work.

B. Procedures

1. **Protect in Place:** Protect utilities in place, unless abandoned, and maintain the utility in service, unless otherwise specified in the drawings or in the specifications.
2. **Cut and Plug Ends:** Cut abandoned utility lines and plug the ends. Plug storm drains and sewers with an 8-inch wall of brick and mortar. Cap waterlines with a cast-iron cap or install a 3-foot-long concrete plug. Dispose of the cut pipe as unsuitable material.
3. **Remove and Reconstruct:** Where so indicated in the drawings or as required by the Owner's Representative, remove the utility and, after passage, reconstruct it with new materials. Provide temporary service for the disconnected utility.

C. Compaction

1. **Utilities Protected in Place:** Backfill and compact under and around the utility so that no voids are left.
2. **Utilities Reconstructed:** Prior to replacement of the utility, backfill the trench and compact to an elevation 1 foot above the top of the ends of the utility. Excavate a cross trench of the proper width for the utility and lay, backfill, and compact.
3. **Alternative Construction--Sand-Cement Slurry:** Sand-cement slurry consisting of one sack (94 pounds) of portland cement per cubic yard of sand and sufficient moisture for workability may be substituted for other backfill materials to aid in reducing compaction difficulties. Submit specific methods and procedures for the review of the Owner's Representative prior to construction.

D. Special Construction

1. **Reinforced Concrete Beam:** Where indicated in the drawings or as determined by the Owner's Representative, support utilities by a reinforced concrete beam as shown on the utility support details in the drawings. The primary purpose of the beam is to prevent settlement of the utility line after construction. The Contractor is responsible for the protection of the utility during construction and shall incorporate the beam as part of the protection.
2. **Concrete Support Wall:** Where indicated in the drawings or as determined by the Owner's Representative, support the utilities by a concrete support wall as shown on the utility support details in the drawings. The purpose of the concrete support wall is to prevent settlement of the utility line after construction. The Contractor is responsible for the protection of the utility during construction.

E. Thrust Blocks on Waterlines

1. The Contractor's attention is called to thrust blocks for waterlines throughout the project whose thrust is in the direction of the new excavation and, therefore, may be affected by the construction. These waterlines are owned and operated by the Owner. Protect thrust blocks in place or shore to resist the thrust by a means approved by the Owner's water division superintendent, respectively, and reconstruct. If the thrust blocks are exposed or rendered to be ineffective in the opinion of the Owner's Representative, reconstruct them to bear against firm unexcavated or backfill material.
2. Provide firm support by backfilling that portion of the trench for a distance of 2 feet on each side of the thrust block to be reconstructed from the pipe bedding to the pavement subgrade, with either:
 - a. Sand-cement slurry (94 pounds of cement per cubic yard).
 - b. The native material compacted to a relative compaction of 95%.
3. Then excavate the backfill material for construction of the thrust block.
4. Test compaction of the backfill material before pouring any concrete thrust block. Use Class A concrete per Section 030500 for reconstruction.

F. Adjacent Parallel Utilities

1. The Contractor's attention is called to the existing underground utilities such as water, storm drain, sanitary sewer, electrical conduits and chemical conduits.
2. Protect these utilities from any disturbances and repair the pipelines and associated vaults and appurtenances if they are damaged in any way.

SECTION 020130
CONNECTIONS TO EXISTING BURIED PIPELINES

PART 1 - GENERAL

A. Description

This section includes materials and installation of connections to existing buried ductile-iron and steel and PVC pipes and replacement of existing piping.

B. Related Work Specified Elsewhere

1. Protecting Existing Underground Utilities: 020120.
2. Painting and Coating: 099000.
3. Cold-Applied Wax Tape Coating: 099752.
4. Polyethylene Sheet Encasement: 099754.
5. Fusion-Bonded Epoxy Linings and Coatings: 099761.
6. Manual, Check, and Process Valves: 400520.

C. Submittals

1. Submit shop drawings in accordance with the General Conditions and Section 013300.
2. Submit manufacturer's catalog data for tapping sleeves. Show coatings.
3. Submit shop drawing for design and fabrication of steel outlet connections to existing steel pipes.

PART 2 - MATERIALS

A. Tapping Sleeves for Asbestos Cement, Ductile-Iron, Steel and PVC (Cast-Iron Outside Diameter) Pipes

1. Tapping sleeves shall comply with MSS SP-60 and MSS SP-113.
2. Tapping Sleeve for Ductile-Iron and PVC (Cast-Iron Outside Diameter) Pipes: Mueller H-615 or equal.
3. Tapping Sleeve for Asbestos Cement Pipe: Mueller H-619 or equal.
4. Pressure rating shall be at least 200 psi for piping 12 inches and smaller and at least 150 psi for piping 14 through 24 inches.

B. Coating for Tapping Sleeves

Coat with epoxy per Section 099000, System No. 21 or fusion-bonded epoxy per Section 099761, or wax tape and polyethylene wrap per Sections 099752 and 099754.

C. Tapping Gate Valves

Type V-135 or V-137 per Section 400520.

D. Connections to Existing Steel Pipes

Provide a fabricated steel collar with nozzle. Minimum thickness of collar plate and nozzle shell shall be 3/8 inch. Width of collar from the inside surface of the outlet to the outside edge of the collar shall be one-third to one-half of the diameter of the outlet. Collar may be oval or rectangular with rounded corners. An entire wrapper plate may be substituted for the collar. Steel material shall have a minimum yield stress of 30,000 psi.

PART 3 - EXECUTION

A. Verification of Pipe Outside Diameter Prior to Installation

Excavate the points of connection prior to submittal of shop drawings. Verify outside diameter prior to ordering materials.

B. Wrapping or Coating Tapping Sleeves

After installation, wrap the entire sleeve and tapping valve with cold-applied wax tape per Section 099752 and polyethylene sheet wrap per Section 099754.

C. Installing Connections to Existing Steel Pipes

1. Remove any existing coating to a point 3 inches beyond the area of the pipe that will be covered by the collar or wrapper.
2. Weld the collar to the pipe shell. Weld the entire circumference of the collar.
3. After installation, coat per Section 099000, System No. 21. Then wrap the entire connection and tapping valve with cold-applied wax tape per Section 099752 and polyethylene sheet wrap per Section 099754.

D. Line Stopping Procedure

1. Install concrete and support thrust blocking before installing the temporary pressure tapping machinery and valve. After tapping and line stopping operations have been completed, seal the tee fitting with an ASTM A36 steel pin-locked completion plug with Buna-N O-ring seal. After the completion plug has been successfully installed, close the fitting with a blind flange meeting the requirements of AWWA C110.

2. Any damage that occurs due to the Contractor's work to the line stop fitting, accessories, or existing main shall be repaired at Contractor's expense.
3. Dispose of water and existing pipe at no additional cost to the Owner. Comply with local discharge requirements. Any violation of permit requirements shall be the sole responsibility of the Contractor.
4. In order to aid the Contractor in the construction of the replacement pipe or main, the upstream water pumping stations may be temporarily shut down by coordinating with the Owner. A shutdown time period has been set by the Owner and is summarized in the table below:

Time Period	Upstream Pumping Shutdown Time
Daily	08:00 a.m. to 12:00 a.m.
Weekends	08:00 a.m. to 12:00 a.m.

5. If a longer time period is needed by the Contractor than is outlined above to complete the connections to the existing pipe, then provide the means for conveying the sewage flow from the upstream pumping stations. The means may include bypass force main and/or tanker truck. Coordinate with the Owner.

SECTION 030500
GENERAL CONCRETE CONSTRUCTION

PART I - GENERAL

A. Description

This section includes materials, installation, and testing of formwork, reinforcing steel, joints, concrete, and finishing and curing for general concrete construction.

B. Related Work Specified Elsewhere

1. Painting and Coating: 099000.
2. Chemical-Resistant Coatings for Concrete: 099720.
3. Installing Horizontal Centrifugal Pumps: 432101.
4. Western Hills Water District Standard Drawings and Specifications (Section 90)

C. Submittals

1. Submit shop drawings in accordance with the General Provisions and Section 013300.
2. Prepare concrete and mortar mix designs and laboratory 7-day and 28-day compressive tests, or submit test reports of 7- and 28-day compressive tests of the mix where the same mix has been used on two previous projects. Prepare mix designs in accordance with ACI 318, Chapters 4 and 5, except as modified herein. Submit mix design in writing for review by the Owner at least 15 days before placing of any concrete.

PART 2 - MATERIALS

A. Nondomestic Cement and Additives

1. The use of nondomestic cement and additives in concrete may be permitted only after review of a written request to use such materials. The request to use nondomestic materials shall include a chemical analysis that indicates the material meets the project specifications. Certifications that state the nondomestic materials meet the project requirements will not be accepted.
2. Test reports for concrete materials shall be current to within three months of inclusion into the project and shall be identifiable to the materials supplied.

B. Formwork

1. Design forms according to ACI 347.

2. Class I Forms: Use steel forms, ply form, or smooth-surface plywood 3/4-inch minimum thickness for straight surfaces and 1/2-inch minimum thickness for curved surfaces.
3. Class II Forms: Use plywood in good condition, metal, or smooth-planed boards free from large or loose knots with tongue and groove or ship lap joints.
4. Class II forms may be used for exterior concrete surfaces that are 1 foot or more below finished grade. Use Class I forms for all other surfaces.
5. Coat forms with form release agent.

C. Form Release Agent

1. Form release agent shall effectively prevent absorption of moisture and prevent bond with the concrete. Agent shall be nonstaining and nontoxic after 30 days.
2. For steel forms, release agent shall prevent discoloration of the concrete due to rust.

D. Reinforcing Steel

1. Reinforcement shall conform to ASTM A615 or A706, Grade 60.
2. Fabricate reinforcing in accordance with the current edition of the Manual of Standard Practice, published by the Concrete Reinforcing Steel Institute. Bend reinforcing steel cold.
3. Deliver reinforcing steel to the site bundled and with identifying tags.

E. Welded Wire Reinforcement

Welded wire reinforcement shall conform to ASTM A185.

F. Tie Wire

Tie wire shall be 16 gauge minimum, black, soft annealed.

G. Bar Supports

Bar supports in beams and slabs exposed to view after form stripping shall be galvanized and plastic coated. Use concrete supports for reinforcing in concrete placed on grade.

H. Bar Couplers

Reinforcing steel bar splicing couplers shall be a mechanical type as manufactured by Dayton Barsplice Inc. or equal. Use couplers that do not reduce tensile or ultimate strength of bars.

I. Joint Sealant for Concrete Structures

1. Joint sealant shall be a multipart, gray, nonstaining, nonsagging, gun grade polyurethane sealant, which cures at ambient temperature to a firm, flexible, resilient, tear-resistant rubber. Sealant shall comply with ASTM C920, Type M, Grade P, Class 25 for horizontal joints and Grade NS, Class 25 for vertical joints and be recommended by the manufacturer for continuous immersion in water.

Characteristic or Parameter	Technical Requirements
Pot life	1 to 3 hours
Hardness	35 Shore A, ± 5 , ASTM D2240
Elongation	650%, ASTM D412
Tensile strength	200 psi, ASTM D412
Peel strength on concrete	No adhesion loss at 25 pounds
Temperature service range	40°F to 167°F
Immersion in water	Continuous

2. Sealant shall be Tremco Vulkem 227 or Sikaflex-2CNS (for Grade NS, Class 25), Sikaflex-2CSL of Sika Corporation or Vulkem 245 (for Type M, Grade P, Class 25), or equal. Troweling of sealants into joints will not be permitted.

J. Backing Rod for Expansion Joints

Backing rod shall be an extruded closed-cell polyethylene foam rod, such as Minicel backer rod, manufactured by Industrial Systems Department, Plastic Products Group of Hercules, Inc., Middletown, Delaware; Ethafoam SB, as manufactured by Dow Chemical Company, Midland, Michigan; or equal. The rod shall be 1/4 inch larger in diameter than the joint width. Where possible, provide full-length sections for the joint; minimize splices. Apply backup rod and bond breaker tape in expansion joints.

K. Bond Breaker Tape

Bond breaker tape shall be an adhesive-backed glazed butyl or polyethylene tape that will adhere to the premolded joint material or concrete surface. The tape shall be the same width as the joint. The tape shall be compatible with the sealant.

L. Preformed Control Joint

Preformed control joint shall be a one-piece, flexible, PVC joint former, such as Kold-Seal Zip-Per Strip KSF-150-50-50, manufactured by Vinylex Corp., Knoxville, Tennessee, or a one-piece steel strip with preformed groove, such as Keyed Kold Retained Kap, manufactured by Burke Concrete Accessories, Inc., San Mateo, California, or equal. Provide the preformed control joint material in full-length unspliced pieces.

M. Premolded Joint Filler

Joint filler shall be preformed, nonextruded type constructed of closed-cell neoprene conforming to ASTM D1752, Type I, as manufactured by W. R. Grace Company of Cambridge, Massachusetts; W. R. Meadows, Inc., Elgin, Illinois; or equal or bituminous-type preformed expansion joint filler conforming to ASTM D994.

N. Steel Expansion Joint Dowels

1. Steel expansion joint dowels shall conform to one of the following:
 - a. Steel bar dowels with a 12-mil-thick epoxy coating. Steel bar dowels shall conform to ASTM A36 or ASTM 615, plain rounds, Grade 40. Epoxy coating shall be in conformance with ASTM A775.
 - b. Stainless steel bar dowels conforming to ASTM A276, Type 302.
2. Exposed portion of expansion joint dowels shall be thoroughly greased prior to casting of adjoining wall or slab.

O. Cement

1. Use domestic portland cement that conforms to ASTM C150, Type I, or Type II Use Type III cement for high early strength concrete only for special locations and only when reviewed in advance by the Owner's Representative. Use Type I cement for tremie concrete. Use only one brand of cement in any individual structure. Use no cement that has become damaged, partially set, lumpy, or caked. Reject the entire contents of the sack or container that contains such cement. Use no salvaged or reclaimed cement.
2. Maximum tricalcium aluminate shall not exceed 8%. The maximum percent alkalis shall not exceed 0.6%.

P. Aggregates

Aggregates shall be natural rock, sand, or crushed natural rock and shall comply with ASTM C33, and shall contain less than 1% asbestos by weight or volume. Aggregates shall be free from any substances that will react with the cement alkalis, as determined by Appendix X-1 of ASTM C33.

Q. Water and Ice

Use water and ice that is clean and free from objectionable quantities of organic matter, alkali, salts, and other impurities that might reduce the strength, durability, or otherwise adversely affect the quality of the concrete. Water shall not contain more than 500 mg/L of chlorides or more than 500 mg/L of sulfate.

R. Color Additive for Exterior Electrical Duct Encasement

For exterior electrical duct concrete encasements, use a color additive for identification purposes: brick red "Colorfull" as manufactured by Owl Manufacturing Company, Arcadia, California; coral red "Chromix C-22" as manufactured by L. M. Scofield Company, Los Angeles, California; or equal. Add the color additive while the concrete is being mixed using the quantity per cubic yard of concrete recommended by the manufacturer for the class of concrete indicated.

S. Concrete Admixtures

1. Class A concrete shall contain an air-entraining admixture conforming to ASTM C260. Admixtures shall be Master Builders MB-AE 90, Sika AER, or equal.
2. Class A concrete shall contain a water-reducing admixture conforming to ASTM C494, Type A. It shall be compatible with the air-entraining admixtures. The amount of admixture added to the concrete shall be in accordance with the manufacturer's recommendations. Admixture shall be Master Builders Pozzolith polymer-type normal setting, Plastocrete 161 or Plastiment, Sika Chemical Corporation, or equal.
3. Mineral Admixture: Class A concrete shall contain a mineral admixture, fly ash Class F, conforming to ASTM C618, not to exceed or replace more than 15% of the cement material required without the mineral admixture.
4. Do not use any admixture that contains chlorides or other corrosive elements in any concrete. Admixtures shall be nontoxic after 30 days.

T. Grout

1. Nonshrink grout shall conform to ASTM C1107 and to these specifications. Use a nongas-liberating type, cement base, premixed product requiring only the addition of water for the required consistency. Grout shall be UPCON High Flow, Master Flow 928, or equal. Components shall be inorganic.
2. Ordinary type grout (dry pack) shall consist of one part portland cement to two parts sand (100% passing a No. 8 sieve). Add sufficient water to form a damp formable consistency.
3. Expansive Grout: Premixed, cementitious mixture with a minimum 28-day strength of 3,500 psi. Provide air-entraining admixture as recommended by the manufacturer.
4. Epoxy Grout:
 - a. Mix the two components of epoxy bonding compound in compliance with the manufacturer's instructions.
 - b. Use sand that is oven dry and meets the following gradation requirements for epoxy grout:

Sieve Size	No. 8	No. 50	No. 100
% Passing	100	30 ±15	5 ±5

U. Grout Bedding for Horizontal Joints

The grout placed on horizontal construction joints shall be a mixture of cement, sand, and water in the same proportions and strength used in the overplaced concrete with coarse aggregate omitted.

V. Repair Mortar

1. Mortar used for repair of concrete voids shall be made of the same materials as used for concrete, except that the coarse aggregate shall be omitted or the mortar shall consist of not more than one part cement to two and one-half parts sand by damp loose volume. The quantity of mixing water shall be no more than necessary for handling and placing.
2. Materials for repair of major defects or cracks shall be in accordance with "Repair of Defects and Cracks" specified in Part 3.

W. Bonding Compound

1. Epoxy bonding compound shall be Sikadur 32 Hi-Mod, Sika Chemical Corporation, Lyndhurst, New Jersey; Coneresive by BASF; Euco Epoxy 452 by Euclid Chemical Company; or equal.
2. Non epoxy bonding compound shall be Weldcrete by Larsen Products Corp., Link by Sta-Dry Manufacturing Corp., Euco Weld by Euclid Chemical Co., or equivalent. The compound shall be rewettable for up to two weeks.

X. Concrete Mix Design

1. Conform to ASTM C94, except as modified by these specifications.
2. Air content as determined by ASTM C231 shall be 4% ±1%.
3. Maximum water-cement ratio for Class A concrete = 0.45 by weight.
4. Use classes of concrete as described in the following table:

Class	Type of Work	28-Day Compressive Strength (in psi)	Minimum Cement Content (in lbs per C.Y.)
A	Concrete for all structures and concrete not otherwise specified. Concrete fill at structure foundations, cradle, supports across pipe trenches, and reinforced pipe encasement.	4,000	564
B	Pavement	3,000	500
C	Floor grout and miscellaneous unreinforced concrete.	2,000	376

5. Measure slump in accordance with ASTM C143. Slump shall be as follows:

Slab on grade or heavy sections wider (in plan view) than 3 feet	3 inches maximum
Floor grout	4 inches maximum

Proportion and produce the concrete to have a maximum slump as shown. A tolerance of up to 1 inch above the indicated maximum shall be allowed for individual batches provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit. Concrete of lower than usual slump may be used provided it is properly placed and consolidated.

6. Aggregate size shall be 3/4 inch maximum for slabs and sections 8 inches thick and less. Aggregate size shall be 1 inch maximum for slabs and sections greater than 8 inches and less than 17 inches. Aggregate size shall be 1 1/2 inches maximum for all larger slabs and sections. Aggregate size for floor grout shall be maximum 3/8 inch.
7. Combined aggregate grading shall be as shown in the following table:

Sieve Sizes	Maximum Aggregate Size		
	1 1/2"	1"	3/4"
	Percent Passing		
2"	100	---	---
1 1/2"	90 - 100	100	---
1"	50 - 86	90 - 100	100
3/4"	45 - 75	55 - 100	90 - 100
3/8"	38 - 55	45 - 75	60 - 80
No. 4	30 - 45	35 - 60	40 - 60
No. 8	23 - 38	27 - 45	30 - 45
No. 16	17 - 33	20 - 35	20 - 35
No. 30	10 - 22	12 - 25	13 - 23
No. 50	4 - 10	5 - 15	5 - 15
No. 100	1 - 3	1 - 5	0 - 5
No. 200	0 - 2	0 - 2	0 - 2

8. Mix design for pumped concrete shall produce a plastic and workable mix. The percentage of sand in the mix shall be based on the void content of the coarse aggregate.

Y. Curing Compound

1. Curing compound shall conform to ASTM C309, Type 1, Class A.
2. Curing compound shall be compatible with required finishes and coatings and shall meet the State of California Clean Air Quality Standards which limit the quantity of volatile organic compounds to 350 grams per liter.

Z. Mats, Paper, and Sheeting for Curing

1. Burlap mats shall conform to AASHTO M182.
2. Sisal-kraft paper and polyethylene sheets shall conform to ASTM C171.

AA. Reinforcing Dowel Adhesive

Dowel anchor adhesive shall be HIT-RE 500-SD by Hilti; Sikadur 31, Hi-Mod Gel by Sika; or equal.

PART 3 - EXECUTION

A. Form Tolerances

1. Failure of the forms to produce the specified concrete surface and surface tolerance shall be grounds for rejection of the concrete work. Rejected work shall be repaired or replaced at no additional cost to the Owner.
2. The following table indicates tolerances or allowable variations from dimensions or positions of structural concrete work:

	Maximum Tolerance (inch)
Sleeves and inserts	+1/4 -1/4
Projected ends of anchors	+1/4 -0.0
Anchor bolt setting	+1/4 -1/4
Finished concrete, all locations	+1/4 -1/4 in 10 feet
	Max ±1-inch in total length

The planes or axes from which the above tolerances are to be measured shall be as follows:

Sleeves and inserts:	Centerline of sleeve or insert.
Projected ends of anchors:	Plane perpendicular to the end of the anchor as located in the drawings.
Anchor bolt setting:	Centerline of anchor bolt.
Finish concrete:	The concrete surface as defined in the drawings.

Where equipment is to be installed, comply with manufacturer's tolerances if more restrictive than above.

B. Form Surface Preparation

1. Clean form surfaces to be in contact with concrete of foreign material prior to installation.
2. Coat form surfaces in contact with concrete with a release agent prior to form installation.

C. Form Reuse

Reuse only forms that provide a uniform surface texture on exposed concrete surfaces. Apply light sanding or other surface treatment between uses for uniform texture. Plug unused tie rod holes with corks, shave flush, and sand the concrete surface side. Do not patch forms other than

filling tie rod holes, except in the case of Class II forms. Do not use metal patching discs on Class I forms.

D. Removal of Forms

1. Forms and shoring for elevated structural slabs or beams shall remain in place until the concrete has reached a compressive strength equal to the specified 28-day compressive strength as determined by test cylinders. Do not remove supports and reshore. The following table indicates the minimum allowable time after the last cast concrete is placed before forms, shoring, or wall bracing may be removed:

Sides of footings and encasements	24 hours
Walls, vertical sides of beams, girders, columns, and similar members not supporting loads	48 hours
Slabs, beams, and girders	10 days (forms only)
Shoring for slabs, beams, and girders	Until concrete strength reaches specified 28-day strength
Wall bracing	Until top or roof slab concrete reaches specified 28-day strength

2. Do not remove forms from concrete that has been placed with outside air temperature below 50°F without first determining if the concrete has properly set without regard for time. Do not apply heavy loading on green concrete. Immediately after forms are removed, the surface of the concrete shall be carefully examined and any irregularities in the surface shall be repaired and finished as specified.

E. Formed Openings

Openings shall be of sufficient size to permit final alignment of pipes or other items without deflection or offsets of any kind. Allow space for packing where items pass through the wall to ensure water tightness. Provide openings with continuous keyways and water stops. Provide a slight flare to facilitate grouting and the escape of entrained air during grouting. Provide formed openings with reinforcement as indicated in the typical structural details. Reinforcing shall be at least 2 inches clear from the opening surfaces and encased items.

F. Embedded Items

Set anchor bolts and other embedded items accurately and hold securely in position until the concrete is placed and set. Check all special castings, channels, or other metal parts that are to be embedded in the concrete prior to and again after concreting. Check nailing blocks, plugs, and strips necessary for the attachment of trim, finish, and similar work prior to concreting.

G. Beveled Edges (Chamfer)

Form 3/4-inch beveled edges on exposed concrete edges and corners, beam soffit corners, and where indicated in the drawings. Reentrant corners in concrete members shall not have fillets, unless otherwise shown in the drawings. The top edges of slabs, walkways, beams, and walls may be beveled with an edging trowel in lieu of using chamfer strips.

H. Construction Joints

1. Provide construction joints in accordance with the following:

a. Slabs: Maximum spacing of 40 feet on center in each direction in plan.

For purposes of maximum spacing requirements, expansion joints are considered to be construction joints.

The foregoing applies unless otherwise indicated in the drawings.

2. Layout of construction joints shall be as shown in the drawings and according to the following guidelines:

a. Provide horizontal construction joints at top of foundation members and slabs-on-grade and at the soffit of supported slabs and beams.

b. Space the construction joints at a maximum horizontal distance of 25 feet and a maximum vertical distance of 16 feet.

c. Space the corner vertical construction joints between 4 and 8 feet from the corner of walls or wall intersections.

d. Space horizontal construction joints at least 8 inches below bottom of slabs.

3. For slabs-on-grade that are not subject to hydraulic loading, use formed construction joints. Maximum size of pour shall be 30 feet each way for slabs with wire mesh reinforcement and 75 feet each way for slabs with bar reinforcement. Allow 24 hours between pours of adjacent slabs. Provide joints as specified or shown. Set continuous expansion joint strips between slabs and abutting vertical surfaces as indicated in the drawings.

4. Place expansion joint fillers every 30 feet in straight runs of walks, at right-angle turns, and wherever concrete walks butt into vertical surfaces.

5. For control joints of nonstructural slabs, provide partial depth plastic strips set flush with finished surface or 1/8-inch-wide joints cut with a diamond saw. Use control joints one-quarter to one-third the depth of the slab unless otherwise indicated.

6. Construction joints shall be keyed, unless otherwise detailed. Form keyways by beveled strips or boards placed at right angles to the direction of shear. Except where otherwise

shown in the drawings or specified, keyways shall be at least 1 1/2 inches in depth over at least 25% of the area of the section.

7. When it is necessary to make a joint because of an emergency, furnish and place reinforcing dowels across the joint normal to the face of joint created if not normal to specified reinforcement and at the centerline of the concrete section being terminated. Carefully remove set concrete to a plane but rough surface near normal to adjacent formed or finish surfaces. Embed and extend dowels 48 bar diameters each side of the joint. Size and spacing of dowels shall match the largest reinforcing in the member but no closer than 6 inches on center. Furnishing and placing such reinforcing steel shall be at the Contractor's expense.
8. After a concrete placement pour has been completed to the construction joint and the concrete has hardened, thoroughly clean the entire surface of the joint of surface laitance, loose or defective concrete, and foreign material. Expose clean aggregate by sandblasting and thoroughly cleaning the surface of construction joints before placing the new concrete. Cover horizontal construction joints with grout bedding. Spread uniformly and work thoroughly into all irregularities of the surface. The consistency of the mortar shall be suitable for placing and working and shall be placed immediately prior to placing new concrete.
9. In case of emergency, place additional construction joints. (An interval of 45 minutes constitutes cause for an emergency construction joint.)

I. Expansion Joints

Provide expansion joints with continuous edge reservoirs, which shall be filled with a joint sealant. Leave the material used for forming the reservoirs in place until immediately before the grooves are cleaned and filled with joint sealant. After removing edge forms from the reservoir, remove grout, loose concrete, and fins; then sandblast the slots. Allow the reservoirs to become thoroughly dry; then blow out the reservoirs and immediately prime and fill with the expansion joint sealant and backup materials. The primer used shall be supplied by the same manufacturer supplying the joint sealant.

J. Time Between Pours

At least two hours shall elapse after depositing concrete in the columns or walls before depositing in beams, girders, or slabs supported thereon. Place beams, girders, brackets, column capitals, and haunches monolithically as part of the floor or roof system, unless otherwise indicated in the drawings.

K. Installation of Premolded Joint Filler

Install in joint accurately as shown. Attach to concrete with a bonding agent recommended by the joint sealant and joint filler manufacturer for compatibility.

L. Installation of Joint Sealants

1. Immediately before installing the joint sealant, clean the joint cavity by sandblasting or power wire brushing. Install bond breaker tape per manufacturer's instructions.
2. After the joints have been prepared as described above, apply the joint sealant. Apply the primer, if required, and joint sealant only with the equipment and methods recommended by the joint sealant manufacturer. Application criteria for the sealant materials, such as temperature and moisture requirements and primer cure time, shall be in accordance with the recommendations of the sealant manufacturer.
3. Apply masking tape along the edges of the exposed surface of the exposed joints. Trowel the joints smooth with a tuck pointing tool wiped with a solvent recommended by the sealant manufacturer.
4. After the sealant has been applied, remove the masking tape and any sealant spillage.

M. Placing Reinforcement

1. Place reinforcing steel in accordance with the current edition of Recommended Practice for Placing Reinforcing Bars, published by the Concrete Reinforcing Steel Institute.
2. Place reinforcing in accordance with the following, unless otherwise indicated:
 - a. Reinforcement indicated in the drawings is continuous through the structure to the farthest extent possible. Terminate bars and hooks 2 inches clear from faces of concrete.
 - b. Splices may be used to provide continuity due to bar length limitations. Minimum length of bars spliced for this reason is 30 feet. Splicing of reinforcement that is detailed to be continuous in the drawings is not permitted.
3. Reinforcing steel, before being positioned and just prior to placing concrete, shall be free from loose mill and rust scale and from any coatings that may destroy or reduce the bond. Clean reinforcing steel by sandblasting or wire brushing and remove mortar, oil, or dirt to remove materials that may reduce the bond.
4. Do not straighten or rebend reinforcing steel in the field.
5. Position reinforcing steel in accordance with the drawings and secure by using annealed wire ties or clips at intersections and support by concrete or metal supports, spacers, or metal hangers. Do not place metal clips or supports in contact with the forms. Bend tie wires away from the forms to provide the specified concrete coverage. Bars, in addition to those shown in the drawings, which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at his own expense.
6. Place reinforcement a minimum of 2 inches clear of any metal pipe or fittings.

7. Secure reinforcing dowels in place prior to placing concrete. Do not press dowels into the concrete after the concrete has been placed.
8. Roll wire mesh used for reinforcement flat before placing concrete. Support and tie wire mesh to prevent movement during concrete placement.
9. Position dowels for masonry walls to occur at reinforced block cells.

N. Site-Mixed Concrete

Conform to ACI 304.

O. Ready-Mixed Concrete

Conform to ASTM C94.

P. Placing Concrete

Conform to ACI 304.

Q. Pumping Concrete

Conform to ACI 304.2R-91.

R. Weather Requirements

1. Conform to ACI 305 for placing during hot weather.
2. Conform to ACI 306 for placing during cold weather.

S. Bonding to Old Concrete

Coat the contact surfaces of structural sections with epoxy bonding compound when noted in the drawings. The method of preparation and application of the bonding compound shall conform to the manufacturer's printed instructions and recommendations for specific application for this project.

T. Grouting Machinery Foundations

Block out the original concrete or finish off a sufficient distance below the bottom of the machinery base to provide for the thickness of grout shown in the drawings. After the machinery has been set in position and placed at the proper elevation by steel wedges, fill the space between the bottom of the machinery base and the original pour of concrete with a pourable nonshrink grout. Grout and grouting procedure shall be in accordance with API 686, Chapter 4, paragraphs 3.6 and 3.7, and Chapter 5 and Section 432101.

U. Concrete Finishes

1. Complete concrete surfaces in accordance with the following schedule:

Finish Designation	Area Applied
F-1	Beams, columns, and exterior walls not exposed to view.
F-3	Beams, columns, and walls of structures or buildings exposed to view. Underside of formed floors or slabs.
F-4	Exterior and interior surfaces to be coated.
S-1	Slabs and floors to be covered with concrete or grout.
S-4	Slabs and floors of structures or buildings exposed to view.
S-5	Slabs and floors at slopes greater than 10% and stairs.
E-1	Exposed edges. EXCEPTION: edges normally covered with earth.
E-2	Top of walls, beams, and similar unformed surfaces.

2. Finish F-1: Repair defective concrete, fill depressions deeper than 1/2 inch, and fill tie holes.

Finish F-3: In addition to Finish F-1, remove fins, fill depressions 1/4 inch or deeper, fill depressions and airholes with mortar. Dampen surfaces and then spread a slurry consisting of one part cement and one and one-half parts sand by damp loose volume, over the surface with clean burlap pads or sponge rubber floats. Remove any surplus by scraping and then rubbing with clean burlap.

Finish F-4: Repair defective concrete, remove fins, fill depressions 1/16 inch or deeper, fill tie holes, remove mortar spatter, and remove bulges higher than 1/16 inch.

Finish S-1: Screed to grade without special finish.

Finish S-4: Steel trowel finish without local depressions or high points and apply a light hair-broom finish. Do not use stiff bristle brooms or brushes. Leave hair-broom lines parallel to the direction of slab drainage.

Finish S-5: Steel trowel finish without local depressions or high points. Apply a stiff bristle broom finish. Leave broom lines parallel to the direction of slope drainage.

Finish E-1: Provide chamfer or beveled edges.

Finish E-2: Strike smooth and float to an F-3 or F-4 finish.

V. Curing Concrete

1. Conform to ACI 308.
2. Water cure with burlap mats unless optional curing methods are permitted.

3. Do not use curing compound on surfaces that are to be coated in accordance with Section 099720 and 099000.
4. It is the responsibility of the Contractor to select the appropriate curing method in response to climatical and/or site conditions occurring at the time of concrete placement. Take appropriate measures as described in ACI 305 and 306 for protecting and curing concrete during hot and cold weather.

W. Repair of Defects and Cracks

1. Do not repair defects until concrete has been evaluated by the Owner's Representative.
2. Surface Defects:
 - a. Repair surface defects that are smaller than 1 foot across in any direction and are less than 1/2 inch in depth.
 - b. Repair by removing the honeycombed and other defective concrete down to sound concrete, cut or grind edges perpendicular to the surface and at least 3/8 inch deep, abrasive clean and thoroughly dampen the surface, work into the surface an epoxy bonding agent, and fill the hole with one part cement to one part fine sand. Match the finish on the adjacent concrete, and cure as specified.
3. Severe Defects:
 - a. Repair severe defects that are larger than surface defects but do not appear to affect the structural integrity of the structure.
 - b. Repair by removing the honeycombed and other defective concrete down to sound concrete, make edges of the repair area perpendicular to the surface, as required above, sandblast the sound concrete surface, coat the exposed surfaces with epoxy bonding compound, place nonshrink grout, match the finish on the adjacent concrete, and cure as specified.
4. Repair minor cracks in concrete structures that are wider than 1/10 inch by cutting out a square edged and uniformly aligned joint 3/8 inch wide by 3/4 inch deep, preparing exposed surfaces of the joint, priming the joint, and applying polyurethane joint sealant.
5. If the cracks are major or affect the hydraulic capacity or function of the element, the Owner's Representative may require the concrete to be repaired by epoxy injection.
6. Major Defects and Cracks: If the defects affect the structural integrity of the structure or if patching does not satisfactorily restore quality and appearance to the surface, the Owner's Representative may require the concrete to be removed and replaced, complete.

X. Concrete Surfaces To Be Coated

See Sections 099000 and 099720.

Y. Aluminum Surfaces in Contact With Concrete

Coat aluminum surfaces in contact with concrete per Section 099000, System No. 54.

Z. Concrete Tests

1. Concrete quality testing may be performed on the concrete by the Owner as follows:

- a. Frequency of Sampling: Cast four concrete test cylinders from each 5075 cubic yards, or fraction thereof, of each class of concrete placed in any one day. Sampling and curing of cylinders shall conform to ASTM C31.
- b. Strength Testing: Test cylinders in accordance with ASTM C39. Test one cylinder at 7 days for information; test two cylinders at 28 days for acceptance; and hold one cylinder for verification. Strength acceptance will be based on the average of the strengths of the two cylinders tested at 28 days. If one cylinder of a 28-day test manifests evidence of improper sampling, molding, or testing, other than low strength, discard it and use the fourth cylinder for the test result.
- c. Determine concrete slump by ASTM C143 with each strength test sampling and as required to establish consistency.
- d. Determine air content of the concrete using ASTM C231 to verify the percentage of air in the concrete immediately prior to depositing in forms.
- e. The average value of concrete strength tests shall be equal to or greater than the specified 28-day strength. No test shall be less than 90% of the specified 28-day strength.
- f. If the 28-day strength tests fail to meet the specified minimum compressive strength, the concrete will be assumed to be defective and one set of three cores from each area may be taken as selected by the Owner and in accordance with ASTM C42. If the average compressive strength of the set of three concrete cores fails to equal 85% of the specified minimum compressive strength or if any single core is less than 75% of the minimum compressive strength, the concrete will be considered defective. The Owner may require additional coring, nondestructive load testing, or repair of defective concrete. Costs of coring, testing of cores, load testing, and required repairing pertaining thereto shall be paid by the Contractor at no extra cost to the Owner.
- g. Concrete acceptance shall be based on the requirements of ACI 318.

2. To facilitate concrete sampling and testing, the Contractor shall:

- a. Furnish labor to assist the Owner in obtaining and handling samples at the project site.

- b. Advise the Owner in advance of concrete placing operations to allow for scheduling and completion of quality testing.
- c. Provide and maintain facilities for safe storage and proper curing of concrete test specimens on the project site, as required by ASTM C31.

END OF SECTION

SECTION 034220
PRECAST CONCRETE VAULTS

PART 1 - GENERAL

A. Description

This section includes materials, design, and installation of precast concrete vaults and structures.

B. Related Work Specified Elsewhere

1. General Concrete Construction: 030500.
2. Grating, Cover Plates, and Access Hatches: 055300.
3. Underground Electrical Duct Systems: 260543.
4. Earthwork: 312300.
5. Gravel and Crushed Rock Base for Structures: 312323.

C. Submittals

1. Submit shop drawings in accordance with the General Provisions and Section 013300.
2. Submit manufacturer's catalog data on precast concrete items. Show dimensions of vaults and thicknesses of walls, floors, and top slabs. Show reinforcing wire and steel. Show materials of construction by ASTM reference and grade.
3. Submit manufacturer's design calculations and certification signed and sealed by a professional structural engineer registered in the state of California that vault design and construction comply with the specified design load conditions and the referenced ASTM specifications (e.g., ASTM C857 and C858).

PART 2 - MATERIALS

A. Manufacturers

Precast concrete vaults shall be manufactured by Brooks Products Inc., Utility Vault Company, or equal.

B. Precast Concrete Vaults

1. Precast concrete vaults shall comply with ASTM C858 except as modified herein.
2. Design loads shall be in accordance with ASTM C857, except as modified herein. Traffic loads, unless otherwise stated, shall conform to Load Designation A-16 per Table 1. Soil

lateral loads shall be as determined by ASTM C857 or loadings specified in the project soils report, whichever is greater. Alternate design by the strength design method shall include a load factor of 1.7 times the lateral earth or hydrostatic pressures.

3. Include the following load conditions in the design:
 - a. Vault roof removed while structure is backfilled to grade and subject to live and dead loads.
 - b. Vault roof in place and walls subject to simultaneous vertical and horizontal application of all live, impact, and dead loads. Include the case of an A-16 designated load placed directly above the wall.
 - c. Open bottom with no reinforced concrete slab.
4. Design shall also comply with the following restrictions:
 - a. The maximum reinforcement ratio allowed is one-half the reinforcement ratio that would produce a balanced strain condition.
 - b. Earth pressure shall be converted to a horizontal pressure using a coefficient of earth pressure at rest of 0.5 and not a coefficient of active earth pressure.
 - c. Include a live load surcharge of 2 feet of soil in the design of the walls.
5. Design all vaults to receive the specified traffic loading.
6. Precast vault construction shall be in the form of monolithic walls or horizontal wall sections; do not use panel walls.
7. Minimum wall thickness shall be 6 inches. Design knockout wall panels to accommodate loading pressures defined above.
8. Design and construct vaults to be watertight when subjected to groundwater over the entire height of the vault.
9. Floor slab shall be precast concrete. Calculations for the floor slab design shall be included in the vault design submittal.
10. Design joints using a butyl rubber sealant per ASTM C990.

C. Sealants and Mortar

Butyl rubber sealing compound shall comply with ASTM C990. Mortar shall comply with ASTM C387, Type S or use grout complying with Section 030500.

D. Access Hatches

1. Provide traffic-rated access hatches per Section 055300.

2. Electrical vault hatches shall have identification per Section 260543.

E. Inserts

Handling eyes, lifting inserts, and threaded inserts shall be galvanized steel. Design load capacity shall be 2,000 pounds unless shown otherwise in the drawings.

F. Cement

Cement shall be ASTM C150, Type II.

G. Admixtures

Provide air-entraining and water-reducing concrete admixtures as specified in Section 030500.

H. Crushed Rock Base

Crushed rock base material shall comply with Section 312323.

PART 3 - EXECUTION

A. Vault Base

1. Excavate for the vault and install a crushed rock base, 12 inches thick.
2. Crushed rock base material shall extend 1 foot beyond the outside edge of the concrete vault base. Compact to 90% relative density.

B. Sealing and Grouting

Fill joints between precast sections with either a butyl rubber sealing compound or mortar.

C. Installing Vaults

1. Set each precast concrete vault section plumb on a bed of sealant or cement mortar at least 1/2-inch thick to make a watertight joint with the concrete base and with the preceding unit. Point the inside joint and wipe off the excess mortar or sealant.
2. Install the concrete roof such that it slopes at least 1/8 inch per foot toward the drainage channel around the roof hatch.

D. Backfill Around Vaults

Backfill and compact around the vaults using fill as specified in Section 312300. Compact to 90% relative compaction.

END OF SECTION

SECTION 050520
BOLTS, WASHERS, ANCHORS, AND EYEBOLTS

PART 1 - GENERAL

A. Description

This section describes materials and installation of anchor bolts, connecting bolts, washers, drilled anchors, epoxy anchors, screw anchors, eyebolts, and stainless steel fasteners.

B. Related Work Specified Elsewhere

1. General Concrete Construction: 030500.
2. Miscellaneous Structural Steel and Aluminum: 051210.
3. General Piping Requirements: 400500.
4. Pipe Hangers and Supports: 400764.

C. Design Criteria

Structural Connections: AISC Specification for Structural Steel Buildings (March 9, 2005), except connection details are shown in the contract drawings.

D. Submittals

1. Submit shop drawings in accordance with the General Provisions and Section 013300.
2. Submit manufacturer's catalog data and ICC reports for bolts, washers, and concrete anchors. Show dimensions and reference materials of construction by ASTM designation and grade.

PART 2 - MATERIALS

A. Anchor Bolts

Steel anchor bolts shall conform to ASTM A307, Grade A, B, or C.

B. Connection Bolts

1. Steel connection bolts shall conform to ASTM A307 or A325, Type 1 or 2. Connection type shall be per the AISC handbook.
2. Provide self-locking nuts or lockwashers and plain nuts where shown in drawings.

3. Provide galvanized bolts where shown in drawings. Galvanizing of bolts, nuts, and washers shall be in accordance with ASTM F2329.

C. Stainless Steel Bolts

Stainless steel bolts shall be ASTM A193, Grade B8 or ASTM F593, Type 304. Nuts shall be ASTM A194, Grade 8 or ASTM F594, Type 304. Use ASTM A194 nuts with ASTM A193 bolts; use ASTM F594 nuts with ASTM F593 bolts. Provide washer for each nut and bolthead. Washers shall be of the same material as the nuts.

D. Lubricant for Stainless Steel Bolts and Nuts

Lubricant shall be chloride free and shall be RAMCO TG-50, Anti-Seize by RAMCO, Specialty Lubricants Corporation Husky™ Lube O'Seal, or equal.

E. Hardened Steel Washers

Washers for American Standard beams and channels shall be square or rectangular, tapered in thickness, smooth, hot-dipped galvanized, and conforming to ASTM F436.

F. Plain Unhardened Steel and Stainless Steel Washers

Washers shall comply with ASTM F844. Stainless steel washers shall be Type 304. Provide clipped washers where space limitations necessitate.

G. Drilled Anchors

1. Unless otherwise indicated in the drawings, drilled anchors shall be Type 304 or 316 stainless steel wedge anchors as manufactured by ITW Ramset/Redhead, Kwik Bolt TZ by Hilti, or equal.
2. Where indicated in the drawings, drilled anchors shall be Type 304 stainless steel heavy-duty wedge anchors suitable for dynamic loading. Anchors shall be HSL-3 heavy-duty wedge anchor by Hilti, Power-Bolt by Rawlplug Company, or equal. For metric anchors, use the size that is closest to, but no smaller than, the required English size.

H. Epoxy Anchors

1. Epoxy anchors in concrete shall be Type 304 threaded rod adhesive anchors. Adhesive shall be Rawl Power-Fast, Hilti HIT RE 500-SD, Simpson Epoxy-tie with SET epoxy, or equal.

PART 3 - EXECUTION

A. Storage of Materials

Store material, either plain or fabricated, above ground on platforms, skids, or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

B. Galvanizing

Zinc coating for bolts, anchor bolts, and threaded parts shall be in accordance with ASTM F2329.

C. Installing Connection Bolts

1. Use steel bolts to connect structural steel members. Use stainless steel bolts to connect structural aluminum members.
2. Install ASTM A325 bolts per the AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
3. Install washers per AISC Specification for ASD.
4. Bolt holes in structural members shall be 1/16 inch in diameter larger than bolt size. Measure cast-in-place bolt locations in the field before drilling companion holes in structural steel beam or assembly.
5. Slotted holes, if required in the drawings, shall conform to AISC Specifications, Chapter J, Section J3, Table J3.1.
6. Drive bolts accurately into the holes without damaging the thread. Protect boltheads from damage during driving. Boltheads and nuts or washers shall rest squarely against the metal. Where bolts are to be used on beveled surfaces having slopes greater than 1 in 20 with a plane normal to the bolt axis, provide beveled washers to give full bearing to the head or nut. Where self-locking nuts are not furnished, bolt threads shall be upset to prevent the nuts from backing off.
7. Bolts shall be of the length that will extend entirely through but not more than 1/4 inch beyond the nuts. Draw boltheads and nuts tight against the work. Tap boltheads with a hammer while the nut is being tightened.

D. Installing Anchor Bolts

1. Preset bolts and anchors by the use of templates. For mechanical equipment (pumps, compressors, and blowers), do not use concrete anchors set in holes drilled in the concrete after the concrete is placed.
2. For static items (storage tanks), use preset anchor bolts.
3. After anchor bolts have been embedded, protect projecting threads by applying grease and having the nuts installed until the time of installation of the equipment or metalwork.
4. Minimum depth of embedment of drilled mechanical anchors shall be as recommended by the manufacturer, but no less than that shown in the drawings.

5. Minimum depth of embedment of epoxy anchors shall be as recommended by the manufacturer, but no less than that shown in the drawings.
6. Prepare holes for drilled and epoxy anchors in accordance with the anchor manufacturer's recommendations prior to installation.

E. Installation of Stainless Steel Bolts and Nuts

Prior to assembly, coat threaded portions of stainless steel bolts and nuts with lubricant.

END OF SECTION

SECTION 051210
MISCELLANEOUS STRUCTURAL STEEL AND ALUMINUM

PART 1 - GENERAL

A. Description

This section describes materials, fabrication, and installation of structural steel, structural aluminum, stainless steel plate and members, steel tubing, aluminum tubing, and aluminum sheet.

B. Related Work Specified Elsewhere

1. General Concrete Construction: 030500.
2. Bolts, Washers, Anchors, and Eyebolts: 050520.
3. Grating, Cover Plates, and Access Hatches: 055300.
4. Painting and Coating: 099000.

C. Design Criteria

Structural Connections and Framing: AISC Specification for Structural Steel Buildings (March 9, 2005), except connection details are shown in the contract drawings.

D. Submittals

1. Submit shop drawings in accordance with the General Provisions and Section 013300.
2. Submit placing or erection drawings that indicate locations of fabricated items. Reproductions of contract documents will not be accepted for this purpose.

PART 2 - MATERIALS

A. Structural Steel

Material for all-purpose bolted or welded construction shall conform to the following:

1. ASTM A992: W shapes (rolled wide flange shapes).
2. ASTM A36 or A572, Grade 50: S, M, HP, and channels.
3. ASTM A36: Angles and plates.

B. Bolts and Washers

See Section 050520.

C. Steel Pipe Columns

Conform to ASTM A53, Grade B or A501.

D. Hollow Structural Steel (HSS) and Stainless Steel Tubing

1. Steel: Conform to ASTM A500, Grade A or A501.
2. Stainless Steel: Conform to ASTM A554, Grade 316L.

E. Aluminum Sheet

Aluminum sheet shall conform to ASTM B209, Alloy 3003, H 14 temper.

F. Structural Aluminum

Aluminum structural members shall conform to ASTM B308, Alloy 6061-T6. Aluminum bars and rods shall conform to ASTM B221, Alloy 6061-T6.

G. Aluminum Tubing

Aluminum seamless pipe and tubing shall conform to ASTM B241, Alloy 6061-T6. Wall thickness shall be Schedule 80, per ANSI H35.2, unless otherwise shown in the drawings.

H. Welding Electrodes

1. Welding electrodes for structural steel shall conform to AWS A5.5. Use electrodes in the E-70 series.
2. Filler metal shall have a minimum charpy V-notch toughness of 20 ft-lbs at -20°F.
3. Welding electrodes for aluminum shall be ER4043 filler metal.
4. Welding electrodes for stainless steel shall conform to AWS A5.4. Use electrodes as follows:

Stainless Steel Material	Welding Electrode Material
Type 304	E 308
Type 304L	E 347
Type 316	E 316
Type 316L	E 318

PART 3 - EXECUTION

A. Storage of Materials

Store structural material, either plain or fabricated, above ground on platforms, skids, or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

B. Fabrication and Erection

1. Fabricate miscellaneous metal items to straight lines and true curves. Drilling and punching shall not leave burrs or deformations. Continuously weld permanent connections along the entire area of contact. Exposed work shall have a smooth finish with welds ground smooth. Joints shall have a close fit with corner joints coped or mitered and shall be in true alignment. Unless specifically indicated in the drawings, there shall be no bends, twists, or open joints in any finished member nor any projecting edges or corners at intersections. Conceal fastenings wherever possible. Built-up parts shall be free of warp. Exposed ends and edges of metal shall be slightly rounded.
2. Clean the surfaces of metalwork to be in contact with concrete of rust, dirt, grease, and other foreign substances before placing concrete.
3. Set embedded metalwork accurately in position when concrete is placed and support rigidly to prevent displacement or undue vibration during or after the placement of concrete. Unless otherwise specified, where metalwork is to be installed in recesses in formed concrete, said recesses shall be made, metalwork installed, and recesses filled with dry-pack mortar in conformance with Section 030500.

C. Galvanizing for Steel Plates, Pipe, and Tubing

Zinc coating shall be in accordance with ASTM A123.

D. Welding

1. Perform welding on steel by the SMAW process. Welding shall conform to the AWS D1.1-2008, except as modified in AISC Section J2.
2. Perform welding on aluminum by the gas metal arc (MIG) or gas tungsten arc (TIG) process. Welding shall conform to the AWS D1.2-2003.
3. Perform welding on stainless steel by the TIG process. All welds shall be full penetration and smooth unless otherwise indicated in the drawings. Provide inert gas on the inside of pipe during welding to reduce oxidation.
4. Provide a minimum of two passes for metal in excess of 5/16-inch thickness.
5. Produce weld uniform in width and size throughout its length with each layer of weldment smooth; free of slag, cracks, pinholes, and undercuttings; and completely fused to the

adjacent weld beads and base metal. Avoid irregular surface, nonuniform bead pattern, and high crown. Form fillet welds of the indicated size of uniform height and fully penetrating. Accomplish repair, chipping, and grinding of welds in manner that will not gouge, groove, or reduce the base metal thickness.

E. Bolting

See Section 050520.

F. Control of Flame Cutting

Do not use a gas-cutting torch in the field for correcting fabrication errors on any member in structural framing. Use a gas-cutting torch only on minor members when the member is not under stress.

G. Repair of Galvanized Surfaces

Repair or replace metal with damaged galvanized surfaces at no additional cost to the Owner. Repair galvanized surfaces per Section 099000, System No. 55.

H. Corrosion Protection of Aluminum Surfaces

1. Coat aluminum surfaces to be embedded or which will be in contact with concrete or masonry, per Section 099000, System No. 51 and 54 before installation. Allow the coating to dry before the aluminum is placed in contact with the concrete.
2. Where aluminum surfaces come in contact with dissimilar metals, except stainless steel, keep the dissimilar metallic surfaces from direct contact by use of neoprene gaskets or washers.

I. Painting and Coating of Structural Steel

Coat nongalvanized structural steel surfaces per Section 099000, System No.10. Apply prime coat in the shop prior to shipping to the site. Apply intermediate and finish coats after erection, except surfaces that will be inaccessible for coating after erection or assembly shall be finish coated prior to erection or assembly. Color of finish coat shall be selected by Owner. Faying surfaces of connections that are not specified to be slip critical may be primed and need not be further painted.

END OF SECTION

SECTION 055300
GRATING, COVER PLATES, AND ACCESS HATCHES

PART 1 - GENERAL

A. Description

This section describes materials, fabrication, and installation of steel and aluminum grating, cover and floor plates, and access hatches.

B. Related Work Specified Elsewhere

1. General Concrete Construction: 030500.
2. Painting and Coating: 099000.

C. Design Criteria

1. Grating, Floor Plates, and Miscellaneous Cover Plates: Design live load of 100 psf, maximum deflection of 1/240 of span.
2. Access Hatches: AASHTO H20 loading.

D. Submittals

1. Submit shop drawings in accordance with the General Provisions and Section 013300.
2. Submit drawings of grating, cover plates, and access hatches. Show dimensions and reference materials of construction by ASTM designation and grade. Show design criteria.

PART 2 - MATERIALS

A. Design of Grating, Floor Plates, and Miscellaneous Cover Plates

1. Grating, floor plates, and miscellaneous cover plates shall be as detailed in the drawings or, if not detailed, shall be designed per subsection on "Design Criteria" in Part 1. No single piece of grating, floor plate, or miscellaneous cover plate shall weigh more than 80 pounds. Length of individual pieces shall not exceed one and one-half times the width, unless limited by the installation.
2. Field measure grating and cover plates for proper cutouts and size.
3. Grating shall be completely banded. For pipe and conduits (including electrical conduit) larger than 1 inch in diameter penetrating grating, cut and band grating before galvanizing.

B. Stainless Steel Plate and Members

Except where otherwise specified, stainless steel plate and members shall be Type 304 or 304L, ASTM A240 or A666.

C. Aluminum Sheet

Aluminum sheet shall conform to ASTM B209, Alloy 3003, H 14 temper.

D. Steel Access Hatches

1. Access hatches shall be Bilco Type J of the size and configuration shown in the drawings. Steel doors and frames shall be hot-dipped galvanized per ASTM A123 Aluminum doors shall be anodized. Latch and lifting mechanism assemblies, hold-open arms and guides, and brackets, hinges, pins, and fasteners shall be Type 316 stainless steel.

2. Locking and Latching Devices:

- a. Lugs welded to the exterior door surface to receive a padlock.
- b. Hinged hasp on exterior door surface.
- c. Recessed hasp covered by a hinged lid flush with the exterior surface.
- d. Cylinder lock with keyway protected by a threaded cover plug.
- e. Snap lock with a removable handle.

E. Grating

Grating shall be welded steel as indicated in the drawings. Steel grating shall be hot-dipped galvanized after fabrication. Main bars shall be of the thickness and of the depth indicated in the drawings.

F. Checkered Cover Plates

Checkered cover plates shall be steel. Minimum thickness shall be as shown in the drawings. Provide U-bolt lifting handles located at opposite ends on each removable section. Handles shall be recessed to reduce tripping hazards. Steel plates, including angle edgings, support angles, and lifting handles, shall be stainless steel. Steel plates shall comply with ASTM A786. Stainless steel plates shall conform to ASTM A793.

G. Frames and Supports for Grating and Checkered Plates

Fabricated frames and supports for grating and checkered cover plates shall be stainless steel. Corners of embedded angle frames shall be mitered and welded with the welds ground smooth.

H. Welding Electrodes

1. Welding electrodes for structural steel shall conform to AWS A5.5. Use electrodes in the E-70 series.
2. Welding electrode for aluminum shall be ER4043 filler metal.
3. Welding electrodes for stainless steel shall conform to AWS A5.4. Use electrodes as follows:

Stainless Steel Material	Welding Electrode Material
Type 304	E 308
Type 304L	E 347
Type 316	E 316
Type 316L	E 318

PART 3 - EXECUTION

A. Storage of Materials

Store structural material, either plain or fabricated, above ground on platforms, skids, or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

B. Installation and Erection

1. Clean the surfaces of metalwork to be in contact with concrete of rust, dirt, grease, and other foreign substances before placing concrete.
2. Set grating seats and frames and checkered plate frames and supports accurately in position when concrete is placed and support it rigidly to prevent displacement or undue vibration during or after the placement of concrete. Unless otherwise specified, where metalwork is to be installed in recesses in formed concrete, said recesses shall be made, metalwork installed, and recesses filled with dry-pack mortar in conformance with Section 030500.
3. Set seat angles for grating so that the grating will be flush with the floor. Maintain the grating and floor plates flush with the floor. Seat angles and anchors shall be galvanized steel.

C. Fastening

Fasten grating panels to supporting members with minimum of two 1-inch-long welds at each end of each panel or with two saddle clips at each end of each panel bolted to studs that are welded to supporting member s or by bolting to two weld lugs shop-welded to each end of each

panel. Weld bolt studs to supporting members. Bolt studs shall be 1/4 inch in diameter and of the same material as the supporting members. Saddle clips and Weld lugs shall be the same material as the grating.

D. Galvanizing

Zinc coating for plates, bolts, anchor bolts, and threaded parts shall be in accordance with ASTM A153 and F2329.

E. Welding

1. Perform welding on steel by the SMAW process. Welding shall conform to AWS D1.1-2006, except as modified in AISC Section J2.
2. Perform welding on aluminum by the gas metal arc (MIG) or gas tungsten arc (TIG) process. Welding shall conform to AWS D1.2-2003.
3. Perform welding on stainless steel by the gas tungsten arc (TIG) process. Welds shall be full penetration and smooth. Provide inert gas on the inside of pipe during welding to reduce oxidation.
4. Provide a minimum of two passes for metal in excess of 5/16-inch thickness.
5. Produce weld uniform in width and size throughout its length with each layer of weldment smooth; free of slag, cracks, pinholes, and undercuttings; and completely fused to the adjacent weld beads and base metal. Avoid irregular surface, nonuniform bead pattern, and high crown. Form fillet welds of the indicated size of uniform height and fully penetrating. Accomplish repair, chipping, and grinding of welds in manner that will not gouge, groove, or reduce the base metal thickness.

F. Repair of Galvanized Surfaces

Repair or replace metal with damaged galvanized surfaces at no additional cost to the Owner. Repair galvanized surfaces per Section 099000, System No. 55.

G. Corrosion Protection of Aluminum Surfaces

1. Coat aluminum surfaces to be embedded or which will be in contact with concrete or masonry per Section 099000, System No. 51 or 54 before installation. Allow the coating to dry before the aluminum is placed in contact with the concrete.
2. Where aluminum surfaces come in contact with dissimilar metals, keep the dissimilar metallic surfaces from direct contact by use of neoprene gaskets or washers.

SECTION 099000
PAINTING AND COATING

PART 1 - GENERAL

A. Description

This section includes materials and application of painting and coating systems for the following surfaces:

1. Submerged metal.
2. Exposed metal.
3. Buried metal.
4. Concrete and masonry.
5. PVC.
6. Metal in contact with concrete.

It does not include coating steel water tanks and reservoirs.

B. Related Work Specified Elsewhere

1. General Concrete Construction: 030500.
2. Cold-Applied Wax Tape Coating: 099752.
3. Fusion-Bonded Epoxy Linings and Coatings: 099761.
4. Equipment, Piping, Duct, and Valve Identification: 400775.
5. Western Hills Water District Standard Drawings and Specifications

C. Submittals

1. Submit shop drawings in accordance with the General Provisions and Section 013300.
2. Submit manufacturer's data sheets showing the following information:
 - a. Percent solids by volume.
 - b. Minimum and maximum recommended dry-film thickness per coat for prime, intermediate, and finish coats.
 - c. Recommended surface preparation.

- d. Recommended thinners.
 - e. Statement verifying that the specified prime coat is recommended by the manufacturer for use with the specified intermediate and finish coats.
 - f. Application instructions including recommended equipment and temperature limitations.
 - g. Curing requirements and instructions.
3. Submit color swatches.
 4. Submit certificate identifying the type and gradation of abrasives used for surface preparation.
 5. Submit material safety data sheets for each coating.

PART 2 - MATERIALS

A. Painting and Coating Systems

The following index lists the various painting and coating systems by service and generic type:

PAINT COATINGS SYSTEM INDEX

No.	Title	Generic Coating
Submerged Metal Coating Systems		
7.	Submerged Metal, Potable or Nonpotable Water	Epoxy
Exposed Metal Coating Systems		
10.	Exposed Metal, Corrosive Environment	High-build epoxy (two-coat system) with polyurethane topcoat
15.	Exposed Metal, Atmospheric Weathering or Water Condensation Environment	Acrylic
18.	Exposed Metal, Organic Zinc Primer for Shop Coating and Field Touch-Up	Organic zinc
Buried Metal Coating Systems		
21.	Buried Metal	Epoxy
24.	Buried Metal	Corrosion-resisting grease
PVC, CPVC, and FRP Coating Systems		
42.	PVC, CPVC, and FRP, Ultraviolet Exposure	Acrylic latex
Coating Systems for Nonferrous Metals		

52.	Exposed Metal, Galvanized Steel, Aluminum, and Copper	Synthetic resin
54.	Aluminum Insulation from Concrete and Carbon Steel	Epoxy
55.	Repair of Galvanized Surfaces	Cold galvanizing compound
High Temperature Coatings		
91.	Exposed Metal, High-Temperature Resistant, 450°F	Silicone
92.	Exposed Metal, High-Temperature Resistant, 1000°F	Silicone

These systems are specified in detail in the following paragraphs. For each coating, the required surface preparation, prime coat, intermediate coat (if required), topcoat, and coating thicknesses are described. Mil thicknesses shown are minimum dry-film thicknesses.

B. Submerged Metal Coating Systems

1. System No. 7--Submerged Metal, Potable or Nonpotable Water:

Type: Epoxy.

Service Conditions: For use with structures, valves, piping, or equipment immersed in potable or non-potable water.

Surface Preparation: SSPC SP-10.

Coating System: Apply the manufacturer's recommended number of coats to attain the specified minimum coating thickness. Products: Devoe Bar-Rust 233H, Tnemec NMI 40 or 100, PPG AQUAPON® LT NSF Low Temperature Epoxy Coatings 95-172, Carboline Carboguard 891, Ameron 395, International Interline 785HS, Carboline Plasite 7133 or 9133, Keysite 740, Scotchkote 306, or equal; 16 mils total. Color of topcoat: white. Each coat shall be different color than the one preceding it.

C. Exposed Metal Coating Systems

1. System No. 10--Exposed Metal, Corrosive Environment:

Type: High-build epoxy intermediate coat having a minimum volume solids of 60%, with an inorganic zinc prime coat and a pigmented polyurethane finish coat having a minimum volume solids of 52%.

Service Conditions: For use with metal structures or pipes subjected to water condensation; chemical fumes, such as hydrogen sulfide; salt spray; and chemical contact.

Surface Preparation: SSPC SP-10.

Prime Coat: Self-curing, two-component inorganic zinc-rich coating recommended by the manufacturer for overcoating with a high-build epoxy finish coat. Minimum zinc content shall be 12 pounds per gallon. Apply to a thickness of 3 mils. Products: Tnemec 90E-92, Devco Catha-Coat 304 or 304V, International Interzinc 22HS, Ameron 9HS, Carboline Carbozinc 11HS, Sherwin-Williams Zinc-Clad II Plus, PPG METALHIDE® 28 Inorganic Zinc-Rich Primer 97-672, or equal.

Intermediate Coat: Tnemec 104, ICI Devco Devran 224HS or 231, International Interseal 670HS, Ameron 385, Carboline Carboguard 890, Sherwin-Williams Macropoxy 646 B58-600, PPG PITT-GUARD® Direct-to-Rust Epoxy Mastic Coating 97-145 series, or equal; 5 mils.

Finish Coat: Two-component pigmented acrylic or aliphatic polyurethane recommended by the manufacturer for overcoating a high-build epoxy coating. Apply to a thickness of at least 2 mils. Products: Tnemec Series 1075, ICI Devco Devthane 379, International Interline 990HS, Ameron 450HS, Carboline 134HG, Sherwin-Williams Hi-Solids Polyurethane B65-300, PPG PITTHANE® Ultra Gloss Urethane Enamel 95-812 series, or equal.

2. System No. 15--Exposed Metal, Atmospheric Weathering or Water Condensation Environment:

Type: One component acrylic enamel having a minimum volume solids content of 35% with an inorganic zinc primer.

Service Conditions: For use on interior and exterior metal and piping subject to sunlight, weathering, humidity, or water condensation.

Surface Preparation: SSPC SP-10.

Prime Coat: Sherwin-Williams Pro-Cryl Universal Primer, ICI Devco Devflex 4020DTM water-borne primer, Carboline 3358, Tnemec Series 18, or equal, Sherwin-Williams Zinc Clad II Plus primer, ICI Devco Inorganic Zinc 304V, Carboline Carbozinc 11HS, Tnemec 90E-92, or equal applied to a minimum dry-film thickness of 3 mils.

Finish Coats: Two or more coats of Sherwin-Williams Sher-Cryl B66-300, ICI Devco Devflex 659, Carboline 3359 or 3359DTM, Tnemec Series 28 or 29, or equal. Apply sufficient coats to provide a total minimum dry-film thickness of 8 mils. Thickness of any individual coat shall not exceed 4 mils.

3. System No. 18--Organic Zinc Primer for Shop Coating and Field Touch-Up:

Type: Organic zinc primer having a minimum zinc content of 14 pounds per gallon.

Service Conditions: For use as a shop-applied primer or field touch-up primer over inorganic zinc prime coatings on exposed metal.

Surface Preparation: SSPC SP-10.

Coating: Coating shall be of the two- or three-component converted epoxy, epoxy phenolic, or urethane type. Products: Tnemec 90-97, International Interzinc 308, Ameron 68HS, ICI Devoe 313, Carboline 859, Sherwin-Williams Zinc-Clad III HS, PPG DURETHANE™ MCZ 97-679, or equal; applied to a minimum dry-film thickness of 3 mils. Organic zinc primer shall be manufactured by the prime coat manufacturer.

D. Buried Metal Coating Systems

1. System No. 21--Buried Metal:

Type: High solids epoxy or phenolic epoxy having a minimum volume solids of 80% (ASTM D2697).

Service Conditions: Buried metal, such as valves, flanges, bolts, nuts, structural steel, and fittings.

Surface Preparation: SSPC SP-10.

Coating System: Apply three or more coats of Ameron 400, Tnemec 104HS or 80, ICI Devoe Bar-Rust 233H, Carboline 890LT, Sherwin-Williams Tank Clad HS B62-80 series, or equal; 30 mils total. Maximum thickness of an individual coating shall not exceed the manufacturer's recommendation.

2. System No. 24--Buried Metal:

Type: Corrosion-resisting grease.

Service Conditions: Buried metal, such as bolts, bolt threads, tie rods, and nuts.

Surface Preparation: SSPC SP-3 or SP-6.

Coating: NO-OX-ID GG-2 as manufactured by Sanchem, Inc. Apply to a minimum thickness of 1/4 inch.

E. PVC Coating System

1. System No. 42--PVC, CPVC, and FRP, Ultraviolet Exposure:

Type: Acrylic latex primer and topcoats with a minimum volume solids of 35%.

Service Conditions: PVC exposed to sunlight.

Surface Preparation: SSPC SP-1. Then lightly abrade the surface with medium-grain sandpaper.

Prime Coat: One coat of Tnemec Series 28 or 29, Ameron 148, Carboline 3358, PPG PITT-TECH® Int/Ext Industrial DTM Primer/Finish Enamel 90-712 series, or equal. Apply to a minimum dry-film thickness of 2 mils.

Finish Coat: Two coats of Tnemec Series 28 or 29, Ameron 220, Carboline 3359, two coats of PPG PITT-TECH® Int/Ext High Gloss DTM Industrial Enamel 90-374 series, or equal. Apply to a minimum dry-film thickness of 2 mils each.

F. Coating Systems for Nonferrous Metals

1. System No. 52--Exposed Metal, Galvanized Steel, Aluminum, and Copper:

Type: Synthetic resin or epoxy primer.

Service Conditions: Coat galvanized steel, aluminum, and copper surfaces with this system before applying topcoat.

Surface Preparation of Galvanized Steel: Surfaces shall be flat with no protrusions. Remove high spots and tears in the galvanizing with hand and power grinders. Comply with ASTM D6386, paragraph 5.2.1. Do not remove the galvanized coating below the specified thickness. Solvent clean galvanized surfaces per ASTM D6386, paragraph 5.3.2. Then sweep blast per ASTM D6386, paragraph 5.4.1. Use one of the abrasive materials that is described in ASTM D6386, paragraph 5.4.1. Surface preparation for weathered and partially weathered galvanized steel shall be in accordance with ASTM D6386, paragraphs 6 and 7. Apply prime coating within one hour of the surface preparation.

Surface Preparation of Aluminum: Solvent clean or steam clean aluminum surfaces per SSPC SP-1; do not use alkali cleaning. Then dust blast and follow with a chemical conversion coating per MIL-C-5541, Class 1A.

Surface Preparation of Copper: Solvent clean or steam clean copper surfaces per SSPC SP-1; do not use alkali cleaning. Then dust blast.

Prime Coat: Tnemec N69-1211, Ameron 385, ICI Devoe Devran 224HS, Carboline 890, Sherwin-Williams Macropoxy 646 B58-600 series, PPG PITT-GUARD® Direct-to-Rust Epoxy Mastic Coating 97-145 series, or equal. Apply to a minimum thickness of 4 mils.

Intermediate and Finish Coats: Epoxy and polyurethane as described in System No. 10.

2. System No. 54--Aluminum Insulation from Concrete and Carbon Steel:

Type: High solids epoxy or phenolic epoxy having a minimum volume solids of 80% (ASTM D2697).

Service Conditions: Coat areas of aluminum grating, stairs, structural members or aluminum fabrications, in contact with concrete or carbon steel with this system.

Surface Preparation: Solvent or steam cleaning per SSPC SP-1; do not use alkali cleaning. Then dust blast.

Coating System: Apply three or more coats of Ameron 400, Tnemec Series 135, ICI Devoe Bar-Rust 233H, Sherwin-Williams Macropoxy B58-600, PPG PITT-GUARD® Direct-to-

Rust Epoxy Mastic Coating 97-145 series, or equal; 30 mils total. Maximum thickness of an individual coating shall not exceed the manufacturer's recommendation.

3. System No. 55--Repair of Galvanized Steel Surfaces:

Type: Cold galvanizing compound consisting of paint containing oils, solvents, and zinc dust and complying with MIL-P-21035. Minimum metallic zinc content in the cured coating shall be 90%.

Service Conditions: Repair of damaged galvanized coatings on steel surfaces.

Surface Preparation: Clean damaged surfaces per SSPC SP-1 and SP-11.

Coating System: Apply Z.R.C. Galvanizing Compound, RAMCO Specialty Products "Zinckit," NuWave "Galv-Match-Plus," Devcon "Cold Galvanizing," Clearco "Cold Galvanizing Spray," or equal to a minimum dry-film thickness of 3 mils. Apply per ASTM A780, Annex A2.

G. High-Temperature Coatings for Carbon Steel and Stainless Steel

1. System No. 91--Exposed Metal, High-Temperature Resistant (450°F):

Type: Single-component silicone resin with a minimum volume solids of 40%, with a two-component polymeric compound prime coat and intermediate coat.

Service Conditions: For use on exterior metal piping, such as air blower piping, having a maximum continuous temperature of 450°F.

Surface Preparation: SSPC SP-10.

Prime Coat: Two-component polymeric compound coating recommended by the manufacturer to be coated with a silicone resin topcoat. Apply to a thickness of 5 to 6 mils. Product: Dampney Thurmalox 215.

Intermediate Coat: Two-component polymeric compound. Apply to a thickness of 5 to 6 mils. Product: Dampney Thurmalox 216.

Finish Coat: Apply to a thickness of 2 to 2.5 mils. Product: Dampney Thurmalox 217C.

2. System No. 92--Exposed Metal, High-Temperature Resistant (1000°F):

Type: Silicone resins with thermally stable pigments with a minimum volume solids of 50% (ASTM D2697) with a silicone zinc dust primer.

Service Conditions: For use on exterior metal piping, such as engine generator exhaust piping, having a maximum continuous temperature of 1000°F.

Surface Preparation: SSPC SP-10.

mechanical devices used in treatment/transmission/distribution systems (valves, chlorinators, separation membranes) that have not been tested and certified as meeting the specifications of NSF International/American National Standard Institute (NSF/ANSI) 61-2005 / Addendum 1.0-2005 (Drinking Water System Components—Health Effects), which is hereby incorporated by reference. This requirement shall be met under testing conducted by a product certification organization accredited for this purpose by the American National Standards Institute.

PART 3 - EXECUTION

A. Weather Conditions

1. Do not paint in the rain, wind, snow, mist, and fog or when steel or metal surface temperatures are less than 5°F above the dew point.
2. Do not apply paint when the relative humidity is above 85%.
3. Do not paint when temperature of metal to be painted is above 120°F.
4. Do not apply alkyd, inorganic zinc, silicone aluminum, or silicone acrylic paints if air or surface temperature is below 40°F or expected to be below 40°F within 24 hours.
5. Do not apply epoxy, acrylic latex, and polyurethane paints on an exterior or interior surface if air or surface temperature is below 60°F or expected to drop below 60°F in 24 hours.

B. Surface Preparation Procedures

1. Remove oil and grease from metal surfaces in accordance with SSPC SP-1. Use clean cloths and cleaning solvents and wipe dry with clean cloths. Do not leave a film or greasy residue on the cleaned surfaces before abrasive blasting.
2. Remove weld spatter and weld slag from metal surfaces and grind smoothly rough welds, beads, peaked corners, and sharp edges including erection lugs in accordance with SSPC SP-2 and SSPC SP-3. Grind 0.020 inch (minimum) off the weld caps on pipe weld seams. Grind outside sharp corners, such as the outside edges of flanges, to a minimum radius of 1/4 inch.
3. Do not abrasive blast or prepare more surface area in one day than can be coated in one day; prepare surfaces and apply coatings the same day. Remove sharp edges, burrs, and weld spatter.
4. Do not abrasive blast PVC, CPVC, or FRP piping or equipment. Do not abrasive blast epoxy- or enamel-coated pipe that has already been factory coated, except to repair scratched or damaged coatings.

5. For carbon steel, do not touch the surface between the time of abrasive blasting and the time the coating is applied. Apply coatings within two hours of blasting or before any rust bloom forms.
6. Surface preparation shall conform with the SSPC specifications as follows:

Solvent Cleaning	SP-1
Hand Tool Cleaning	SP-2
Power Tool Cleaning	SP-3
White Metal Blast Cleaning	SP-5
Commercial Blast Cleaning	SP-6
Brush-Off Blast Cleaning	SP-7
Pickling	SP-8
Near-White Blast Cleaning	SP-10
Power Tool Cleaning to Bare Metal	SP-11
Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating	SP-12
Surface Preparation of Concrete	SP-13

7. Wherever the words "solvent cleaning," "hand tool cleaning," "wire brushing," or "blast cleaning" or similar words are used in these specifications or in paint manufacturer's specifications, they shall be understood to refer to the applicable SSPC (Society for Protective Coatings), surface preparation specifications listed above.
8. Dust blasting is defined as cleaning the surface through the use of very fine abrasives, such as siliceous or mineral abrasives, 80 to 100 mesh. Apply a fine etch to the metal surface to clean the surface of any contamination or oxide and to provide a surface profile for the coating.
9. For carbon steel surfaces, after abrasive blast cleaning, the height of the surface profile shall be 2 to 3 mils. Verify the surface profile by measuring with an impresser tape acceptable to the Owner's Representative. Perform a minimum of one test per 100 square feet of surface area. Testing shall be witnessed by the Owner's Representative. The impresser tape used in the test shall be permanently marked with the date, time, and locations where the test was made. Test results shall be promptly presented to the Owner's Representative.
10. Do not apply any part of a coating system before the Owner's Representative has reviewed the surface preparation. If coating has been applied without this review, if directed by the Owner's Representative, remove the applied coating by abrasive blasting and reapply the coat in accordance with this specification.

C. Abrasive Blast Cleaning

1. Use dry abrasive blast cleaning for metal surfaces. Do not use abrasives in automatic equipment that have become contaminated. When shop or field blast cleaning with handheld nozzles, do not recycle or reuse blast particles.
2. After abrasive blast cleaning and prior to application of coating, dry clean surfaces to be coated by dusting, sweeping, and vacuuming to remove residue from blasting. Apply the specified primer or touch-up coating within the period of an eight-hour working day. Do not apply coating over damp or moist surfaces. Re-clean prior to application of primer or touch-up coating any blast cleaned surface not coated within said eight-hour period.
3. Keep the area of the work in a clean condition and do not permit blasting particles to accumulate and constitute a nuisance or hazard.
4. During abrasive blast cleaning, prevent damage to adjacent coatings. Schedule blast cleaning and coating such that dust, dirt, blast particles, old coatings, rust, mill scale, etc., will not damage or fall upon wet or newly coated surfaces.

D. Coating Stainless Steel

1. Solvent clean per SSPC SP-1. Solvents and cleaning solutions shall contain less than 200 mg/L of halogens. Then abrasive blast to give a surface profile of 2.0 to 3.0 mils.
2. Do not apply inorganic zinc primers to stainless steel if such primers are specified in the painting system required. Apply only the intermediate and finish coats in such cases.

E. Procedures for Items Having Shop-Applied Prime Coats

1. After application of primer to surfaces, allow coating to cure for a minimum of two hours before handling to minimize damage.
2. When loading for shipment to the project site, use spacers and other protective devices to separate items to prevent damaging the shop-primed surfaces during transit and unloading. If wood spacers are used, remove wood splinters and particles from the shop-primed surfaces after separation. Use padded chains or ribbon binders to secure the loaded items and minimize damage to the shop-primed surfaces.
3. Cover shop-primed items 100% with protective coverings or tarpaulins to prevent deposition of road salts, fuel residue, and other contaminants in transit.
4. Handle shop-primed items with care during unloading, installation, and erection operations to minimize damage. Do not place or store shop-primed items on the ground or on top of other work unless ground or work is covered with a protective covering or tarpaulin. Place shop-primed items above the ground upon platforms, skids, or other supports.

F. Field Touch-Up of Shop-Applied Prime Coats

1. Remove oil and grease surface contaminants on metal surfaces in accordance with SSPC SP-1. Use clean rags wetted with a degreasing solution, rinse with clean water, and wipe dry.
2. Remove dust, dirt, salts, moisture, chalking primers, or other surface contaminants that will affect the adhesion or durability of the coating system. Use a high-pressure water blaster or scrub surfaces with a broom or brush wetted with a solution of trisodium phosphate, detergent, and water. Before applying intermediate or finish coats to inorganic zinc primers, remove any soluble zinc salts that have formed by means of scrubbing with a stiff bristle brush. Rinse scrubbed surfaces with clean water.
3. Remove loose or peeling primer and other surface contaminants not easily removed by the previous cleaning methods in accordance with SSPC SP-7. Take care that remaining primers are not damaged by the blast cleaning operation. Remaining primers shall be firmly bonded to the steel surfaces with blast cleaned edges feathered.
4. Remove rust, scaling, or primer damaged by welding or during shipment, storage, and erection in accordance with SSPC SP-10. Take care that remaining primers are not damaged by the blast cleaning operation. Areas smaller than 1 square inch may be prepared per SSPC SP-11. Remaining primers shall be firmly bonded to the steel surfaces with cleaned edges feathered.
5. Use repair procedures on damaged primer that protects adjacent primer. Blast cleaning may require the use of lower air pressure, smaller nozzles, and abrasive particle sizes, short blast nozzle distance from surface, shielding, and/or masking.
6. After abrasive blast cleaning of damaged and defective areas, remove dust, blast particles, and other debris by dusting, sweeping, and vacuuming; then apply the specified touch-up coating.
7. Surfaces that are shop primed with inorganic zinc primers shall receive a field touch-up of organic zinc primer per System No. 18 to cover scratches or abraded areas.
8. Surfaces that are shop primed shall receive a field touch-up of the same primer used in the original prime coat.

G. Painting Systems

1. All materials of a specified painting system, including primer, intermediate, and finish coats, shall be produced by the same manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the paint manufacturer for the particular coating system.
2. Deliver paints to the jobsite in the original, unopened containers.

H. Paint Storage and Mixing

1. Store and mix materials only in areas designated for that purpose by the Owner's Representative. The area shall be well-ventilated, with precautionary measures taken to prevent fire hazards. Post "No Smoking" signs. Storage and mixing areas shall be clean and free of rags, waste, and scrapings. Tightly close containers after each use. Store paint at an ambient temperature from 50°F to 100°F.
2. Prepare multiple-component coatings using all of the contents of the container for each component as packaged by the paint manufacturer. Do not use partial batches. Do not use multiple-component coatings that have been mixed beyond their pot life. Provide small quantity kits for touch-up painting and for painting other small areas. Mix only the components specified and furnished by the paint manufacturer. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

I. Procedures for the Application of Coatings

1. Conform to the requirements of SSPC PA-1. Follow the recommendations of the coating manufacturer including the selection of spray equipment, brushes, rollers, cleaners, thinners, mixing, drying time, temperature and humidity of application, and safety precautions.
2. Stir, strain, and keep coating materials at a uniform consistency during application. Power mix components. For multiple component materials, premix each component before combining. Apply each coating evenly, free of brush marks, sags, runs, and other evidence of poor workmanship. Use a different shade or tint on succeeding coating applications to indicate coverage where possible. Finished surfaces shall be free from defects or blemishes.
3. Do not use thinners unless recommended by the coating manufacturer. If thinning is allowed, do not exceed the maximum allowable amount of thinner per gallon of coating material. Stir coating materials at all times when adding thinner. Do not flood the coating material surface with thinner prior to mixing. Do not reduce coating materials more than is absolutely necessary to obtain the proper application characteristics and to obtain the specified dry-film thicknesses.
4. Remove dust, blast particles, and other debris from blast cleaned surfaces by dusting, sweeping, and vacuuming. Allow ventilator fans to clean airborne dust to provide good visibility of working area prior to coating applications. Remove dust from coated surfaces by dusting, sweeping, and vacuuming prior to applying succeeding coats.
5. Apply coating systems to the specified minimum dry-film thicknesses as determined per SSPC PA-2.
6. Apply primer immediately after blast cleaning and before any surface rusting occurs, or any dust, dirt, or any foreign matter has accumulated. Reclean surfaces by blast cleaning that have surface colored or become moist prior to coating application.

7. Apply a brush coat of primer on welds, sharp edges, nuts, bolts, and irregular surfaces prior to the application of the primer and finish coat. Apply the brush coat prior to and in conjunction with the spray coat application. Apply the spray coat over the brush coat.
8. Before applying subsequent coats, allow the primer and intermediate coats to dry for the minimum curing time recommended by the manufacturer. In no case shall the time between coats exceed the manufacturer's recommendation.
9. Each coat shall cover the surface of the preceding coat completely, and there shall be a visually perceptible difference in applied shade or tint of colors.
10. Applied coating systems shall be cured at 75°F or higher for 48 hours. If temperature is lower than 75°F, curing time shall be in accordance with printed recommendations of the manufacturer, unless otherwise allowed by the Owner's Representative.
11. Assembled parts shall be disassembled sufficiently before painting or coating to ensure complete coverage by the required coating.

J. Surfaces Not To Be Coated

Do not paint the following surfaces unless otherwise noted in the drawings or in other specification sections. Protect during the painting of adjacent areas:

1. Concrete walkways.
2. Mortar-coated pipe and fittings.
3. Metal letters.
4. Glass.
5. Roofings.
6. Fencing.
7. Electrical fixtures except for factory coatings.
8. Nameplates.
9. Grease fittings.
10. Brass and copper, submerged.
11. Buried pipe, unless specifically required in the piping specifications.
12. Fiberglass items, unless specifically required in the FRP specifications.
13. Aluminum handrail, stairs, and grating.

K. Protection of Surfaces Not To Be Painted

Remove, mask, or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Mask openings in motors to prevent paint and other materials from entering the motors.

L. Surfaces To Be Coated

The exact coating to be applied in any location is not designated by the descriptive phrases in the coating system titles such as "corrosive environment," "buried metal," or "submerged metal." Coat surfaces with the specific coating systems as described below:

1. Coat mechanical equipment, such as pumps, blowers, clarifier mechanisms, as described in the various mechanical equipment specifications. Color of finish coat shall be as shown below.
2. Coat aboveground and exposed piping or piping in vaults and structures as described in the various piping specifications. Color of finish coat shall match existing colors at Water Treatment Plant for exposed piping.
3. Coat valves as described in the various valve specifications. Aboveground valves, or valves in vaults and structures, shall match the color of the connecting piping.
4. Coat aluminum surfaces in contact with concrete per System No. 54.
5. Coat buried flanges, nuts and bolts, valves, flexible pipe couplings, exposed rebar in thrust blocks, and valve boxes as specified in the particular specifications for the above items. Coat buried bolt threads, tie bolt threads, and nuts per System No. 24.
6. Coat aboveground structural steel or structural steel located in vaults and structures as described in Section 051210.
7. Coat exposed indoor galvanized electrical conduit per System No. 52.

M. Dry-Film Thickness Testing

1. Measure coating thickness specified for carbon steel surfaces with a magnetic-type dry-film thickness gauge in accordance with SSPC PA-2. Measure coating thickness specified for stainless steel, aluminum, and copper surfaces with an eddy-current type thickness gauge per ASTM D1400. Provide certification that the gauge has been calibrated by a certified laboratory within the past six months. Provide dry-film thickness gauge as manufactured by Mikrotest or Elcometer.
2. Test the finish coat of metal surfaces (except zinc primer and galvanizing) for holidays and discontinuities with an electrical holiday detector, low-voltage, wet-sponge type. Provide

measuring equipment. Provide certification that the gauge has been calibrated by a certified laboratory within the past six months. Provide detector as manufactured by Tinker and Razor or K-D Bird Dog.

3. Check each coat for the correct dry-film thickness. Do not measure within eight hours after application of the coating.
4. For metal surfaces, make five separate spot measurements (average of three readings) spaced evenly over each 100 square feet of area (or fraction thereof) to be measured. Make three readings for each spot measurement of either the substrate or the paint. Move the probe or detector a distance of 1 to 3 inches for each new gauge reading. Discard any unusually high or low reading that cannot be repeated consistently. Take the average (mean) of the three readings as the spot measurement. The average of five spot measurements for each such 100-square-foot area shall not be less than the specified thickness. No single spot measurement in any 100-square-foot area shall be less than 80%, nor more than 120%, of the specified thickness. One of three readings which are averaged to produce each spot measurement may under run by a greater amount as defined by SSPC PA-2.
5. Perform tests in the presence of the Owner's Representative.

N. Repair of Improperly Coated Surfaces

If the item has an improper finish color or insufficient film thickness, clean and topcoat the surface with the specified paint material to obtain the specified color and coverage. Sandblast or power-sand visible areas of chipped, peeled, or abraded paint, feathering the edges. Then prime and finish coat in accordance with the specifications. Work shall be free of runs, bridges, shiners, laps, or other imperfections.

O. Cleaning

1. During the progress of the work, remove discarded materials, rubbish, cans, and rags at the end of each day's work.
2. Thoroughly clean brushes and other application equipment at the end of each period of use and when changing to another paint or color.
3. Upon completion of painting work, remove masking tape, tarps, and other protective materials, using care not to damage finished surfaces.

END OF SECTION

SECTION 099000
PAINTING AND COATING

PART 1 - GENERAL

A. Description

This section includes materials and application of painting and coating systems for the following surfaces:

1. Submerged metal.
2. Exposed metal.
3. Buried metal.
4. Concrete and masonry.
5. PVC.
6. Metal in contact with concrete.

It does not include coating steel water tanks and reservoirs.

B. Related Work Specified Elsewhere

1. General Concrete Construction: 030500.
2. Cold-Applied Wax Tape Coating: 099752.
3. Fusion-Bonded Epoxy Linings and Coatings: 099761.
4. Equipment, Piping, Duct, and Valve Identification: 400775.
5. Western Hills Water District Standard Drawings and Specifications

C. Submittals

1. Submit shop drawings in accordance with the General Provisions and Section 013300.
2. Submit manufacturer's data sheets showing the following information:
 - a. Percent solids by volume.
 - b. Minimum and maximum recommended dry-film thickness per coat for prime, intermediate, and finish coats.
 - c. Recommended surface preparation.

- d. Recommended thinners.
 - e. Statement verifying that the specified prime coat is recommended by the manufacturer for use with the specified intermediate and finish coats.
 - f. Application instructions including recommended equipment and temperature limitations.
 - g. Curing requirements and instructions.
3. Submit color swatches.
 4. Submit certificate identifying the type and gradation of abrasives used for surface preparation.
 5. Submit material safety data sheets for each coating.

PART 2 - MATERIALS

A. Painting and Coating Systems

The following index lists the various painting and coating systems by service and generic type:

PAINT COATINGS SYSTEM INDEX

No.	Title	Generic Coating
Submerged Metal Coating Systems		
7.	Submerged Metal, Potable or Nonpotable Water	Epoxy
Exposed Metal Coating Systems		
10.	Exposed Metal, Corrosive Environment	High-build epoxy (two-coat system) with polyurethane topcoat
15.	Exposed Metal, Atmospheric Weathering or Water Condensation Environment	Acrylic
18.	Exposed Metal, Organic Zinc Primer for Shop Coating and Field Touch-Up	Organic zinc
Buried Metal Coating Systems		
21.	Buried Metal	Epoxy
24.	Buried Metal	Corrosion-resisting grease
PVC, CPVC, and FRP Coating Systems		
42.	PVC, CPVC, and FRP, Ultraviolet Exposure	Acrylic latex
Coating Systems for Nonferrous Metals		

52.	Exposed Metal, Galvanized Steel, Aluminum, and Copper	Synthetic resin
54.	Aluminum Insulation from Concrete and Carbon Steel	Epoxy
55.	Repair of Galvanized Surfaces	Cold galvanizing compound
High Temperature Coatings		
91.	Exposed Metal, High-Temperature Resistant, 450°F	Silicone
92.	Exposed Metal, High-Temperature Resistant, 1000°F	Silicone

These systems are specified in detail in the following paragraphs. For each coating, the required surface preparation, prime coat, intermediate coat (if required), topcoat, and coating thicknesses are described. Mil thicknesses shown are minimum dry-film thicknesses.

B. Submerged Metal Coating Systems

1. System No. 7--Submerged Metal, Potable or Nonpotable Water:

Type: Epoxy.

Service Conditions: For use with structures, valves, piping, or equipment immersed in potable or non-potable water.

Surface Preparation: SSPC SP-10.

Coating System: Apply the manufacturer's recommended number of coats to attain the specified minimum coating thickness. Products: Devco Bar-Rust 233H, Tnemec NM140 or 100, PPG AQUAPON® LT NSF Low Temperature Epoxy Coatings 95-172, Carboline Carboguard 891, Ameron 395, International Interline 785HS, Carboline Plasite 7133 or 9133, Keysite 740, Scotchkote 306, or equal; 16 mils total. Color of topcoat: white. Each coat shall be different color than the one preceding it.

C. Exposed Metal Coating Systems

1. System No. 10--Exposed Metal, Corrosive Environment:

Type: High-build epoxy intermediate coat having a minimum volume solids of 60%, with an inorganic zinc prime coat and a pigmented polyurethane finish coat having a minimum volume solids of 52%.

Service Conditions: For use with metal structures or pipes subjected to water condensation; chemical fumes, such as hydrogen sulfide; salt spray; and chemical contact.

Surface Preparation: SSPC SP-10.

Prime Coat: Self-curing, two-component inorganic zinc-rich coating recommended by the manufacturer for overcoating with a high-build epoxy finish coat. Minimum zinc content shall be 12 pounds per gallon. Apply to a thickness of 3 mils. Products: Tnemec 90E-92, Devco Catha-Coat 304 or 304V, International Interzinc 22HS, Ameron 9HS, Carboline Carbozinc 11HS, Sherwin-Williams Zinc-Clad II Plus, PPG METALHIDE® 28 Inorganic Zinc-Rich Primer 97-672, or equal.

Intermediate Coat: Tnemec 104, ICI Devco Devran 224HS or 231, International Interseal 670HS, Ameron 385, Carboline Carboguard 890, Sherwin-Williams Macropoxy 646 B58-600, PPG PITT-GUARD® Direct-to-Rust Epoxy Mastic Coating 97-145 series, or equal; 5 mils.

Finish Coat: Two-component pigmented acrylic or aliphatic polyurethane recommended by the manufacturer for overcoating a high-build epoxy coating. Apply to a thickness of at least 2 mils. Products: Tnemec Series 1075, ICI Devco Devthane 379, International Interline 990HS, Ameron 450HS, Carboline 134HG, Sherwin-Williams Hi-Solids Polyurethane B65-300, PPG PITTHANE® Ultra Gloss Urethane Enamel 95-812 series, or equal.

2. System No. 15--Exposed Metal, Atmospheric Weathering or Water Condensation Environment:

Type: One component acrylic enamel having a minimum volume solids content of 35% with an inorganic zinc primer.

Service Conditions: For use on interior and exterior metal and piping subject to sunlight, weathering, humidity, or water condensation.

Surface Preparation: SSPC SP-10.

Prime Coat: Sherwin-Williams Pro-Cryl Universal Primer, ICI Devco Devflex 4020DTM water-borne primer, Carboline 3358, Tnemec Series 18, or equal, Sherwin-Williams Zinc Clad II Plus primer, ICI Devco Inorganic Zinc 304V, Carboline Carbozinc 11HS, Tnemec 90E-92, or equal applied to a minimum dry-film thickness of 3 mils.

Finish Coats: Two or more coats of Sherwin-Williams Sher-Cryl B66-300, ICI Devco Devflex 659, Carboline 3359 or 3359DTM, Tnemec Series 28 or 29, or equal. Apply sufficient coats to provide a total minimum dry-film thickness of 8 mils. Thickness of any individual coat shall not exceed 4 mils.

3. System No. 18--Organic Zinc Primer for Shop Coating and Field Touch-Up:

Type: Organic zinc primer having a minimum zinc content of 14 pounds per gallon.

Service Conditions: For use as a shop-applied primer or field touch-up primer over inorganic zinc prime coatings on exposed metal.

Surface Preparation: SSPC SP-10.

Coating: Coating shall be of the two- or three-component converted epoxy, epoxy phenolic, or urethane type. Products: Tnemec 90-97, International Interzinc 308, Ameron 68HS, ICI Devoe 313, Carboline 859, Sherwin-Williams Zinc-Clad III HS, PPG DURETHANE™ MCZ 97-679, or equal; applied to a minimum dry-film thickness of 3 mils. Organic zinc primer shall be manufactured by the prime coat manufacturer.

D. Buried Metal Coating Systems

1. System No. 21--Buried Metal:

Type: High solids epoxy or phenolic epoxy having a minimum volume solids of 80% (ASTM D2697).

Service Conditions: Buried metal, such as valves, flanges, bolts, nuts, structural steel, and fittings.

Surface Preparation: SSPC SP-10.

Coating System: Apply three or more coats of Ameron 400, Tnemec 104HS or 80, ICI Devoe Bar-Rust 233H, Carboline 890LT, Sherwin-Williams Tank Clad HS B62-80 series, or equal; 30 mils total. Maximum thickness of an individual coating shall not exceed the manufacturer's recommendation.

2. System No. 24--Buried Metal:

Type: Corrosion-resisting grease.

Service Conditions: Buried metal, such as bolts, bolt threads, tie rods, and nuts.

Surface Preparation: SSPC SP-3 or SP-6.

Coating: NO-OX-ID GG-2 as manufactured by Sanchem, Inc. Apply to a minimum thickness of 1/4 inch.

E. PVC Coating System

1. System No. 42--PVC, CPVC, and FRP, Ultraviolet Exposure:

Type: Acrylic latex primer and topcoats with a minimum volume solids of 35%.

Service Conditions: PVC exposed to sunlight.

Surface Preparation: SSPC SP-1. Then lightly abrade the surface with medium-grain sandpaper.

Prime Coat: One coat of Tnemec Series 28 or 29, Ameron 148, Carboline 3358, PPG PITT-TECH® Int/Ext Industrial DTM Primer/Finish Enamel 90-712 series, or equal. Apply to a minimum dry-film thickness of 2 mils.

Finish Coat: Two coats of Tnemec Series 28 or 29, Ameron 220, Carboline 3359, two coats of PPG PITT-TECH® Int/Ext High Gloss DTM Industrial Enamel 90-374 series, or equal. Apply to a minimum dry-film thickness of 2 mils each.

F. Coating Systems for Nonferrous Metals

1. System No. 52--Exposed Metal, Galvanized Steel, Aluminum, and Copper:

Type: Synthetic resin or epoxy primer.

Service Conditions: Coat galvanized steel, aluminum, and copper surfaces with this system before applying topcoat.

Surface Preparation of Galvanized Steel: Surfaces shall be flat with no protrusions. Remove high spots and tears in the galvanizing with hand and power grinders. Comply with ASTM D6386, paragraph 5.2.1. Do not remove the galvanized coating below the specified thickness. Solvent clean galvanized surfaces per ASTM D6386, paragraph 5.3.2. Then sweep blast per ASTM D6386, paragraph 5.4.1. Use one of the abrasive materials that is described in ASTM D6386, paragraph 5.4.1. Surface preparation for weathered and partially weathered galvanized steel shall be in accordance with ASTM D6386, paragraphs 6 and 7. Apply prime coating within one hour of the surface preparation.

Surface Preparation of Aluminum: Solvent clean or steam clean aluminum surfaces per SSPC SP-1; do not use alkali cleaning. Then dust blast and follow with a chemical conversion coating per MIL-C-5541, Class 1A.

Surface Preparation of Copper: Solvent clean or steam clean copper surfaces per SSPC SP-1; do not use alkali cleaning. Then dust blast.

Prime Coat: Tnemec N69-1211, Ameron 385, ICI Devoe Devran 224HS, Carboline 890, Sherwin-Williams Macropoxy 646 B58-600 series, PPG PITT-GUARD® Direct-to-Rust Epoxy Mastic Coating 97-145 series, or equal. Apply to a minimum thickness of 4 mils.

Intermediate and Finish Coats: Epoxy and polyurethane as described in System No. 10.

2. System No. 54--Aluminum Insulation from Concrete and Carbon Steel:

Type: High solids epoxy or phenolic epoxy having a minimum volume solids of 80% (ASTM D2697).

Service Conditions: Coat areas of aluminum grating, stairs, structural members or aluminum fabrications, in contact with concrete or carbon steel with this system.

Surface Preparation: Solvent or steam cleaning per SSPC SP-1; do not use alkali cleaning. Then dust blast.

Coating System: Apply three or more coats of Ameron 400, Tnemec Series 135, ICI Devoe Bar-Rust 233H, Sherwin-Williams Macropoxy B58-600, PPG PITT-GUARD® Direct-to-

Rust Epoxy Mastic Coating 97-145 series, or equal; 30 mils total. Maximum thickness of an individual coating shall not exceed the manufacturer's recommendation.

3. System No. 55--Repair of Galvanized Steel Surfaces:

Type: Cold galvanizing compound consisting of paint containing oils, solvents, and zinc dust and complying with MIL-P-21035. Minimum metallic zinc content in the cured coating shall be 90%.

Service Conditions: Repair of damaged galvanized coatings on steel surfaces.

Surface Preparation: Clean damaged surfaces per SSPC SP-1 and SP-11.

Coating System: Apply Z.R.C. Galvanizing Compound, RAMCO Specialty Products "Zinckit," NuWave "Galv-Match-Plus," Devcon "Cold Galvanizing," Clearco "Cold Galvanizing Spray," or equal to a minimum dry-film thickness of 3 mils. Apply per ASTM A780, Annex A2.

G. High-Temperature Coatings for Carbon Steel and Stainless Steel

1. System No. 91--Exposed Metal, High-Temperature Resistant (450°F):

Type: Single-component silicone resin with a minimum volume solids of 40%, with a two-component polymeric compound prime coat and intermediate coat.

Service Conditions: For use on exterior metal piping, such as air blower piping, having a maximum continuous temperature of 450°F.

Surface Preparation: SSPC SP-10.

Prime Coat: Two-component polymeric compound coating recommended by the manufacturer to be coated with a silicone resin topcoat. Apply to a thickness of 5 to 6 mils. Product: Dampney Thurmalox 215.

Intermediate Coat: Two-component polymeric compound. Apply to a thickness of 5 to 6 mils. Product: Dampney Thurmalox 216.

Finish Coat: Apply to a thickness of 2 to 2.5 mils. Product: Dampney Thurmalox 217C.

2. System No. 92--Exposed Metal, High-Temperature Resistant (1000°F):

Type: Silicone resins with thermally stable pigments with a minimum volume solids of 50% (ASTM D2697) with a silicone zinc dust primer.

Service Conditions: For use on exterior metal piping, such as engine generator exhaust piping, having a maximum continuous temperature of 1000°F.

Surface Preparation: SSPC SP-10.

Prime Coat: Two-component silicone base and zinc dust coating system recommended by the manufacturer to be coated with a silicone resin topcoat. Apply to a thickness of 1.5 to 2.0 mils. Product: Dampney 245C.

Finish Coat: Dampney 230C. Apply to a thickness of 1.5 to 2.0 mils.

H. Abrasives for Surface Preparation

1. Abrasives used for preparation of ferrous (excluding stainless steel) surfaces shall be one of the following:
 - a. 16 to 30 or 16 to 40 mesh silica sand or mineral grit.
 - b. 20 to 40 mesh garnet.
 - c. Crushed iron slag, 100% retained on No. 80 mesh.
 - d. SAE Grade G-40 or G-50 iron or steel grit.
2. Abrasives used for preparation of stainless steel surfaces shall be 20 to 40 mesh silicon carbide or aluminum oxide.
3. Abrasives used for preparation of copper and aluminum surfaces shall be one of the following:
 - a. Crushed slag, 80 to 100 mesh.
 - b. Very fine silica sand, 80 to 100 mesh.
4. In the above gradations, 100% of the material shall pass through the first stated sieve size and 100% shall be retained on the second stated sieve size.

I. Organic Zinc Primer for Field Touch-Up and Shop Coating

Where shop-applied inorganic zinc primers cannot be used because of volatile organic compound (VOC) regulations, the organic zinc primer described in System No. 18 may be substituted for the specified inorganic zinc primers.

J. Indirect Additive Requirements

All coatings coming in contact with potable water will need to meet the indirect additive requirements of the Water Works Standards, Chapter 16 of Title 22, specifically:

§64591. Indirect Additives. (a) Except as provided in Section 64593 or where a more stringent statutory requirement exists, after March 9, 2008, a water system shall not use any chemical, material, lubricant, or product in the production, treatment, or distribution of drinking water including process media (carbon, sand), protective materials (coatings, linings, liners), joining and sealing materials (solvent cements, welding materials, gaskets, lubricating oils), pipes and related products (pipes, tanks, fittings), and

mechanical devices used in treatment/transmission/distribution systems (valves, chlorinators, separation membranes) that have not been tested and certified as meeting the specifications of NSF International/American National Standard Institute (NSF/ANSI) 61-2005 / Addendum 1.0-2005 (Drinking Water System Components—Health Effects), which is hereby incorporated by reference. This requirement shall be met under testing conducted by a product certification organization accredited for this purpose by the American National Standards Institute.

PART 3 - EXECUTION

A. Weather Conditions

1. Do not paint in the rain, wind, snow, mist, and fog or when steel or metal surface temperatures are less than 5°F above the dew point.
2. Do not apply paint when the relative humidity is above 85%.
3. Do not paint when temperature of metal to be painted is above 120°F.
4. Do not apply alkyd, inorganic zinc, silicone aluminum, or silicone acrylic paints if air or surface temperature is below 40°F or expected to be below 40°F within 24 hours.
5. Do not apply epoxy, acrylic latex, and polyurethane paints on an exterior or interior surface if air or surface temperature is below 60°F or expected to drop below 60°F in 24 hours.

B. Surface Preparation Procedures

1. Remove oil and grease from metal surfaces in accordance with SSPC SP-1. Use clean cloths and cleaning solvents and wipe dry with clean cloths. Do not leave a film or greasy residue on the cleaned surfaces before abrasive blasting.
2. Remove weld spatter and weld slag from metal surfaces and grind smoothly rough welds, beads, peaked corners, and sharp edges including erection lugs in accordance with SSPC SP-2 and SSPC SP-3. Grind 0.020 inch (minimum) off the weld caps on pipe weld seams. Grind outside sharp corners, such as the outside edges of flanges, to a minimum radius of 1/4 inch.
3. Do not abrasive blast or prepare more surface area in one day than can be coated in one day; prepare surfaces and apply coatings the same day. Remove sharp edges, burrs, and weld spatter.
4. Do not abrasive blast PVC, CPVC, or FRP piping or equipment. Do not abrasive blast epoxy- or enamel-coated pipe that has already been factory coated, except to repair scratched or damaged coatings.

5. For carbon steel, do not touch the surface between the time of abrasive blasting and the time the coating is applied. Apply coatings within two hours of blasting or before any rust bloom forms.
6. Surface preparation shall conform with the SSPC specifications as follows:

Solvent Cleaning	SP-1
Hand Tool Cleaning	SP-2
Power Tool Cleaning	SP-3
White Metal Blast Cleaning	SP-5
Commercial Blast Cleaning	SP-6
Brush-Off Blast Cleaning	SP-7
Pickling	SP-8
Near-White Blast Cleaning	SP-10
Power Tool Cleaning to Bare Metal	SP-11
Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating	SP-12
Surface Preparation of Concrete	SP-13

7. Wherever the words "solvent cleaning," "hand tool cleaning," "wire brushing," or "blast cleaning" or similar words are used in these specifications or in paint manufacturer's specifications, they shall be understood to refer to the applicable SSPC (Society for Protective Coatings), surface preparation specifications listed above.
8. Dust blasting is defined as cleaning the surface through the use of very fine abrasives, such as siliceous or mineral abrasives, 80 to 100 mesh. Apply a fine etch to the metal surface to clean the surface of any contamination or oxide and to provide a surface profile for the coating.
9. For carbon steel surfaces, after abrasive blast cleaning, the height of the surface profile shall be 2 to 3 mils. Verify the surface profile by measuring with an impresser tape acceptable to the Owner's Representative. Perform a minimum of one test per 100 square feet of surface area. Testing shall be witnessed by the Owner's Representative. The impresser tape used in the test shall be permanently marked with the date, time, and locations where the test was made. Test results shall be promptly presented to the Owner's Representative.
10. Do not apply any part of a coating system before the Owner's Representative has reviewed the surface preparation. If coating has been applied without this review, if directed by the Owner's Representative, remove the applied coating by abrasive blasting and reapply the coat in accordance with this specification.

C. Abrasive Blast Cleaning

1. Use dry abrasive blast cleaning for metal surfaces. Do not use abrasives in automatic equipment that have become contaminated. When shop or field blast cleaning with handheld nozzles, do not recycle or reuse blast particles.
2. After abrasive blast cleaning and prior to application of coating, dry clean surfaces to be coated by dusting, sweeping, and vacuuming to remove residue from blasting. Apply the specified primer or touch-up coating within the period of an eight-hour working day. Do not apply coating over damp or moist surfaces. Re-clean prior to application of primer or touch-up coating any blast cleaned surface not coated within said eight-hour period.
3. Keep the area of the work in a clean condition and do not permit blasting particles to accumulate and constitute a nuisance or hazard.
4. During abrasive blast cleaning, prevent damage to adjacent coatings. Schedule blast cleaning and coating such that dust, dirt, blast particles, old coatings, rust, mill scale, etc., will not damage or fall upon wet or newly coated surfaces.

D. Coating Stainless Steel

1. Solvent clean per SSPC SP-1. Solvents and cleaning solutions shall contain less than 200 mg/L of halogens. Then abrasive blast to give a surface profile of 2.0 to 3.0 mils.
2. Do not apply inorganic zinc primers to stainless steel if such primers are specified in the painting system required. Apply only the intermediate and finish coats in such cases.

E. Procedures for Items Having Shop-Applied Prime Coats

1. After application of primer to surfaces, allow coating to cure for a minimum of two hours before handling to minimize damage.
2. When loading for shipment to the project site, use spacers and other protective devices to separate items to prevent damaging the shop-primed surfaces during transit and unloading. If wood spacers are used, remove wood splinters and particles from the shop-primed surfaces after separation. Use padded chains or ribbon binders to secure the loaded items and minimize damage to the shop-primed surfaces.
3. Cover shop-primed items 100% with protective coverings or tarpaulins to prevent deposition of road salts, fuel residue, and other contaminants in transit.
4. Handle shop-primed items with care during unloading, installation, and erection operations to minimize damage. Do not place or store shop-primed items on the ground or on top of other work unless ground or work is covered with a protective covering or tarpaulin. Place shop-primed items above the ground upon platforms, skids, or other supports.

F. Field Touch-Up of Shop-Applied Prime Coats

1. Remove oil and grease surface contaminants on metal surfaces in accordance with SSPC SP-1. Use clean rags wetted with a degreasing solution, rinse with clean water, and wipe dry.
2. Remove dust, dirt, salts, moisture, chalking primers, or other surface contaminants that will affect the adhesion or durability of the coating system. Use a high-pressure water blaster or scrub surfaces with a broom or brush wetted with a solution of trisodium phosphate, detergent, and water. Before applying intermediate or finish coats to inorganic zinc primers, remove any soluble zinc salts that have formed by means of scrubbing with a stiff bristle brush. Rinse scrubbed surfaces with clean water.
3. Remove loose or peeling primer and other surface contaminants not easily removed by the previous cleaning methods in accordance with SSPC SP-7. Take care that remaining primers are not damaged by the blast cleaning operation. Remaining primers shall be firmly bonded to the steel surfaces with blast cleaned edges feathered.
4. Remove rust, scaling, or primer damaged by welding or during shipment, storage, and erection in accordance with SSPC SP-10. Take care that remaining primers are not damaged by the blast cleaning operation. Areas smaller than 1 square inch may be prepared per SSPC SP-11. Remaining primers shall be firmly bonded to the steel surfaces with cleaned edges feathered.
5. Use repair procedures on damaged primer that protects adjacent primer. Blast cleaning may require the use of lower air pressure, smaller nozzles, and abrasive particle sizes, short blast nozzle distance from surface, shielding, and/or masking.
6. After abrasive blast cleaning of damaged and defective areas, remove dust, blast particles, and other debris by dusting, sweeping, and vacuuming; then apply the specified touch-up coating.
7. Surfaces that are shop primed with inorganic zinc primers shall receive a field touch-up of organic zinc primer per System No. 18 to cover scratches or abraded areas.
8. Surfaces that are shop primed shall receive a field touch-up of the same primer used in the original prime coat.

G. Painting Systems

1. All materials of a specified painting system, including primer, intermediate, and finish coats, shall be produced by the same manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the paint manufacturer for the particular coating system.
2. Deliver paints to the jobsite in the original, unopened containers.

H. Paint Storage and Mixing

1. Store and mix materials only in areas designated for that purpose by the Owner's Representative. The area shall be well-ventilated, with precautionary measures taken to prevent fire hazards. Post "No Smoking" signs. Storage and mixing areas shall be clean and free of rags, waste, and scrapings. Tightly close containers after each use. Store paint at an ambient temperature from 50°F to 100°F.
2. Prepare multiple-component coatings using all of the contents of the container for each component as packaged by the paint manufacturer. Do not use partial batches. Do not use multiple-component coatings that have been mixed beyond their pot life. Provide small quantity kits for touch-up painting and for painting other small areas. Mix only the components specified and furnished by the paint manufacturer. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

I. Procedures for the Application of Coatings

1. Conform to the requirements of SSPC PA-1. Follow the recommendations of the coating manufacturer including the selection of spray equipment, brushes, rollers, cleaners, thinners, mixing, drying time, temperature and humidity of application, and safety precautions.
2. Stir, strain, and keep coating materials at a uniform consistency during application. Power mix components. For multiple component materials, premix each component before combining. Apply each coating evenly, free of brush marks, sags, runs, and other evidence of poor workmanship. Use a different shade or tint on succeeding coating applications to indicate coverage where possible. Finished surfaces shall be free from defects or blemishes.
3. Do not use thinners unless recommended by the coating manufacturer. If thinning is allowed, do not exceed the maximum allowable amount of thinner per gallon of coating material. Stir coating materials at all times when adding thinner. Do not flood the coating material surface with thinner prior to mixing. Do not reduce coating materials more than is absolutely necessary to obtain the proper application characteristics and to obtain the specified dry-film thicknesses.
4. Remove dust, blast particles, and other debris from blast cleaned surfaces by dusting, sweeping, and vacuuming. Allow ventilator fans to clean airborne dust to provide good visibility of working area prior to coating applications. Remove dust from coated surfaces by dusting, sweeping, and vacuuming prior to applying succeeding coats.
5. Apply coating systems to the specified minimum dry-film thicknesses as determined per SSPC PA-2.
6. Apply primer immediately after blast cleaning and before any surface rusting occurs, or any dust, dirt, or any foreign matter has accumulated. Reclean surfaces by blast cleaning that have surface colored or become moist prior to coating application.

7. Apply a brush coat of primer on welds, sharp edges, nuts, bolts, and irregular surfaces prior to the application of the primer and finish coat. Apply the brush coat prior to and in conjunction with the spray coat application. Apply the spray coat over the brush coat.
8. Before applying subsequent coats, allow the primer and intermediate coats to dry for the minimum curing time recommended by the manufacturer. In no case shall the time between coats exceed the manufacturer's recommendation.
9. Each coat shall cover the surface of the preceding coat completely, and there shall be a visually perceptible difference in applied shade or tint of colors.
10. Applied coating systems shall be cured at 75°F or higher for 48 hours. If temperature is lower than 75°F, curing time shall be in accordance with printed recommendations of the manufacturer, unless otherwise allowed by the Owner's Representative.
11. Assembled parts shall be disassembled sufficiently before painting or coating to ensure complete coverage by the required coating.

J. Surfaces Not To Be Coated

Do not paint the following surfaces unless otherwise noted in the drawings or in other specification sections. Protect during the painting of adjacent areas:

1. Concrete walkways.
2. Mortar-coated pipe and fittings.
3. Metal letters.
4. Glass.
5. Roofings.
6. Fencing.
7. Electrical fixtures except for factory coatings.
8. Nameplates.
9. Grease fittings.
10. Brass and copper, submerged.
11. Buried pipe, unless specifically required in the piping specifications.
12. Fiberglass items, unless specifically required in the FRP specifications.
13. Aluminum handrail, stairs, and grating.

K. Protection of Surfaces Not To Be Painted

Remove, mask, or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Mask openings in motors to prevent paint and other materials from entering the motors.

L. Surfaces To Be Coated

The exact coating to be applied in any location is not designated by the descriptive phrases in the coating system titles such as "corrosive environment," "buried metal," or "submerged metal." Coat surfaces with the specific coating systems as described below:

1. Coat mechanical equipment, such as pumps, blowers, clarifier mechanisms, as described in the various mechanical equipment specifications. Color of finish coat shall be as shown below.
2. Coat aboveground and exposed piping or piping in vaults and structures as described in the various piping specifications. Color of finish coat shall match existing colors at Water Treatment Plant for exposed piping.
3. Coat valves as described in the various valve specifications. Aboveground valves, or valves in vaults and structures, shall match the color of the connecting piping.
4. Coat aluminum surfaces in contact with concrete per System No. 54.
5. Coat buried flanges, nuts and bolts, valves, flexible pipe couplings, exposed rebar in thrust blocks, and valve boxes as specified in the particular specifications for the above items. Coat buried bolt threads, tie bolt threads, and nuts per System No. 24.
6. Coat aboveground structural steel or structural steel located in vaults and structures as described in Section 051210.
7. Coat exposed indoor galvanized electrical conduit per System No. 52.

M. Dry-Film Thickness Testing

1. Measure coating thickness specified for carbon steel surfaces with a magnetic-type dry-film thickness gauge in accordance with SSPC PA-2. Measure coating thickness specified for stainless steel, aluminum, and copper surfaces with an eddy-current type thickness gauge per ASTM D1400. Provide certification that the gauge has been calibrated by a certified laboratory within the past six months. Provide dry-film thickness gauge as manufactured by Mikrotest or Elcometer.
2. Test the finish coat of metal surfaces (except zinc primer and galvanizing) for holidays and discontinuities with an electrical holiday detector, low-voltage, wet-sponge type. Provide

measuring equipment. Provide certification that the gauge has been calibrated by a certified laboratory within the past six months. Provide detector as manufactured by Tinker and Razor or K-D Bird Dog.

3. Check each coat for the correct dry-film thickness. Do not measure within eight hours after application of the coating.
4. For metal surfaces, make five separate spot measurements (average of three readings) spaced evenly over each 100 square feet of area (or fraction thereof) to be measured. Make three readings for each spot measurement of either the substrate or the paint. Move the probe or detector a distance of 1 to 3 inches for each new gauge reading. Discard any unusually high or low reading that cannot be repeated consistently. Take the average (mean) of the three readings as the spot measurement. The average of five spot measurements for each such 100-square-foot area shall not be less than the specified thickness. No single spot measurement in any 100-square-foot area shall be less than 80%, nor more than 120%, of the specified thickness. One of three readings which are averaged to produce each spot measurement may under run by a greater amount as defined by SSPC PA-2.
5. Perform tests in the presence of the Owner's Representative.

N. Repair of Improperly Coated Surfaces

If the item has an improper finish color or insufficient film thickness, clean and topcoat the surface with the specified paint material to obtain the specified color and coverage. Sandblast or power-sand visible areas of chipped, peeled, or abraded paint, feathering the edges. Then prime and finish coat in accordance with the specifications. Work shall be free of runs, bridges, shiners, laps, or other imperfections.

O. Cleaning

1. During the progress of the work, remove discarded materials, rubbish, cans, and rags at the end of each day's work.
2. Thoroughly clean brushes and other application equipment at the end of each period of use and when changing to another paint or color.
3. Upon completion of painting work, remove masking tape, tarps, and other protective materials, using care not to damage finished surfaces.

END OF SECTION

SECTION 099752
COLD-APPLIED WAX TAPE COATING

PART 1 - GENERAL

A. Description

This section includes materials and application of a three-part, cold-applied wax tape coating system for buried piping per NACE RP0375-2006, Section 4 except as modified herein.

B. Related Work Specified Elsewhere

1. Polyethylene Sheet Encasement (AWWA C105): 099754.
2. Western Hills Water District Standard Drawings and Specifications

C. Submittals

1. Submit shop drawings in accordance with the General Conditions and Section 013300.
2. Submit manufacturer's catalog data sheets and application instructions.

PART 2 - MATERIALS

A. Primer

1. Primer shall be a blend of petrolatums, plasticizers, and corrosion inhibitors having a paste-like consistency. The primer shall comply with NACE RP0375-2006 and shall have the following properties:
 - a. Pour Point: 100°F to 110°F.
 - b. Flash Point: 350°F.
 - c. Coverage: 1 gallon per 100 square feet.
2. Primer shall be Trenton Wax Tape Primer, Denso Paste Primer, or equal.

B. Wax Tape

1. Wax tape shall consist of a synthetic-fiber felt, saturated with a blend of microcrystalline wax, petrolatums, plasticizers, and corrosion inhibitors, forming a tape coating that is easily formable over irregular surfaces. The tape shall comply with NACE RP0375-2006 and shall have the following properties:
 - a. Saturant Pour Point: 115°F to 120°F.

- b. Thickness: 50 to 70 mils.
 - c. Tape Width: 6 inches.
 - 2. Wax tapes used for pipe soil-to-air transitions shall be UV light stable so as not to degrade in the presence of sunlight.
 - 3. Wax tape shall be Trenton No. 1 Wax Tape, Denso "Densyl Tape," or equal.

C. Plastic Wrapper

- 1. Wrapper shall be a polyvinylidene chloride plastic with three 50-gauge plies wound together as a single sheet. The wrapper shall have the following properties:
 - a. Color: Clear.
 - b. Thickness: 1.5 mils.
 - c. Tape Width: 6 inches.
- 2. Plastic wrapper shall be Trenton Poly-Ply, Denso Tape PVC Self-Adhesive, or equal.

D. Polyethylene Sheet Coating

See Section 099754.

PART 3 - EXECUTION

A. Wax Tape Coating Application

- 1. Surfaces shall be clean and free of dirt, grease, water, and other foreign material prior to the application of the primer and wax tape.
- 2. Apply primer by hand or brush to fitting surfaces. Work the primer into crevices and completely cover exposed metal surfaces.
- 3. Apply the wax tape immediately after the primer application. Work the tape into the crevices around fittings. Apply the wax tape by pressing and molding the tape into conformity with the surface so that it does not bridge over irregular surfaces configurations. Begin wrapping approximately 3 inches behind the area to be wrapped. If starting at a straight edge, wrap the tape spirally around the pipe while touching the end edge before starting the angle to begin the spiral. If the previous roll is headed in a downward direction, tuck the next roll under the previous roll. Stretch each roll tight as wrapping continues to avoid air bubbles.
- 4. Wrap the wax tape spirally around the pipe and across the fitting. Use a minimum overlap of 50% of the tape width. Apply tape to flanges, mechanical and restrained joint bolts, nuts and glands, and grooved-end couplings to 6 inches beyond each side of the item.

5. Work the tape into the crevices and contours of irregularly shaped surfaces and smooth out so that there is a continuous protective layer with no voids or spaces under the tape.
6. After application, seal the overlap seams of the tape by hand by tapering and pressing the seam, attempting to create a continuous surface. There shall be no air pockets underneath the tape. The tape shall have direct intimate contact with the pipe surface.
7. On vertical sections of the piping, such as at pipe-to-soil transitions, wrap the pipe starting from the bottom and proceeding upward so that downward flowing water and backfill do not catch in a seam.
8. Overwrap the completed wax tape installation with the plastic wrapping material. Wrap spirally around the pipe and across the fitting. Use a minimum overlap of 55% of the tape width and apply two layers or applications of overwrap. Secure plastic wrapper to pipe with adhesive tape.

B. Application of Polyethylene Sheet Coating to Buried Piping

Wrap completed wax tape coating system with polyethylene film per Section 099754 and secure around the adjacent pipe circumference with adhesive tape.

C. Handling and Installing Wax-Tape Coated Pipe

1. Handle pipe in a manner to minimize damage to the coating. Equipment used for the handling of coated pipe shall be designed and constructed to avoid damaging the protective coating system. Inspect supported areas of the pipe prior to installation. Repair damaged areas before installation.
2. The pipeline trench shall be free of rocks, foreign matter, and projections that could damage the coating system.

END OF SECTION

SECTION 099754
POLYETHYLENE SHEET ENCASUREMENT (AWWA C105)

PART 1 - GENERAL

A. Description

This section includes materials and installation of a polyethylene sheet encasement for buried steel and iron pipe, fittings, and valves.

B. Related Work Specified Elsewhere

1. Cold-Applied Wax Tape Coating: 099752.
2. Trenching, Backfilling, and Compacting: 312316.
3. General Piping Requirements: 400500.
4. Flexible Pipe Couplings and Expansion Joints: 400722.
5. Ductile-Iron Pipe: 402040.
6. Western Hills Water District Standard Drawings and Specifications

C. Submittals

1. Submit shop drawings in accordance with General Conditions and Section 013300.
2. Submit manufacturer's catalog literature and product data sheets describing the physical, chemical, and electrical properties of the encasement material.

PART 2 - MATERIALS

A. Polyethylene Wrap

1. The encasement shall consist of low-density polyethylene wrap of at least 8-mil thickness conforming to AWWA C105. Color: Blue or Black.
2. Polyethylene encasement for ductile-iron pipe shall be supplied as a flat tube meeting the dimensions of Table 1 in AWWA C105 and shall be supplied by the ductile-iron pipe manufacturer.

B. Plastic Adhesive Tape

1. Tape shall consist of polyolefin backing and adhesive which bonds to common pipeline coatings including polyethylene.

2. Minimum Width: 2 inches.
3. Products: Canusa Wrapid Tape; Tapecoat 35; Polyken 934; AA Thread Seal Tape, Inc.; or equal.

PART 3 - EXECUTION

A. Application of Moldable Mastic Filler to Irregular Adjacent Surfaces

When the adjacent joints are bell-and-spigot or mechanical joints and any associated welding specifications do not require an external full fillet weld, apply a moldable mastic filler (per Section 400500) at the step-down area prior to the application of the sheet encasement and tape.

B. Applying Sheet Coating to Buried Piping and Fittings

1. Apply wrapping per AWWA C105 as modified herein.
2. Apply a double wrapping.
3. Install the polyethylene to completely encase the pipe and fittings to provide a watertight corrosion barrier. Continuously secure overlaps and ends of sheet and tube with polyethylene tape. Make circumferential seams with two complete wraps, with no exposed edges. Tape longitudinal seams and longitudinal overlaps, extending tape beyond and beneath circumferential seams.
4. Wrap bell-spigot interfaces, restrained joint components, and other irregular surfaces with wax tape or moldable sealant prior to placing polyethylene encasement.
5. Minimize voids beneath polyethylene. Place circumferential or spiral wraps of polyethylene tape at 2-foot intervals along the barrel of the pipe to minimize the space between the pipe and the polyethylene.
6. Overlap adjoining polyethylene tube coatings a minimum of 1 foot and wrap prior to placing concrete anchors, collars, supports, or thrust blocks. Hand wrap the polyethylene sheet, apply two complete wraps with no exposed edges to provide a watertight corrosion barrier, and secure in place with 2-inch-wide plastic adhesive tape.

C. Applying Sheet Coating to Buried Valves

1. Wrap flanges and other irregular surfaces with wax tape or moldable sealant. Press tightly into place leaving no voids underneath and a smooth surface under coating for polyethylene sheet.
2. Wrap with a flat sheet of polyethylene. Place the sheet under the valve and the flanges or joints with the connecting pipe and fold in half. Extend the sheet to the valve stem and secure the sheet in place with 2-inch-wide plastic adhesive tape. Apply a second layer and secure with tape. Make two complete wraps, with no exposed edges, to provide a

watertight corrosion barrier. Secure the sheets with tape around the valve stem below the operating nut and around the barrel of the connecting pipe to prevent the entrance of water and soil. Place concrete anchor and support blocks after the wrap has been installed.

D. Applying Sheet Coating to Buried Flexible Pipe Couplings

1. Wrap irregular surfaces with wax tape or moldable sealant. Press tightly into place leaving no voids underneath and a smooth surface under coating for polyethylene sheet.
2. Apply two layers or wraps around the coupling. Overlap the adjoining pipe or fitting a minimum of 1 foot and secure in place with tape. Provide sufficient slack in polyethylene to allow backfill to be placed around fitting without tearing polyethylene. Apply tape around the entire circumference of the overlapped section on the adjoining pipe or fitting in two complete wraps, with no exposed edges, to provide a watertight corrosion barrier.

E. Repair of Polyethylene Material

Repair polyethylene material that is damaged during installation. Use polyethylene sheet, place over damaged or torn area, and secure in place with 2-inch-wide plastic adhesive tape.

F. Applying Sheet Coating to Existing Buried Piping

When connecting polyethylene-encased pipe or fittings to existing pipe, expose existing pipe, thoroughly clean the surface, and securely tape the end of the polyethylene to the existing as specified above. When the existing pipe is polyethylene encased, wrap new polyethylene encasement over the existing, with overlap of at least 2 feet. Tape securely as specified above.

G. Backfill for Polyethylene-Wrapped Pipe, Valves, and Fittings

Place sand backfill within 1 foot of the pipe, valves, and fittings wrapped with polyethylene encasement per Section 312316.

H. Installation and Repair of Polyethylene at Service Taps

1. Wrap two or three layers of polyethylene adhesive tape completely around the pipe to cover the area where the tapping machine and chain will be mounted.
2. Mount the tapping machine on the pipe area covered by the polyethylene tape. Then make the tap and install the corporation stop directly through the tape and polyethylene.
3. After making the direct service connection, inspect the entire circumferential area for damage and make repairs.
4. To minimize the possibility of dissimilar metal corrosion at service connections, wrap the corporation stop a minimum clear distance of 3 feet of copper service pipes with polyethylene or dielectric tape.

END OF SECTION

SECTION 099761
FUSION-BONDED EPOXY LININGS AND COATINGS

PART 1 - GENERAL

A. Description

This section includes materials, application, and testing of one-part, fusion-bonded, heat-cured, thermosetting, 100% solids epoxy linings and coatings on steel, cast-iron, and ductile-iron equipment, such as valves, flexible pipe couplings, structural steel, and steel pipe.

B. Related Work Specified Elsewhere

1. Painting and Coating: 099000.
2. Flexible Pipe Couplings and Expansion Joints: 400722.
3. Western Hills Water District Standard Drawings and Specifications

C. Submittals

1. Submit shop drawings in accordance with the General Conditions and Section 013300.
2. Submit manufacturer's catalog literature and product data sheets, describing the physical and chemical properties of the epoxy coating. Describe application and curing procedure.
3. Submit coating application test records for measuring coating thickness and holiday detection for each item or pipe section and fitting. Describe repair procedures used.

PART 2 - MATERIALS

A. Piping and Equipment Surfaces

1. The Contractor shall require the equipment suppliers to provide equipment that is free of salts, oil, and grease to the coating applicator.
2. The Contractor shall require pipe suppliers to provide bare pipe that is free of salts, oil, and grease to the coating applicator.

B. Shop-Applied Epoxy Lining and Coating

Lining and coating shall be a 100% solids, thermosetting, fusion-bonded, dry powder epoxy resin: Scotchkote 134 or 206N, Lilly Powder Coatings "Pipeclad 1500 Red," H. B. Fuller 1F-3003, or equal. Epoxy lining and coating shall meet or exceed the following requirements:

Hardness (minimum)	Barcol 17 (ASTM D2583) Rockwell 50 ("M" scale)
Abrasion resistance (maximum value)	1,000 cycles: 0.05 gram removed
	5,000 cycles: 0.115 gram removed
	ASTM D1044, Tabor CS 17 wheel, 1,000-gram weight
Adhesion (minimum)	3,000 psi (Elcometer)
Tensile strength	7,300 psi (ASTM D2370)
Penetration	0 mil (ASTM G17)
Adhesion overlap shear, 1/8-inch steel panel, 0.010 glue line	4,300 psi, ASTM D1002
Impact (minimum value)	100 inch-pounds (Gardner 5/8-inch diameter tup)

C. Field-Applied Epoxy Coating for Patching

Use a two-component, 80% solids liquid resin, such as Scotchkote 306.

D. Painting and Coating of Grooved-End and Flexible Pipe Couplings

Line and coat couplings the same as the pipe. Color shall match the color of the pipe fusion epoxy coating.

PART 3 - EXECUTION

A. Shop Application of Fusion-Bonded Epoxy Lining and Coating--General

1. Grind surface irregularities, welds, and weld spatter smooth before applying the epoxy. The allowable grind area shall not exceed 0.25 square foot per location, and the maximum total grind area shall not exceed 1 square foot per item or piece of equipment. Do not use any item, pipe, or piece of equipment in which these requirements cannot be met.
2. Remove surface imperfections, such as slivers, scales, burrs, weld spatter, and gouges. Grind outside sharp corners, such as the outside edges of flanges, to a minimum radius of 1/4 inch.
3. Uniformly preheat the pipe, item, or piece of equipment prior to blast cleaning to remove moisture from the surface. The preheat shall be sufficient to ensure that the surface temperature is at least 5°F above the dew point temperature during blast cleaning and inspection.
4. Sandblast surfaces per SSPC SP-5. Protect beveled pipe ends from the abrasive blast cleaning.

5. Apply lining and coating by the electrostatic spray or fluidized bed process. Minimum thickness of lining or coating shall be 15 mils. Heat and cure per the epoxy manufacturer's recommendations. The heat source shall not leave a residue or contaminant on the metal surface. Do not allow oxidation of surfaces to occur prior to coating. Do not permit surfaces to flash rust before coating.

B. Shop Application of Fusion-Bonded Epoxy Lining and Coating to Pipe--Additional Requirements

1. Apply lining and coating per AWWA C213 except as modified herein.
2. Grind 0.020 inch (minimum) off the weld caps on the pipe weld seams before beginning the surface preparation and heating of the pipe.

C. Shop Application of Fusion-Bonded Epoxy Lining and Coating to Joint Areas of Ductile-Iron and Cast-Iron Fittings--Additional Requirements

Limit the protective coating thickness in the joints of ductile-iron and cast-iron fittings to maintain a leak-proof joint. However, the coating thickness in the joint area shall not be less than 4 mils.

D. Quality of Lining and Coating Applications

The cured lining or coating shall be smooth and glossy, with no graininess or roughness. The lining or coating shall have no blisters, cracks, bubbles, underfilm voids, mechanical damage, discontinuities, or holidays.

E. Factory Testing of Coating--General

1. Test linings and coatings with a low-voltage wet sponge holiday detector. Test pipe linings and coatings per AWWA C213, Section 5.3.3. If the number of holidays or pinholes is fewer than one per 20 square feet of coating surface, repair the holidays and pinholes by applying the coating manufacturer's recommended patching compound to each holiday or pinhole and retest. If the number of pinholes and holidays exceeds one per 20 square feet of coating surface, remove the entire lining or coating and recoat the item or pipe.
2. Measure the coating thickness at three locations on each item or piece of equipment or pipe section using a coating thickness gauge calibrated at least once per eight-hour shift. Record each measured thickness value. Where individual measured thickness values are less than the specified minimum thickness, measure the coating thickness at three additional points around the defective area. The average of these measurements shall exceed the specified minimum thickness value, and no individual thickness value shall be more than 2 mils below or 3 mils above the specified minimum value. If a section of the pipe, item, or piece of equipment does not meet these criteria, remove the entire lining or coating and recoat the entire item or piece of equipment.

F. Factory Testing of Lining and Coating of Pipe--Additional Requirements

Check for coating defects on the weld seam centerlines. There shall be no porous blisters, craters, or pimples lying along the peak of the weld crown.

G. Field Repairs

Patch scratches and damaged areas incurred while installing fusion-bonded epoxy coated items with a two-component, 80% solids (minimum), and liquid epoxy resin. Wire brush or sandblast the damaged areas per SSPC SP-10. Lightly abrade or sandblast the coating or lining on the sides of the damaged area before applying the liquid epoxy coating. Apply a two-part epoxy coating to defective linings and coatings to areas smaller than 20 square inches. Patched areas shall overlap the parent or base coating a minimum of 0.5 inch. If a defective area exceeds 20 square inches, remove the entire lining and coating and recoat the entire item or piece of equipment. Apply the liquid epoxy coating to a minimum dry-film thickness of 15 mils.

END OF SECTION

SECTION 260000
ELECTRICAL

PART 1 - GENERAL

SEE: ELECTRICAL AND CONTROLS - DIVISION 16

END OF SECTION

SECTION 16110
CONDUIT, RACEWAYS, FITTINGS AND SUPPORTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. General

1. Furnish all labor, materials, tools, equipment and services for all conduits, raceways, cable trays and wireways as indicated in accordance with provision of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

B. Conduit runs are diagrammatic. Verify locations in field.

C. All above ground raceways shall be Schedule 40 steel pipe dimension conduit unless otherwise indicated. All raceway material delivered to the job site shall bear the UL label and shall be stored so as to be protected from physical damage and weather elements. Underground raceways, whether encased or direct buried, shall be rigid nonmetallic conduit. Final raceway runs to electrical equipment on machinery requiring flexibility or subject to vibration shall be jacketed liquidtight flexible metal conduit.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Rigid steel conduit shall conform to ANSI 1 C80.1. Zinc coating shall be applied inside and out by hot-dip galvanizing after threading. Unless specifically noted, minimum conduit size shall be ¾ inch.
 - B. Nonmetallic conduit shall be Schedule 40 high impact polyvinylchloride, UL approved for direct burial or concrete encasement for cables operating at 90°C. Minimum size shall be ¾ inch. Fittings used with PVC conduit shall be PVC solvent weld type.
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- C. Liquidtight conduit shall be formed from spirally wound galvanized steel strip with successive convolutions securely interlocked and jacketed with liquidtight plastic cover. Minimum size shall be ½ inch. Fittings for liquidtight conduit shall have cadmium-plated malleable iron body and gland nut, brass grounding ferrule threaded to engage conduit spiral and O-ring seals around the conduit and box connection and insulated throat. Forty-five and 90° fittings shall be used where applicable.
- D. Intermediate rigid metal conduit, electrical metallic tubing, non-jacketed flexible metallic conduit shall not be used.
- E. Wireways and auxiliary gutters shall not be used unless specifically shown on the plans. Where shown, they shall be of the class and type specified on the drawing.
- F. Liquidtight hubs with insulated throats shall be installed for all conduit entries to sheet metal enclosures. Nut and locknut assemblies will not be acceptable.

Expansion fittings in exposed conduit runs shall be weatherproof units with external bonding jumpers.

Expansion fittings in concealed conduit runs shall be specially designed as required using galvanized ¼ inch steel plate covers, frames and structure to allow 1 inch relative movement of adjoining structures in any direction.

Conduit unions shall be similar to Crouse-Hinds Type UNF or UNY.

Conduits making bottom entry to free standing panels shall be fitted with appropriate insulating bushings or bell fittings to avoid damage to insulation during pulling in of cables. Bushings for metallic conduit shall be malleable iron with insulating collars.

- G. Conduit identification plates shall be of Type 316 stainless steel, which are fastened with Type 316 stainless steel ties at both ends of the plate. The plates shall be 3/8-inch wide and 3-1/2 inch long. The conduit numbers shall be stamped on each plate with 3/16-inch high characters.

The plates shall be Panduit MMP350W38-C3 16 or equal and ties shall be Panduit MLT-S316 or equal.

- H. Explosion-proof couplings shall have a flexible brass inner core and outer bronze braid covering attached to threaded fittings, and shall be rated for the particular hazardous area. The metallic braid and fittings shall be shipped completely factory assembled. The couplings shall be capable of withstanding internal explosive pressures. Couplings shall have conductivity on a similar length basis, equal to rigid

steel conduit. Manufacturers of flexible couplings shall be Crouse-Hinds, Appleton, O-Z/Gedney, or approved equal.

- I. Sealing fittings shall be Crouse-Hinds, type 'EYS' or approved equal. Ceramic or other non-asbestos fiber materials and sealing compound (UL listed to match the fitting) shall be provided for completing the seal.
- J. Conduit wall seals shall consist of a synthetic rubber sealing ring between two pressure rings or a series of synthetic rubber links between pressure plates held together with corrosion resistant bolts, nuts and washers. When the bolts are tightened, the synthetic rubber shall expand to provide a watertight seal between the outer surface of the entering conduit, and the inner surface of the wall penetration. The synthetic rubber shall resist aging, ozone, sunlight, water, chemicals and extreme temperature variations. The seals shall be Thunderline "Link-Seal," O-Z/Gedney Type CSM, FSK, WSK or approved equal.
- K. **Raceway Supports:**
 - 1. General: Raceway support systems shall be designed to provide a factor of safety of not less than 5.
 - 2. Conduit Clamps: Conduit clamps and backs shall be one-hole design of cadmium-plated malleable iron, except in corrosive environments where clamps and support hardware shall be plastic-coated steel.

PART 3 - EXECUTION

3.01 INSTALLATION

Exposed conduit installation is only permitted as required for the final service connection of wall, structure, or platform-mounted outdoor light fixtures, receptacles, switches, junction boxes, control stations and control panels. Exposed conduit installation shall also be used in interior areas where specifically shown on the plans.

Conduit routing shall not be altered from exposed to concealed or vice versa without express written permission of the Construction Manager.

Welding, brazing or otherwise heating of the conduit will not be allowed. Plumber's perforated hanger iron shall not be used for any purpose.

Conduit constructed in concrete which is in contact with earth or water shall be adequately separated from the earth or water by at least 4 inch of concrete. PVC conduit shall be used for underground runs. Vertical risers to equipment including the bottom 90° bend shall be a

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rigid steel conduit joined to the PVC conduit in the concrete encasement. Concrete encasement shall extend 4 inch above finished grade. Minimum cover requirements for underground conduit shall comply with NEC Article 300-5.

Conduit rising through a slab shall be protected by a dry pack concrete pad approximately 6-inch in diameter and 3-inch above the finished floor or the conduit shall come up through the equipment pad. Clearances equal to the conduit trade diameter but not less than 1½ inch shall be maintained between conduits encased in slabs. Clearances of less than 1½ inch at conduit crossings and terminating locations may be allowed at the discretion of the Construction Manager.

Where required for ease of pulling and as necessary to meet code, the Contractor shall supply and install junction or pull boxes even though not shown on the plans. In all cases, however, the Contractor shall limit the number of directional changes of the conduit to total not more than 270 degrees in any run between pull points. Bends and offsets shall be avoided where possible, but where necessary shall be made with an approved hickey or conduit bending machine. Turns shall consist of fittings or symmetrical bends. Secure all conduits and fittings on exposed work by means of clamp backs and channels or struts. Spacing of conduit supports shall be as required by the National Electrical Code, but shall not exceed 4 ft. Run all conduits on exposed work at right angles to and/or parallel with the surrounding walls and conform exposed conduit runs to the form of the ceiling. No diagonal runs will be allowed. Provide concentric bends for parallel conduit runs. Where two or more conduit runs use the same pull box the conduits shall be adequately separated. Install conduit wall seals for all conduits penetrating walls. Install expansion and deflection fittings where conduits cross building expansion joints. Make all roof penetrations watertight with weatherproof metal flashing caps utilizing hot-dipped galvanized sheet metal for the caps.

Explosion-proof flexible couplings shall be used for connections at motors, solenoid valves, instrument devices and other devices where vibration is encountered in Class I, Division 1, Groups C and D hazardous areas. Couplings shall be complete with flexible vinyl plastic protective coating.

Install explosion-proof seals as detailed on the plans and as required by the National Electrical Code and plug with fiber and sealing compound in accordance with the fitting manufacturer's recommendations.

All conduit-entering cabinets shall be secured. The conduit shall have an insulating bushing constructed in the conduit end. All conduit entering non-cast metallic NEMA boxes shall be terminated with a raintight hub having an insulated liner. All surface-mounted cast boxes and plastic enclosures shall have threaded hubs. All joints shall be made with standard couplings or specified unions. Metal parts of plastic control stations and coated boxes shall be bonded to the conduit system. Running threads shall not be used in lieu of conduit nipples nor shall excessive thread be used on any conduit. The ends of all conduit shall be cut square, reamed and threaded with straight threads. Rigid steel conduit shall be

made up tight and without thread compound. Exposed threads shall be cleaned, primed and painted.

Liquid-tight flexible conduit shall be used for all motor connections as detailed. Where flexibility is required for electrical raceways on equipment, liquidtight flexible conduit shall be used in accordance with JIC standards, these specifications and the local inspection agency. The maximum length of this conduit shall be 24 inch for conduits 1½ inch or smaller and 36 inch for conduits 2 inch or larger.

Underground conduit installation shall comply with the following:

- Trench bottoms shall be free from rocks, clods, and foreign material.
- Trench bottoms shall be compacted and leveled before conduit installation.
- For runs with two or more conduits, install molded plastic spacers every six feet to provide a separation of three inches.
- Unless otherwise indicated on the plans, install conduits so that top of conduit will be a minimum of 24 inches below finish grade for circuits 600 volt and below, and 36 inches below finish grade for all circuits above 600 volts.
- Slope uniformly all outdoor underground conduits away from buildings and underground structures toward pull boxes or manholes.
- Avoid and/or prevent damage to existing underground piping, conduits and cables. All such repair of damage to existing facilities shall be at the expense of the Contractor.
- If existing pavement or concrete slabs are required to be removed under this project or are damaged by underground electrical work, install and repair the pavement and concrete slabs in accordance with other sections of this Specification.

The Contractor shall exercise the necessary precautions to prevent the lodging of dirt, concrete or trash in the conduit, fittings and boxes during the course of construction.

Contractor shall install a pull rope in each empty conduit run. Rope shall be the polypropylene type at least 3/16 inch in diameter.

Identify all conduits with conduit identification plates at all terminations, enclosures, wall and floor penetrations, etc., in accordance with the conduit number listed in the conduit schedules.

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CONDUIT, RACEWAYS, FITTINGS AND SUPPORTS

Provide the minimum separation for instrumentation conduit runs from the power conduits as follows:

<u>Voltage</u>	<u>Separation (inches)</u>
120 volts	12
240 volts	24
480 volts	36
Above 600 volts	72

Install continuous copper ground conductors in all conduit runs. Size ground conductor per National Electrical Code Table 250-95 except minimum size shall be No. 12 AWG.

After installation of all conductors all conduit ends shall be sealed with 'Fire Stop' duct seal.

****END OF SECTION****

SECTION 16120

WIRE AND CABLE - 600 VOLT AND BELOW

PART 1 - GENERAL

1.01 DESCRIPTION

A. General

1. Furnish all labor, materials, tools, equipment and services for all wire and cable (600V and below) as indicated in accordance with provision of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

PART 2 - PRODUCTS

2.01 MATERIAL

A. Low Voltage (through 600V except instrument signals)

1. General: Low voltage conductors shall be used for power, control, lighting and miscellaneous circuits and shall conform to NEMA standards WC3 and WC5 and UL requirements. Unless otherwise noted, conductors shall have Class B stranding. Conductors shall be copper. Solid conductors shall not be used. Insulation for cables in raceways shall be NEC Type THHN/THWN. Minimum size for field wiring shall be No. 12 AWG and panel wiring shall be No. 14 AWG. Labeling of conductors shall be in accordance with Section 16110, CONDUIT, RACEWAYS, FITTINGS, AND SUPPORTS.
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Section 16120
WIRE AND CABLE-600 VOLTS AND BELOW

2. Color Coding: Insulated conductors routed in raceways shall be color coded as follows:

<u>System</u>	<u>Service</u>	<u>Color</u>
480V, 3-Phase	Phase A	Brown
	Phase B	Orange
	Phase C	Yellow
208V, 3-Phase	Phase A	Black
	Phase B	Red
	Phase C	Blue
208 or 240V, 1-Phase	L1	Black
	L2	Red
120V, 1-Phase	L	Black
All	Control	Violet
	Neutral	White
	Ground	Green

The same color shall be connected to the same phase throughout the plant. On cable No. 4 AWG and larger, black may be used with colored 3/4 inch vinyl plastic tape for 6 inch at each end at all terminations and in all pull boxes. Internal MCC and Control Panel single conductors wiring shall be SIS wire, color code gray.

B. Instrument Signal Conductors

Various special cables may be required for different field instrument input measurements. Such cable shall be installed in accordance with the instrument vendor's recommendation as approved. Instrument measurements from field to panel or panel to panel shall be with appropriately rated signal cables. Signal cables shall be single or multiple pair cables with overall outer PVC jacket and overall outer ground. Each twisted pair shall be No. 16 AWG stranded copper conductor with polyethylene chloride insulation for 300V service. Each pair shall be provided with an individual ground (shield) and be insulated from every other pair. Signal cables shall be Beldon or equal.

C. Portable Cords

Cord shall be NEMA Type SO or STO with NEMA Class G copper stranding. Cords larger than No. 2 AWG shall be National Bureau of Mines Type G. All cords shall contain an equipment-grounding conductor.

Fittings for terminating the cords shall provide a watertight seal between the cord and the terminator and between the terminator and mounting hub. The cable terminator shall be provided with a neoprene liner which grips the cord jacket when the back-nut applications are called for. A stainless steel wire mesh cord grip shall be provided as an integral part of the cord terminator.

D. **Connectors, Splicing Materials and Terminations**

1. Cable Connectors: Lugs and splices shall be 1 piece tubular compression type. Connectors for copper cable shall be tinned electrolytic copper.
2. Terminal Blocks: Terminal blocks shall be barriered and of ample size and capacity to handle the required loads and shall be solderless type pressure lugs. All terminals shall be numbered and shall be provided with white fiber marking strips. The numbering shall be hand printed with black India ink in a neat and legible manner or shall be machine printed with black India ink. All control terminal boards shall be of ample size to accept two No. 12 AWG field conductors per point and shall have pressure type conductor clamps. Terminal blocks for instrument and signal circuits shall be screw type for use with ring lugged conductors.
3. Isolating Terminal Blocks/Foreign Potentials: Isolating terminal blocks shall be used in instrument and station control panels and other locations as required to isolate foreign station potentials of 50V or greater. These blocks shall be of the pull-apart type with disconnecting handles. Miniature individual knife type switches or door operated limited switches will not be acceptable. Isolating terminal blocks shall have marking strips and identification of points the same as terminal blocks hereinbefore specified.

PART 3 - EXECUTION

3.01 INSTALLATION

A. **Cable**

An appropriately sized cleaning mandrel shall be pulled through all completed conduit segments prior to the installation of any wire or cable.

Care shall be exercised in pulling cables into conduit or trays so as to avoid kinking, putting undue stress on the cables or otherwise abrading them. No grease will be permitted in pulling cables. Soapstone, talc or UL approved pulling compound only

Section 16120
WIRE AND CABLE-600 VOLTS AND BELOW

will be permitted. The raceway constructed shall be complete and protected from the weather before cable is pulled into it.

Incoming cables in panels and motor control center, No. 6 AWG and smaller, shall be bundled and laced at intervals not greater than 6 inch and neatly spread into trees and connected to their respective terminals. Sufficient slack shall be allowed in cables for alterations in terminal connections. Lacing shall be done with plastic cable ties. Where plastic panel wiring duct is provided for cable runs, lacing is not necessary when the cable is properly constructed in the duct.

Cables crossing hinges shall be made up into groups not exceeding 12 and shall be so arranged that they will be protected from chafing when the hinged member is moved.

Cables shall be numbered at both ends using the numbering system shown on the plans.

All data and communication cables shall be installed in strict compliance with their manufacturer's requirements and recommendations.

B. Wire and Cable Termination and Splicing

1. General: Power and control conductors shall be terminated in terminal blocks with solderless box lugs. Signal leads shall be terminated in terminal blocks with saddle type pressure connectors capable of receiving two No. 6 AWG, or smaller, conductors on each point.

Solid wire shall not be used nor shall electric spring connectors be used on any wiring. Lugs and connectors shall be installed with a compression tools. Compression tool may be indent type for conductors to No. 2 AWG but shall be diamond or hexagon multiple indents for all larger conductors.

Controls circuit conductors shall be tagged at each end in motor control centers, control panels and control stations with a legible permanent coded wire-marking sleeve. Markings shall be in accordance with the wire numbers and prefixes as shown in the diagrams.

Field control conductors shall be similarly tagged at each end.

2. 600V Splice and Terminations: All splices and termination for No. 1/0 AWG cable and larger shall be inspected by the Construction Manager prior to and after insulation is applied. Terminations at 460V motors shall be made by bolt connecting the lugged conductors and then applying 1/2 lapped layers of Scotch No. 33 tape to equal or exceed the thickness of conductor

insulation. One 1/2 lapped layer of Scotch No. 70 shall be carefully applied as a protective cover and shall not be stretched during wrapping.

3. Instrument Cable Shield Termination: Particular care is required to assure proper shield connections and grounding. Shield conductors shall be grounded at one end only. Shields shall be grounded at the control panel terminal strip unless grounding is specifically required by the instrument supplier to be at the transmitter/ transducer location. Shield conductors shall be landed on terminal strips for bonding or grounding. Ungrounded end shall be neatly taped to avoid inadvertent grounding.

C. Portable Cords

Portable cord feeding permanent installations such as sump pumps, cranes, hoists, and portable equipment shall have a wire mesh cord grip of flexible stainless steel wire to take the tension for the cable termination. Weatherproof stain relief fittings shall be used where applicable to prevent unnecessary strain on cords.

Flexible cords feeding submersible motors shall be similarly protected but the cord shall be of a nonwicking neoprene construction.

D. Grounding

All grounding surfaces shall be thoroughly cleaned before connecting the grounding electrodes. All conduit shall be grounded directly or through equipment frames and ground busses to the grounding system.

Ground connections to water supply pipe shall be provided where local codes require such connections. Except for this connection to the water pipe, all connections in the grounding system shall be bolted or welded by the thermite process as shown.

In addition to the conduit system, all equipment having a 240 or 480V supply shall be grounded to the supply source ground bus by a green insulated cable installed in the conduit with the phase cables. Ground cable for small panels and equipment shall be No. 8 AWG unless otherwise required for compliance with NEC 250-94.

END OF SECTION

SECTION 16700
CONTROL PANELS

PART 1 - GENERAL

1.01 DESCRIPTION

A. General

1. Furnish all labor, materials, tools, equipment and services for supply, installation and wiring of control panels as indicated in accordance with provisions of the Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. The Instrumentation System Supplier (ISS) described in Section 16710, PROCESS INSTRUMENT AND CONTROL SYSTEMS, shall furnish all labor, materials, appurtenances, and incidentals required for fabrication and field commissioning of control panels.

1.02 CODES AND STANDARDS

All equipment shall be designed, manufactured and supplied in accordance with the latest applicable standards of:

- American National Standard Institute, Inc. (ANSI).
- California Administrative Code, Title 24, Part 3, Basic Electrical regulations (BER).
- Institute of Electrical and Electronics Engineers, Inc. (IEEE).
- Insulated Cable Engineers' Association (ICEA).
- National Electrical Code (NEC).
- National Electrical Manufacturer's Association (NEMA).
- Underwriters' Laboratories (UL).

The following individual standards are specifically listed for their applicability to the particular type of equipment to be supplied, but are not intended as a complete or exclusive list of applicable standards or standards organizations:

NEMA National Electrical Manufacturer's Association

ICS-1 *General Standards for Industrial Control and Systems*

Section 16700
CONTROL PANELS

ICS-2 *Industrial Control Devices, Controllers and Assemblies*

ICS-6 *Enclosures for Industrial Controls and Systems*

All equipment furnished shall be designed and constructed to comply with all applicable laws and regulations of the State of California, and the requirements of any local codes effective at the site.

1.03 SUBMITTALS

Submit for approval shop drawings, factory test reports, and technical data.

The following information and drawings shall be submitted to delineate the specific characteristics of the equipment supplied:

- A. Front and side elevations, top and floor plans, structural details, weights, and conduit entry/exit locations.
- B. Equipment anchorage provisions.
- C. Nameplate schedules.
- D. Major components technical bulletins, instruction and maintenance manuals and bill of materials.
- E. Complete AC, DC, and instrumentation loop control schematics.
- F. Complete panel wiring diagrams.

PART 2 - PRODUCTS

2.01 MATERIAL - GENERAL

Where manufacturers are named for a particular item of equipment, it is intended as a guide to acceptable quality and performance and does not except such equipment from the requirements of these specifications or plans.

All material of a given type shall be of a single manufacture for all equipment. All material shall bear a UL label where such is available for the class of equipment involved.

2.02 ELECTRICAL CONTROL PANELS (ECPs)

Electrical control panels (ECPs) shall be utilized throughout the work as central control stations for individual process areas.

A. Construction

1. Structure: Electrical control panel enclosure shall consist of single or multiple-compartment, freestanding or wall-mounted, code gauge steel enclosure designed for top or bottom conduit entry. Indoor enclosures shall be rated NEMA 12. Outdoor enclosures shall be stainless steel and rated NEMA 4X. Where outdoor enclosures have door-mounted equipment, the enclosure shall be constructed with the addition of deadfront, weatherwrap exterior doors. Maximum width of individual compartments shall not exceed 36 inches. A full-length key lockable door with three-point latching mechanism shall be provided over each compartment. A common key shall open all doors. Panel doors shall open to at least 90° and shall be supplied with door latching rod with rollers. A full-length backpan shall be provided in each compartment. The ECP enclosure shall be given a rust preventative treatment, primed, and painted. Enclosure exterior finish shall be manufacturer's standard medium gray for standalone ECPs. Exterior finish for ECPs supplied in a line-up with motor control centers, switchboards, switchgear, etc. shall match exterior finish of equipment in the line-up. Panel interior (and backpan) finish shall be white enamel. The enclosure finish shall be uniform and completely free of pits and blemishes.

The arrangement of components in the ECP shall be as shown on the plans and described in these Specifications. All internal components shall be mounted on mounting pans. Door-mounted components shall be flush or semi-flush-mounted and arranged as shown. Door sheet steel gauge shall be selected to provide proper rigidity with doors open or closed, after all door-mounted components have been installed. Door stiffeners or ribs are not permitted.

2. Wiring Methods: Wiring shall be routed in plastic ductwork with removable covers. Wiring not routed in ductwork shall be neatly bundled, treed, and laced with plastic ties. Wiring across door hinges shall be carefully made up and supported to avoid straining and chafing of the conductors or from putting any strain on their terminations.

120VAC and 24VDC control wiring shall be with THHN/THWN type wire #16 AWG minimum. 4-20mADC instrument loop wiring shall be shielded twisted pair, 600V, 16 gauge Belden #8719 or approved equal.

4-20mADC and 24VDC wiring shall not be run together with 120VAC wiring. Separate ductwork, wire bundles, and terminal blocks shall be used. 24VDC and 4-20mADC wiring shall cross 120VAC wiring at right angles where crossing is required.

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CONTROL PANELS

4-20mADC wiring shall have shields grounded at one end only (panel terminal block) as shown on the drawings. Insulate shield at opposite end with heat shrink tube. At signal wire terminations strip back shield approximately 1.5 inches maximum to minimize RFI, EMI interference. Apply wire labels to signal cable, not signal conductors. Connect black wire electrically closest to 24V positive source, white wire closest to negative. Show cable number and wire color on submittal wiring schematics.

ECPS shall be completely factory-wired and function tested prior to shipment.

3. Terminal Blocks: Terminal blocks shall be of ample size to accept two No. 12 AWG field conductors per point, and shall have compression type clamps capable of accepting ring and spade lug terminations. Terminal blocks shall be Buchanan #B112 or equal. Terminal blocks shall be provided for all panel remote-wiring connections with 10% spare points.

4-20mADC signal wiring and other instrumentation circuits indicated shall be with DIN rail mount terminals as shown on the plans. DIN rail terminals shall be installed with proper accessories for a complete termination system including end plates, separator plates, rail clamps, terminal labels, etc. DIN rail terminals shall be Phoenix Contact #UK3-TWIN, #UK4-T-P-P, #UK3-TWIN-PE, #UK6.3-HESILED or approved equal.

4. Wire Marking: Wire marking shall be as follows: All conductors except single-speed motor leads, lighting circuits and electronic-printed circuit boards and other similar devices shall be marked at each end with wire marker letters and numbers in accordance with the approved submittal drawings. Markers shall consist of plastic sleeves, heat shrunk or otherwise firmly anchored, with indelible ink machine printed characters.

The wire numbering system shall be by circuit branch and shall be submitted for review and approval.

5. Nameplates: Each device shall be identified with a laminated phenolic nameplate fastened with corrosion resistant screws. Internal relays and other control devices shall be identified by equipment number and device designation in letters 3/16-inches high. Nameplates shall be black and white phenolic adjacent to the device. Nameplates shall be fastened to panels with stainless steel drive screws. Nameplates schedule shall be submitted to the Construction Manager for approval.

PART 3 – EXECUTION

3.01 INSTALLATION

Install electrical control panels at locations as shown on the drawings and anchor in compliance with manufacturer's recommendations.

Correct damage to factory paint finish with factory-approved touch-up paint.

****END OF SECTION****

SECTION 16710

PROCESS INSTRUMENT AND CONTROL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. General

1. Furnish all labor, materials, tools, equipment and services for all process instrument and control systems as indicated in accordance with provisions of the Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

B. Instrumentation System Supplier (ISS)

The Contractor shall cause the complete process instrumentation and control systems to be furnished and installed by a single company. The Instrumentation System Supplier (ISS) shall be regularly engaged in the manufacture and installation of pneumatic, electronic and process instrumentation systems. These requirements shall not, however, be construed as relieving the Contractor of his responsibility for this part of the work.

The ISS shall provide all materials, labor, engineering, as required, per:

Section 16700, CONTROL PANELS

Section 16710, PROCESS INSTRUMENT AND CONTROL SYSTEMS

Section 16800, PROGRAMMABLE LOGIC CONTROLLERS AND ASSOCIATED EQUIPMENT

Section 16850, HMI MONITORING AND CONTROL SYSTEMS

The ISS shall be responsible for the satisfactory operation of the entire system. The ISS shall produce detailed drawings (panel schematics, inter-connection, and loop diagrams) for the complete coordination and installation of the various system components. The ISS shall perform coordination and field investigation as required to interconnect new and existing controls, and to interface with other trades and package control vendors, so as to provide a complete, documented, and properly operable system.

The ISS shall provide the services of a qualified Commissioning Engineer to perform and/or supervise the installation, calibration, start-up procedures, pre-operational testing, and commissioning of each system.

Functional system data is shown on instrumentation diagrams and is augmented by accompanying schedules and details. All elements shall be provided as shown and/or other such elements as may be required to complete the system shall be provided even though not shown.

B. Qualifications of Instrument System Supplier (ISS)

The ISS shall be:

Tesco Controls, Sacramento, CA (no substitution)

The ISS shall be designated in the Contractor's bid documents.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Signal Transmissions and Signal Conditioners

Unless otherwise indicated, electric or electronic signal shall be 4-20mA (milliamps) DC. Signal conditioners and/or isolators shall be provided as required and shall be by AGM, or approved equal.

B. Electronic Equipment

Electronic equipment shall be all solid-state construction. Components shall be substantially derated to assure dependability and long-term stability. Printed circuit boards shall be glass epoxy of ample thickness, wave soldered, and heavily varnished for moisture resistance. Alignment and adjustments shall be non-critical, stable with temperature changes and aging, accomplished with premium grade potentiometers. Selected components shall not be required to obtain specified performance.

C. Power Supplies

- I. Unregulated 120V, 60 Hz power shall be provided to all control panels, and all field instruments indicated as having 120V electric supply. If power is required at any other instruments, if other voltages are required, if regulated power is required, it shall be provided under this item.

2. Components shown with individual 120V AC supplies shall be so provided, they shall not be grouped on common low voltage DC supply. Alternating current power supply connections for panel mounted equipment shall be hardwired. Field mounted units shall be wired in solid and provided with a power disconnect switch either internally or adjacent to the unit. All units shall be protected by individual draw-out fuses.
3. Direct current power supplies shall operate from 120V AC unregulated power and, unless otherwise indicated, shall be 24V DC output. DC output voltage shall be regulated to $\pm 0.005\%$ for 10% AC line voltage change and over rated output range. Output ripple shall be less than 0.25mV. Power supply shall be protected against output short-circuit. Power supplies shall be sized for a minimum of 300% of connected load or as required to successfully start-up with all loads connected. Power supply AC input shall be fused per the manufacturer's requirements. Power supplies shall be Acopian "Gold Box Series A" with "GB8" mounting kit, or approved equal.

D. Flow

1. Magnetic Flowmeter

a. General

The magnetic flowmeter shall be of the electromagnetic design for measuring flow and shall consist of a flanged magnetic flowmeter flowtube and a remote magnetic flowmeter transmitter. Flowtube shall be a Rosemount Model #8707 with remote Rosemount #8712 flowmeter transmitter (no equal).

Magnetic flowmeters shall be provided for the following applications in the quantities and sizes noted:

<u>Flow</u>	<u>Size</u>	<u>Quantity</u>
Finish Water	12"	1

b. Magnetic Flowmeter Flowtube

Magnetic flowmeter flowtube shall be a DC powered, flanged, magnetic flowtube capable of monitoring process flow with conductivity of 5 micromhos/cm or greater.

Flowtube shall be rated for operation in the following environments:

Humidity	0 to 100% (non-condensing)
Temperature	-29° C to +177° C

Section 16710
PROCESS INSTRUMENT AND CONTROL SYSTEMS

Pressure	0 to 150 PSI
Submersibility	0 to 30 feet

Flowtube shall be carbon steel with 304 stainless steel flanges and have a PTFE TEFZEL liner and ANSI class 150 lb. flanges rated at 285 PSI.

Flowtube accuracy shall not be affected by pressure, temperature, density, viscosity, or conductivity changes in the process flow.

The flowtube shall be furnished with 316L stainless steel grounding/liner-protection rings and straps at both ends of the flowtube between the flowtube face and the flange.

Flowtube electrodes shall be 316L stainless steel. The flowtube shall produce a DC voltage signal that is linear with the process flow rate.

Flowtube accuracy shall be $\pm 0.5\%$ of flowrate for flows of 1 to 30 ft./sec. Accuracy shall be $\pm .005$ ft./sec. of flow from the low flow cutoff to flows of 1 ft./sec.

c. Magnetic Flowmeter Transmitter

Magnetic flowmeter transmitter shall be supplied in an NEMA 4X rated enclosure, FM rated for Class I, Division 2, Groups A, B, C, and D locations. Transmitter shall be suitable for operation over a -25°C to $+65^{\circ}\text{C}$ temperature range and 0 to 100% relative humidity. The transmitter shall be capable of processing DC voltage signals from the flowtube from fluids that are traveling between 0.4 and 30.0 ft./sec. for both forward and reverse flow in all flowtube sizes. Full scale shall be continually adjustable between -30 and $+30$ ft./sec. Flowmeter shall operate from a 120V AC, 60 Hz (nominal) $\pm 10\%$ power supply.

Magnetic flowmeter transmitter shall provide a flow proportional 4-20mA DC analog output signal (switch selectable as internally or externally powered) into a 0 to 1000 OHM load. Transmitter shall superimpose a HART communication digital flow signal on the 4-20mA DC output, available for control system interface. The transmitter shall also provide a flow totalized dry contact closure output suitable for 24V DC external sourcing. Flow totalized value of contact closure to be field selectable. Totalized flow values shall be retained in transmitter non-volatile memory. Transmitter shall be equipped with an adjustable (.001 to 1.0 ft./sec.) low flow cutoff, below which the output shall be driven to zero.

Flowmeter transmitter accuracy when used in conjunction with the specified flowtube shall be ± 0.5 % of rate from 1 to 30 ft./sec. and .005 ft./sec. below 1 ft./sec.

The flowmeter transmitter shall be equipped with a local operator interface (LOI) with backlit character display and four optical switches. The LOI shall be capable of performing all necessary functions for setting up the transmitter and flowtube assembly.

One manufacturer's PC software package and HART communication cable shall be furnished for configuration and calibration. The manufacturer or the ISS shall provide a minimum of 4 hours of on-site training to demonstrate the use of the HART configuration software. All magmeter HART configuration files shall be transferred to the Owner.

d. Nameplates

The flowmeter shall have a Type 316 stainless steel plate permanently attached onto which the following information shall be impressed, engraved or embossed.

1. Manufacturer's Name
2. Manufacturer's Model Number
3. Manufacturer's Shop Order Number or Serial Number
4. Instrument Tag Number

e. Spare Spool Pieces

Provide one spare spool piece for each magmeter size with flanged ends having the same diameter, pressure rating, and laying length as the flowmeter. Spool pieces may be utilized for fitting up of piping and in case the magmeter flowtube must be removed for repair.

E. Turbidimeter

The turbidimeter shall consist of a two-channel analyzer, one turbidity sensor, and one debubbling/measuring chamber, all mounted to a common stainless steel backplate and prewired to the analyzer.

The turbidimeter shall be a complete system consisting of sensor, analyzer, flow chamber/debubbler, and interconnecting cable. The analyzer shall accept input from up to two sensors.

The analyzer shall measure turbidity in the range 0 - 100 NTU with a display resolution of 0.001 NTU.

The analyzer display shall be LCD with LED backlighting.

A user-defined security code shall be available to protect against accidental or unauthorized changes to program settings and calibration.

Bubble rejection, signal averaging, and output hold features shall be available.

The analyzer shall continuously monitor itself and the sensor for faults. The analyzer shall display fault and warning messages.

The analyzer shall have dual input and dual output. 4-20 mA outputs shall be provided. Outputs shall be isolated with 500 ohm maximum load.

The analyzer shall be provided with four user configurable electromechanical relays with SPDT contacts. The alarms shall be fully programmable for high/low logic and deadband. One alarm shall be configured as a fault alarm.

Environmental limits for the analyzer shall be 32 to 122°F (0 to 50°C) and 5 to 95% relative humidity.

The analyzer enclosure shall be NEMA 4X.

Interconnecting cable shall plug into the sensor and analyzer.

The turbidimeter shall have the following accuracy (after calibration with 20.0 NTU standard):

- a. 0 - 1 NTU: $\pm 2\%$ of reading or 0.015 NTU, whichever is greater
- b. 1 - 40 NTU: $\pm 2\%$ of reading

Each turbidimeter shall be supplied complete with check standard and calibration cup.

The instrument shall be Hach 1720E Low Range Turbidimeter with Hach SC200 Analyzer (no equal).

F. ITO I Isolator

1. Isolators shall be of the electronic, solid-state type for inside the enclosure mounting and shall complete input/output isolation. It shall accept a 4-20mA DC signal and shall output a similar 4-20mA DC signal. The output shall have a suitable resistor which can be removed in the future. It shall be provided with a NEMA 1 cover, flexible cord plug-in connector, and gold flash jack.

2. Isolators shall have an accuracy of 0.1% and a temperature variation of 0.0025%/°F. The input impedance shall be 50 ohms and the output impedance shall be 1,500 ohms. The input power shall be 115V AC, 60 Hz. Fuse protection shall be provided.
3. Isolators shall be AGM or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

Instruments attached directly to concrete shall be spaced out from the mounting surface not less than 1/2 inch by use of phenolic spacers or framing channel. Expansion shields or cast-in-place inserts shall be used for securing equipment or supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platforms and oriented for optimal display orientation and accessibility.

Each device shall be carefully installed and commissioned in accordance with the Contract Documents, the plans, the Manufacturer's O&M documentation, and as required for a complete and fully functional instrumentation system.

All analog instruments shall be installed such that taps and ports, etc. are available for in-place calibration and test without removal. For those instruments where such in-site calibration is not feasible other calibration methods shall be provided subject to approval by the Construction Manager.

All instrumentation shall be field calibrated using calibration standards at least 4 times more accurate than the instrument under test. Calibration standards shall be recently calibrated, with certification traceable to NIST. Calibrate each instrument at no less than five (5) points (0, 25, 50, 75, and 100%) of calibration. Complete test reports shall be submitted for Construction Manager review and approval.

Final instrument loop commissioning shall include injection of 4-20mA signal into the loop from the connections to the signal transmitter, at five (5) points (0, 25, 50, 75, and 100%) of calibration. At each injected value, record the readings of all receiving instrument including digital panel meters, videographic recorder, PLC analog input value and HMI readout. Perform corrections as required to achieve displays corrected to within 0.1% of full scale. Complete test reports shall be submitted for Construction Manager review and approval.

Analysis instruments shall be compared each with the other for consistency and with plant laboratory methods.

****END OF SECTION****

SECTION 16800

PROGRAMMABLE LOGIC CONTROLLERS AND ASSOCIATED EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included

1. The Instrumentation System Supplier (ISS) described under Section 16710, PROCESS INSTRUMENT AND CONTROL SYSTEMS, shall furnish all labor, materials, equipment, software, appurtenances and incidentals required to program, function test, and operate the existing programmable logic controllers (PLC) and auxiliaries to incorporate the new facilities as specified herein, and as shown on the plans.

The ISS shall furnish field investigation of existing facilities, and engineering and technical expertise as required for complete integration of the new facilities into the existing PLC system for proper control, data storage, and communications. Control logic shall be generally as described herein and as shown on the drawings, but shall be adjusted by the ISS as required for safe and satisfactory operation.

The complete, proven and documented system shall meet the highest standards for this type of service.

2. PLC systems requiring programming modifications by the ISS to incorporate new facilities include:
 - PLC-WTP-01, Water Treatment Plant - Integrate into HMI graphical displays, event-logging, and data logging.
 - PLC-Z3R-01, Zone 3 Reservoir station – PLC and OID integration, remote alarm annunciation, control and start up, integrate HMI graphical displays, event-logging, and data logging.

B. Description of System

1. Existing PLC-WTP-01 and PLC-Z3R-01 are Allen Bradley Control Logix. Refer to Part 2 – Products of this specification for equipment and programming software details.

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PROGRAMMABLE LOGIC CONTROLLERS AND ASSOCIATED EQUIPMENT

Existing OID at PLC-Z3R-01 is Allen Bradley PanelView Plus. Refer to Part 2 – Products of this specification for equipment details.

2. No erratic operation of any PLC output device shall be allowed during operation, start-up, shutdown, loss of power, or restoration of power.
3. Alarms generated at each area PLC shall be latched and logged in local PLC logic until simultaneously cleared and reset. All the alarms from local PLCs would also be transmitted to Water treatment Plant PLC (PLC-WTP-01) for central monitoring and logging at HMI PCs.

PLC-WTP-01 shall serve as a master alarm, data logging, monitoring and stations control hub for all PLCs. It shall log alarm and acknowledge status of all facility and radio networked PLCs in systematically organized groups as under;

- Current, non-latched, alarm status
- Latched alarm status from all PLCs
- Alarm enable/disable status written by HMI-PCs
- Current latched and enabled alarms, read by HMI-PCs for alarm annunciation, rebroadcast via SCADAAlarm, and transmitted for display on OIDs as described below.
- Current latched, enabled, and acknowledged alarms.

All new and existing alarms which are simultaneously latched and enabled shall be displayed at HMI-PCs and at all process area OIDs. Any new unacknowledged alarms shall initiate a “new alarm” audible alarm and remote notification by SCADAAlarm software on the HMI-PCs via TCP/IP communication network between all PLCs.

System-wide alarm acknowledge (including local PLC horn silence) shall be available from all ISS integrated OIDs as above, the HMI-PCs. Occurrence of any subsequent enabled alarm shall re-initiate the audible alarm and remote notification. Alarm acknowledge shall be broadcast to all HMI-PCs, PLCs, and OIDs for simultaneous, integrated functionality. The Operator shall not be required to acknowledge the same alarm on multiple devices.

Alarm reset functions shall be organized by PLC. Each PLC shall allow reset by its local OID and by an appropriately designated HMI reset pushbutton. Upon reset, the local PLC shall unlatch any latched alarm with cleared alarm condition.

4. Provide alarms as shown and as follows:

- a. Except as noted alarms shall be in PLC logic rather than in HMI configuration.
 - b. All analog inputs (AIs) shall have "analog signal failure alarm" for an out-of-range signal. For 4-20mADC AIs, failure alarm shall be for signal below 3.9mA or above 20.1mA.
 - c. All analog signals shall be provided with "high" and "low" alarms with setpoint Operator adjustable from HMI and appropriate OID (with password access). Provide "high-high" and/or "low-low" alarms with Operator adjustable setpoint as indicated or as requested by the Diablo Grande.
 - d. Each PLC shall monitor the availability of its controlled equipment. All command outputs shall be coordinated with sensing inputs and logic to determine whether the desired action actually occurred. For example: "Pump XXX-##-## Fail To Start," "Pump XXX-##-## Fail To Stop," "Valve XXX-##-## Fail To Open," "Valve XXX-##-## Fail To Close."
5. The ISS shall be responsible for incorporation of new facilities into existing PLC and HMI network integration as shown on drawings and shall provide:
- Organization of all PLC data addresses requiring network read or write into a minimum number of contiguous data files to optimize data communication efficiency.
 - Systematic and clearly documented organization and sequencing of data communication commands in PLC logic.
6. OIDs shall be programmed as shown and as required for complete local monitoring and control of the associated area. Simplified graphical representation of the process per the area P&ID diagram with active data display of analog data shall be provided. Systematically organized tabular display of all area status indications analog values and controls shall be provided, segmented into screens as required. Provide access for Operator adjustment of alarm threshold and PID setpoints with password protection. Provide alarm and event logging with time and date-stamp. Provide trend charts display of analog values scaled to display last 12 hours of operation.

1.02 QUALITY ASSURANCE

A. Reference Standards

NEMA ICS 1	<i>General Standards for Industrial Control and Systems</i>
NEMA ICS 1.1	<i>Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control</i>
NEMA ICS 3	<i>Industrial Systems</i>
NEMA/EIA 232-D	<i>Interface Between Data Terminal Equipment and Data Communications Equipment Employing Serial Binary Data Interchange</i>
ANSI/TIA/EIA-568-A	<i>Commercial Building Telecommunications Cabling Standard</i>
ANSI/TIA/EIA-568-B.1	<i>Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements</i>
ANSI/TIA/EIA-568-B.2	<i>Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components, 2001</i>

B. Qualifications

1. The Instrumentation System Supplier (ISS) per Section 16710, PROCESS INSTRUMENT AND CONTROL SYSTEMS shall perform all work necessary to connect, program, test, and place into operation a complete PLC system incorporating the new facilities as specified herein.
2. The ISS's technicians performing the programming and start-up of the PLC System shall have at least three years experience on similar projects. The technicians' full resumes shall be available upon request.

C. Software Submittals

1. All PLC software as described below shall be submitted for approval prior to PLC system testing and start-up.
 2. PLC programs shall be presented in ladder logic which shall be fully documented with all device codes and cross references, function
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descriptions, I/O codes, register addresses, etc. Adequate comments shall be provided to thoroughly explain the program functions. Inputs and outputs shall be tabulated with address number, I/O type, device description, and function description. All I/O and internal addresses shall be shown with address, type, contents, and description. Addresses read or written to by the HMI shall have address descriptions coordinated with HMI tagnames.

Ladder logic printout shall be carefully formatted to print one network per page showing register addresses, descriptions, and numerical content. Network titles and long comments shall be included. Landscape mode printing is recommended. Font size shall not be less than size 8.

3. During start-up all changes shall be carefully and completely documented with hard copy printout and revised program storage on compact disk (CD). The most current printout and CD shall remain on site at all times.

D. As-Built Drawings

All existing PLC wiring drawings, schematics, and I/O tabulation drawings shall be updated by the ISS to reflect the added facilities and transmitted to the Owner as AutoCAD .dwg files.

PART 2 – PRODUCTS (EXISTING FACILITIES – PROVIDED FOR REFERENCE ONLY)

2.01 GENERAL

The ISS shall furnish equipment which is of one manufacturer to the maximum possible extent. Where this is not practical, all equipment of a given type shall be the product of one manufacturer.

2.02 PLC COMPONENTS

- A. The PLCs shall be Allen Bradley with Series 1756 Control Logix CPU and I/O modules, and Series 1769 Compact Logix CPU and I/O modules.
- B. Components shall be as specified below.

2.03 PLC CPU AND COMMUNICATIONS MODULES

- A. For Control Logix, the PLC CPU shall be 1756-L62 (4 M bytes) or approved equal available at time of bid.

Each Control Logix rack shall be provided with an Ethernet communication module #1756-ENBT control net communication module #1756-CNB, where required as shown in the plans.

- B. For Compact Logix, the PLC CPU shall be #1769-L35 E with one built in Ethernet and one RS-232 serial port.

2.04 RACK AND POWER SUPPLY

A. Control Logix PLC Rack

The PLC CPU and I/O Modules shall be housed in 13 slot rack, Allen Bradley #1746-A13 as shown in the plans.

B. Control Logix PLC Power Supplies

Power supply shall be two redundant Allen Bradley #1756-PB75R with #1756-PSCA2 dual power supply adapter, for 24 VDC input power switchable for giving output power to PLC rack backplane.

C. Control Logix I/O

1756 Control Logix local I/O's would be added to rack slots, according to the I/O quantities required per site, as shown in the plans.

D. Compact Logix PLC Assembly

Compact Logix PLCs shall be assembled with adjacent, DIN-rail mounted, CPU, power supply and I/O Modules. CPU should be mounted on the left most of Power supply (1756-PB75R), while I/Os should be mounted on the right side of Power Supply.

The Compact Logix system must be mounted so that all modules are horizontal to each other. The DIN rails for all Compact Logix system components must be mounted on a common, conductive surface to ensure proper electromagnetic Interference (EMI) performance.

2.05 PLC INPUT OR OUTPUT (I/O) MODULES

A. General

1. All Control Logix I/O shall be rack mounted plug-in modules of a universal type. All Compact Logix I/O shall be DIN-rail mounted modules of a universal type.
2. All I/O internal circuits shall be electrically isolated from external circuits.
3. Each discrete input or output point shall have a visual indicator to display on/off status, and write-on labels for point identification adjacent to each indicator.
4. Each module type shall be keyed to prevent insertion in the wrong slot in the rack.

B. Module Types

1. Discrete Input (DI) Modules:

Discrete input (DI) modules-24 VDC

- Control Logix, Allen Bradley # 1756-IB32
- Compact Logix, Allen Bradley # 1769-IQ16
- On state + 12 VDC to +30 VDC @ 24 VDC
- Off state + 5 VDC max @ 24 VDC
- 10 VDC to 30 VDC input voltage
- Sink type connection

2. Discrete Output (DO) Modules:

Discrete Output (DO) Modules-24 VDC

- Control Logix, Allen Bradley # 1756-OB32
- Compact Logix, Allen Bradley # 1769-OB8
- 20-30 VDC source logic
- All motor starters, solenoid valves, or other loads shall be indirectly driven through auxiliary relays. Auxiliary relays (DOXs) shall be DPDT, 10A rated, standard square base plug-in relays with indicating light to facilitate troubleshooting. Relays shall be Allen Bradley Model 700 HB 32Z24-1 or equal.

3. Analog Input Modules:

Analog Input (AI) Modules Voltage/Current

- Control Logix, Allen Bradley # 1756-IF8
- Compact Logix, Allen Bradley # 1769-IF4
- ± 10 VDC / ± 20 mADC / 4-20 mADC input
- 16 bit resolution (14 bit Compact Logix)
- $\pm 0.05\%$ full scale recovery
- Configure for 4-20 mADC or 1-5VDC input as shown.

4. Analog Output Modules:

- Control Logix, Allen Bradley # 1756-OF8
- Compact Logix, Allen Bradley # 1769-OF4CI
- 4-20 mADC output
- 15 bits resolution
- Configure for 4-20 mADC output

2.06 PLC COMMUNICATION AND CABLES

- A. All PLC power supply, communication, and interconnect cables shall be the PLC manufacturer's standard cables and shall be furnished by the ISS.

Ethernet cables for inside-panel interconnection shall be factory assembled shielded cables.

Control Net cable shall be Quad Shield high flex coax cable, Allen Bradley # 1786-RG6F and connected via T-tap connectors Allen Bradley #1786-TPR, installed per manufacturer's requirements. Detailed connection diagrams shall be provided.

- B. Local control panel Ethernet switches shall be provided at each panel. Ethernet switches shall be Hirschmann # RS2-5TX or other appropriate Hirschmann model, when additional ports are required.

2.07 SOFTWARE

- A. PLC programming software shall be RS Logix 5000 Professional Edition. Furnish to the Diablo Grande for their use with full user license. ISS shall install this software on a Laptop, and will provide to Diablo Grande. The software license shall permit the user to access the full features of the software to configure the Ethernet/Control Net Communication, modifying, uploading and downloading the ladder logic configuration to Compact Logix and Control Logix PLCs.

The programming software shall also include one-year technical support contract which shall be initiated only after the ISS provided training.

- B. HMI Programming software for local operator interface terminal (Panel View Plus 700 Keypad) and HMI PCs shall be RS View Studio Machine Edition, For HMI PCs located at Water Treatment Plant central control room, RS View Runtime Machine Edition would also be provided for two PCs with 1500 tags and 70 displays.

Complete configuration software and documentation shall be supplied to Diablo Grande upon start-up, and installed on HMI-PCs.

2.08 PLC OPERATOR INTERFACE DEVICE (OID)

Local operator interface device shall be Allen Bradley Panel View plus 700 Keypad, (#2711P-K7C4D1). Furnish and install properly configured and documented. Ethernet port connection of OID to PLC Ethernet port would be via network switch.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. PLC AI and AO modules shall be connected with #18 shielded twisted pair, Belden #8760 or approved equal.
- B. 24VDC control, analog signal, and communication wiring shall be carefully segregated from 120VAC power wiring. Cross low voltage and AC power wiring at right angles only as necessary.

3.02 START-UP TESTING

The ISS shall perform thorough start-up testing in close co-ordination with Diablo Grande Construction Manager. The designated ISS Commissioning Engineer shall be responsible for submittal of test procedures, test scheduling and coordination, and documentation and submittal of test results. Start-up tests shall include:

- A. Point-to-point wire checking of all PLC I/O circuits.
- B. Verification of proper functioning of all analog I/O loops. Verify proper scaling in PLC registers and proper display on OIDs and HMI-PCs. Verify "signal out of range" and all "high" and/or "low" alarms.

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PROGRAMMABLE LOGIC CONTROLLERS AND ASSOCIATED EQUIPMENT

- C. Schedule and perform demonstration testing of all I/O to be witnessed by designated Owner or Construction Manager Inspector.
- D. Check program for proper logic, I/O and internal register address assignments, and timer, counter, and setpoint values.
- E. Provide test procedures, scheduling, and coordination of operational tests to demonstrate for each subsystem complete operability to be witnessed by designated Owner or Construction Manager inspector for certification of system "substantially complete" and initiation of in-service commissioning period. Demonstration shall include operability of OI and HMI interfaces.
- F. All PLC and OI program modifications shall be documented thoroughly and immediately. Back-up copies on disc shall be made promptly. Printout of final OI screens and PLC ladder logic shall be submitted.

****END OF SECTION****

SECTION 16850

HMI MONITORING AND CONTROL SYSTEM

PART 1 – GENERAL

1.01 DESCRIPTION

A. Work Included

The Instrumentation System Supplier (ISS) per Section 16710, PROCESS INSTRUMENTATION AND CONTROL SYSTEMS, shall furnish field investigation of existing facilities, engineering and technical expertise as required for complete integration of new facilities into the existing HMI system for proper control, data storage, and communications. Control logic shall be generally as described herein and as shown but shall be adjusted by the ISS as required for safe and satisfactory automatic and HMI supervised operation.

The ISS shall completely coordinate his work with the work of all other trades.

The complete, proven, and thoroughly documented system shall meet the highest standards for this type of service.

B. Description of System

1. The ISS shall develop screens, charts, and trends for existing HMI and Data Historian to incorporate new facilities into the existing SCADA architecture.

The ISS shall prepare graphical screens for new facilities to show all monitored process parameters and equipment status. All screens shall conform to the look, feel, symbology and color convention of existing facility screens.

2. The existing HMI system is centered upon two independent PCs, HMI-PC-1 for process operator and HMI-PC-2 for process manager/supervisor. HMI-PC-1 and -2 primary function is graphical display, monitoring, and control functions provided by RSVIEW Supervisory edition HMI software.
3. Existing HMI-PC-1 and -2, trend chart screens show trends for all analogue points and are arranged to display not more than 6 pens per chart. All new trend chart labels shall indicate tag name and engineering units of vertical scale.

Scan time for process variables trending shall be the minimum possible, and under no conditions shall be more than 5 seconds.

4. Existing HMI-PC-1 and -2 are fully independent. Each communicates independently with Master PLC for data acquisition from all other sites, maintaining its own tag data, event, and alarm logs.
5. Existing HMI-PC-1 and -2 each independently run RSView Supervisory Edition (SE) Server with RS linx enterprise and RSView SE Client software packages for graphical monitoring of all process variables, trends acquisition, data logging, notification of alarms for entire facility. Alarm notification and acknowledge functionality are as described in Section 16800, PROGRAMMABLE LOGIC CONTROLLERS AND ASSOCIATED EQUIPMENT.
6. Existing OIDs (Panel View Plus) at all remote sites run RSView Machine Edition (ME) software package for graphical monitoring of all process variables, trends acquisition, data logging, notification of alarms for entire facility. Alarm notification and acknowledge functionality are as described in Section 16800, PROGRAMMABLE LOGIC CONTROLLERS AND ASSOCIATED EQUIPMENT.
7. Existing Historical Database Server Computer has "RS Bizware" Historian Server & RS Bizware client software, and Windows XP Server, and maintains one database for the data accumulated from the Master PLC.

The Historical Database Server configuration incorporates all analog data, all alarms, and critical events which are logged by "RS Bizware" Historian Server.

Viewing of historical data and report generation is available with RS Bizware client software on this computer. The ISS shall coordinate with the end user for configuring the new display screens and production reports with the new chart displays.

8. The ISS shall make necessary modifications to the configuration of standard report templates with links to data stored in the Historian database required to incorporate the new facilities. Details of report organization and format shall be implemented by the ISS as approved and coordinated with the customer. All reports shall be thoroughly annotated to clearly describe the displayed variable with description and engineering units, as well as the time and date reference. As a minimum, reports shall be prepared by the ISS as follows:

- Tabulate data called from the Historian database. Daily reports shall calculate and display hourly averages. Weekly and monthly reports summaries shall tabulate daily averages calculated from the above hourly averages. Annual spreadsheet summaries shall tabulate weekly averages calculated from the above daily averages. Spreadsheet summaries shall include print-out in both tabular spreadsheet format and as a line graph.
- Totalization summaries shall integrate and/or sum data from the Historian database for presentation of totalized values. Daily summaries shall integrate instantaneous data records over the 24 hour period. Weekly, monthly, and annual summaries shall sum the above daily values. Totalization summaries shall be prepared for flows monitored by all facility flow meters.

1.02 QUALITY ASSURANCE

A. Qualifications

1. The ISS' technicians performing the programming and start-up of the HMI System shall have at least three years experience on similar projects. The technicians' full resumes shall be available upon request.

B. Software Submittals

1. Each HMI software submittals shall include two paper printouts and two copies of the program files on CD-R disk. Each major program revision shall be carefully indicated by incrementing a letter appended to the program file name. For example: "HMI-DG _g" shall indicate the program file for the HMI-PC's, version 'g.'
2. HMI program printouts shall include printouts of the screens and tag cross-reference database.

C. Software Back-up

During start-up and commissioning, all application programming or configuration changes shall be regularly backed up on CD-R disk. One copy of the most current file version back-up shall remain on site at all times and the other back-up copy shall be carefully stored by the ISS off the job site. The ISS shall be responsible for recovery from any file corruption or deletion, disk drive failure, back-up media loss, or other PC failure at no extra cost to the Owner.

D. As-Builts

All software submittals described above shall be corrected to the final as-built state of the equipment and delivered to the Construction Manager prior to final acceptance of the work.

PART 2 – (NOT USED)

PART 3 - EXECUTION

3.01 INSTALLATION

- A. This work shall be coordinated with that of all other trades.
- B. The ISS shall be responsible for coordinating the equipment, performing the installation and start-up in a timely manner, and assuring a fully operable and function tested system.

3.02 START-UP TESTING

The ISS shall perform thorough start-up testing in close co-ordination with the customer. Start-up tests shall include:

- A. Verification of proper addressing and tag referencing, by rigorous function testing of all analog and discrete input points and alarm functions from the PLC through to the HMI display and data logs.
- B. All program modifications shall be documented thoroughly and immediately. Back-up copies on disc shall be made promptly.

END OF SECTION

EETS:

DIVISION 16- ELECTRICAL AND CONTROLS

16110 CONDUIT, RACEWAYS, FITTINGS AND SUPPORTS

16120 WIRE AND CABLE - 600 VOLT AND BELOW

16700 CONTROL PANELS

16710 PROCESS INSTRUMENT AND CONTROL SYSTEMS

16800 PROGRAMMABLE LOGIC CONTROLLERS AND ASSOCIATED
EQUIPMENT

16850 HMI MONITORING AND CONTROL SYSTEM

SECTION 311100
CLEARING, STRIPPING, and GRUBBING

PART I - GENERAL

A. Description

This section describes the work included in clearing, stripping, grubbing, and preparing the project site for construction operations.

B. Related Work Specified Elsewhere

1. Existing Conditions: General Provisions and Section 013300
2. Protecting Existing Underground Utilities: 020120.
3. Earthwork: 312300.
4. Trenching, Backfilling, and Compacting: 312316.
5. Western Hills Water District Standard Drawings and Specifications

C. Clearing

Remove and dispose of trees, snags, stumps, shrubs, brush, limbs, sticks, branches, and other vegetative growth. Remove rocks, tiles, and lumps of concrete. Remove all evidence of their presence from the surface. Remove and dispose of trash piles, and rubbish. Protect structures and piping above and below ground, trees, shrubs, and vegetative growth which are not designated for removal.

D. Stripping

1. Remove and dispose of organic sod, topsoil to a depth of 3 inches, grass and grass roots, and other objectionable material remaining after clearing from the areas designated to be stripped.

E. Grubbing

After clearing and stripping, remove and dispose of wood or root matter, including stumps, logs, trunks, roots, or root systems greater than 1 inch in diameter or thickness to a depth of 12 inches below the ground surface.

PART 2 - MATERIALS

A. Trees and Shrubbery

Existing trees, shrubbery, and other vegetative material may not be shown in the drawings. Inspect the site as to the nature, location, size, and extent of vegetative material to be removed or preserved, as specified herein.

B. Preservation of Trees, Shrubs, and Other Plant Material

1. Save and protect plant materials (trees, shrubbery, and plants) beyond the limits of clearing and grubbing from damage resulting from the work. No filling, excavating, trenching, or stockpiling of materials will be permitted within the drip line of these plant materials. The drip line is defined as a circle drawn by extending a line vertically to the ground from the outermost branches of a plant or group of plants. To prevent soil compaction within the drip line area, no equipment will be permitted within this area.
2. Cut and remove tree branches where necessary for construction. Remove branches other than those required for a balanced appearance of any tree. Treat cuts with a tree sealant.

PART 3 - EXECUTION

A. Clearing, Stripping, and Grubbing Areas and Limits

1. Clear, strip, and grub excavation and embankment areas associated with new structures, slabs, walks, and roadways.
2. Clear and strip stockpile areas.
3. Limits of clearing, stripping, and grubbing:
 - a. Excavation, Excluding Trenches: 5 feet beyond tops of cut slopes.
 - b. Trench excavation for piping and electrical conduits: 3 feet from edge of trench.
 - c. Earth Fill: 5 feet beyond toe of permanent fill as indicated in the drawings.
 - d. Structures: 15 feet beyond footings.

B. Disposal of Clearing and Grubbing Debris

Do not burn combustible materials. Remove cleared and grubbed material from the worksite and dispose.

C. Disposal of Strippings

Remove stripped material and dispose offsite, except topsoil.

END OF SECTION

SECTION 312300
EARTHWORK

PART 1 - GENERAL

A. Description

This section includes materials, testing, and installation of earthwork for excavations, and fills for structures, and sites.

B. Related Work Specified Elsewhere

1. Existing Conditions: General Provisions.
2. Protecting Existing Underground Utilities: 020120.
3. General Concrete Construction: 030500.
4. Clearing, Stripping, and Grubbing: 311100.
5. Trenching, Backfilling, and Compacting: 312316.
6. Gravel and Crushed Rock Base for Structures: 312323.
7. Western Hills Water District Standard Drawings and Specifications

C. Testing for Compaction

1. The Owner shall retain a certified materials testing laboratory and pay for the testing for compaction and relative density as described below.
2. Determine the density of soil in place by the sand cone method, ASTM D1556 or by nuclear methods, ASTM D6938. Compaction tests will be performed for each lift or layer. If nuclear methods are used for in-place density determination, verify the accuracy with one sand cone, and one maximum laboratory dry density, for every five nuclear tests taken if the backfill material is processed fill or visually consistent. More sand cones and densities will be required if the backfill material is visually variable. The minimum depth for the sand cone test hole shall be 12 inches. The minimum size shall be 8 inches, and size 16/30 or 10/20 silica sand shall be used.
3. Determine laboratory moisture-density relations of soils per ASTM D1557. If nuclear methods are used for in-place density determination, the compaction test results for maximum dry density and optimum water content shall be adjusted in accordance with ASTM D4718. This will be required for determination of percent relative compaction and moisture variation from optimum.
4. Determine the relative density of cohesionless soils per ASTM D4253 and D4254.

5. Sample materials per ASTM D75.

6. "Relative compaction" is the ratio, expressed as a percentage, of the in-place dry density to the laboratory maximum dry density.

7. Compaction shall be deemed to comply with the specifications when no more than one test of any three consecutive tests falls below the specified relative compaction. The one test shall be no more than three percentage points below the specified compaction. The Contractor shall pay the costs of any retesting of work not conforming to the specifications.

D. Disposal of Excess Materials

Excess site excavated or wasted material shall be disposed of offsite by the Contractor at his expense. No prearranged disposal site or related permits have been determined or secured by the Owner.

E. Material Availability

Obtain backfill material from onsite or offsite borrow areas as designated in the drawings.

F. Measurement and Payment

Payment for all the work in this section, exclusive of authorized overexcavation and fill and surcharge fill, shall be included as part of the lump-sum bid amount stated in the Proposal but not be paid as a separate item but shall be included in other bid items that include this work.

G. Measurement and Payment for Authorized Overexcavation

Measurement of the volume of material for payment of authorized overexcavation will be made by taking cross sections after excavation and calculating the volume using the average end area method. The Owner will measure and calculate the volume. The volume for payment will be the gross volume, up to the elevation of the finished earthwork subgrade. A change order will be made as described in the General Provisions based upon a unit price according to actual time and material volume of earthwork. No payment will be made for unauthorized excavated and fill material exceeding the contract lines and grades.

PART 2 - MATERIALS

A. Structural Fill

Structural fill is material that is to be placed beneath structures to the limits indicated in the drawings. Material shall be excavated material that is free from organic matter, roots, debris, and rocks larger than 3 inches in the greatest dimension.

B. Structural Backfill

C. Structural Backfill

1. Structural backfill is material that is to be placed adjacent to and around piping and structures.
2. Material shall be free from deleterious material and shall have a minimum sand equivalent greater than 30 per ASTM D2419 have the following gradation:

Sieve Size	Percent Passing By Weight
3/4 inch	100
1/2 inch	95 to 100
3/8 inch	50 to 100
No. 4	20 to 65
No. 8	10 to 40
No. 40	0 to 20
No. 200	0 to 5

3. Excavated onsite material may be used for structural backfill provided it conforms to the above specifications for structural backfill material

D. Fill

Fill material is material that is to be placed in locations that are not to be constructed as structural fill or structural backfill. Fill material shall be same as structural backfill.

E. Sand, Including Imported Sand for Pipe Zone and Pipe Base in Pipe Trenches

1. Granular material free from clay balls, organic matter, and other deleterious substances and conforming to the following gradations:

Sieve Size	Percent Passing By Weight
3/8 inch	100
No. 4	75 to 100
No. 30	12 to 50
No. 100	5 to 20
No. 200	0 to 10

2. Sand shall have a coefficient of permeability greater than 0.014 cm/s measured in accordance with ASTM D2434 or a minimum sand equivalent of 30 per ASTM D2419.

F. Sand-Cement Slurry Backfill

Sand-cement slurry backfill shall consist of one sack (94 pounds) of Type I or II portland cement added per cubic yard of imported sand and sufficient water for workability.

G. Water for Compaction

Water shall be free of organic materials and shall have a pH of 7.0 to 9.0, a maximum chloride concentration of 500 mg/L, and a maximum sulfate concentration of 500 mg/L. Provide all water needed for earthwork. Provide temporary piping and valves to convey water from the source to the point of use.

PART 3 - EXECUTION

A. Dewatering

Provide and operate equipment adequate to keep excavations and trenches free of water. Remove water during period when concrete is being deposited, when pipe is being laid, and during the placing of backfill. Avoid settlement or damage to adjacent property. Dispose of water in a manner that will not damage adjacent property. When dewatering open excavations, dewater from outside the structural limits and from a point below the bottom of the excavation..

B. Excavation

1. Excavations shall have sloping, sheeting, shoring, and bracing conforming with 29CFR1926 Subpart P-Excavations, CAL/OSHA requirements, and the General Provisions.
2. Excavation is unclassified. Perform excavation regardless of the type, nature, or condition of the material encountered to accomplish the construction. Do not operate excavation equipment within 5 feet of existing structures or newly completed construction. Excavate with hand tools in these areas.
3. After the required excavation has been completed, the Owner will observe the exposed subgrade to determine the need for any additional excavation. It is the intent that additional excavation is to be conducted in all areas within the influence of the structure where unacceptable subgrade materials exist at the exposed subgrade. Overexcavation shall include the removal of all such unacceptable material that exists directly beneath the structure or within a zone outside and below the structure defined by a line sloping at 1-horizontal to 1-vertical from 1 foot outside the edge of the footing. Refill the overexcavated areas with structural backfill material.
4. The Contractor will not receive any additional payment for refill material used for his convenience.

C. Limits of Foundation Excavation

Excavate to the depths and widths needed to accomplish the construction. Allow for forms, working space, structural backfill, and site grading. Do not excavate for footings, slabs, or conduits below elevations indicated. Unless unacceptable material is encountered and overexcavation is authorized by the Owner, backfill overexcavations with compacted structural backfill material. Correct cuts below grade by trimming adjoining areas and creating a smooth transition. The Contractor shall bear all costs for correcting unauthorized overexcavated areas.

D. Preparation of Foundation Subgrade

1. The finished subgrade shall be within a tolerance of ± 0.08 of a foot of the grade and cross section indicated, shall be smooth and free from irregularities, and shall be at the specified relative compaction. The subgrade shall extend over the full width and extend 1 foot beyond the edge of the foundations.
2. Compact the top 12 inches of the subgrade to 95% relative compaction. Recomposition will not be required if rock is exposed at final subgrade.
3. Remove soft material encountered and replace with structural backfill. Fill holes and depressions to the required line, grade, and cross sections with structural backfill.
4. If rock is encountered at final grade, overexcavate to a depth of 6 inches and place structural backfill to establish final grade.

E. Preparation for Placing Fill or Backfill

1. After excavation of existing material or removal of unacceptable material at the exposed subgrade, scarify the final subgrade surface to a depth of 12 inches and compact to 95% relative compaction.
2. Remove foreign materials and trash from the excavation before placing any fill material. Obtain the specified compressive strength and finish of concrete work per Sections 030500 before backfilling.

F. Placing and Compacting Fill and Structural Fill

1. Excavated material may be used for fill and structural fill providing all deleterious materials have been removed from the stockpiled material.
2. Place in maximum 8-inch lifts and compact each lift to 95% relative compaction.
3. Where fill is to be constructed on slopes steeper than 3:1, bench the fill into competent undisturbed materials as the fill progresses up the slope. Benches shall be sloped at least 2% into the slope and shall be of a width at least equal to the height of fill lift.

G. Placing and Compacting Structural Backfill

1. Place structural backfill material around piping, structures, channels, and other areas, including authorized overexcavation areas, to the lines and grades shown or specified. Do not exceed loose lifts of 8 inches.
2. Limits of Structural Backfill: Limits of structural backfill shall be 1.0 feet from edge of footing and shall extend at a 1:1 slope to the finish grade.
3. Compact each lift to 95% relative compaction, unless otherwise shown in the drawings. Stop structural backfill at least 6 inches below finished grade in all areas where topsoil is to be placed.
4. Backfill around concrete structures as specified in Section 030500.
5. Do not operate earthmoving equipment within 5 feet of walls of concrete structures. Place and compact backfill adjacent to concrete walls with hand-operated tampers or other equipment that will not damage the structure.

H. Moisture Control

During the compacting operations, maintain optimum practicable moisture content required for compaction purposes in each lift of the material. Maintain uniform moisture content throughout the lift. Insofar as practicable, add water to the material at the site of excavation. Supplement by sprinkling the material. At the time of compaction, the water content of the material shall be at optimum water content or within 2 percentage points above optimum. Aerate material containing excessive moisture by blading, discing, or harrowing to hasten the drying process.

I. Site Grading

Perform earthwork to the lines and grades shown in the drawings. Shape, trim, and finish slopes of channels to conform to the lines, grades, and cross sections as shown. Remove exposed roots and loose rocks exceeding 3 inches in diameter. Round tops of banks to circular curves of not less than a 6-foot radius. Neatly and smoothly trim rounded surfaces. Do not overexcavate and backfill to achieve the proper grade.

SECTION 312316
TRENCHING, BACKFILLING, AND COMPACTING

PART 1 - GENERAL

A. Description

This section includes materials, testing, and installation for pipeline and ductbank trench excavation, backfilling, and compacting.

B. Related Work Specified Elsewhere

1. Existing Conditions: General Provisions.
2. Protecting Existing Underground Utilities: 020120.
3. General Concrete Construction: 030500.
4. Clearing, Stripping, and Grubbing: 311100.
5. Earthwork: 312300.
6. Asphalt Concrete Paving (California): 321216.
7. Pressure Testing of Piping: 400515.
8. Equipment, Piping Duct, and Valve Identification: 400775.
9. Western Hills Water District Standard Drawings and Specifications

C. Testing for Compaction

1. The Contractor shall test for compaction as described in Section 312300. Provide a minimum of three compaction tests at trench backfill as selected by the Owner's Representative.

D. Pavement Zone

The pavement zone includes the asphalt concrete and aggregate base pavement section placed over the trench backfill.

E. Street Zone

The street zone is the top 30 inches of the trench immediately below the pavement zone in paved areas. Where the depth of cover over the pipe does not permit the full specified thickness of the street zone, construct a thinner street zone, extending from the top of the pipe zone to the bottom of the pavement zone.

F. Trench Zone

The trench zone includes the portion of the trench from the top of the pipe zone to the bottom of the street zone in paved areas or to the existing surface in unpaved areas. If the resulting trench zone is less than 24 inches thick, the street zone shall extend to the top of the pipe zone and there shall be no separate trench zone.

G. Pipe Zone

The pipe zone shall include the full width of trench from the bottom of the pipe or conduit to a horizontal level above the top of the pipe, as specified below. Where multiple pipes or conduits are placed in the same trench, the pipe zone shall extend from the bottom of the lowest pipe to a horizontal level above the top of the highest or topmost pipe. Thickness of pipe zone above the highest top of pipe shall be as follows unless otherwise shown in the drawings or otherwise described in the specifications for the particular type of pipe installed.

Pipe Diameter	Thickness of Pipe Zone Above Top of Pipe
6 inches or smaller	6 inches
8 inches and larger	10 inches

H. Pipe Base or Bedding

The pipe base or bedding shall be defined as a layer of material immediately below the bottom of the pipe or conduit and extending over the full trench width in which the pipe is bedded. Thickness of pipe base shall be as follows unless otherwise shown in the drawings or otherwise described in the specifications for the particular type of pipe installed.

Pipe Diameter	Thickness of Pipe Base
Smaller than 4 inches	3 inches
4 inches through 16 inches	4 inches
18 inches and larger	6 inches

PART 2 - MATERIALS

A. Granular Material for Backfill--Street and Trench Zones

Granular material or granular soil for backfill used above the pipe zone shall be lean bank-run or pit-run gravel, or native soil. The maximum particle size shall be 2 inches. A maximum of 10% shall pass a No. 200 sieve.

B. Native Earth Backfill--Street and Trench Zones

1. Native earth backfill used above the pipe zone shall be excavated fine-grained materials free from roots, debris, rocks larger than 3 inches, asbestos, organic matter, clods, clay balls, broken pavement, and other deleterious materials. Less than 50% shall pass a No. 200 sieve. At least 40% shall pass a No. 4 sieve. The coarser materials shall be well distributed throughout the finer material.

C. Imported Sand--Pipe Zone and Pipe Base

1. See Section 312300.

D. Gravel and Crushed Rock--Pipe Zone and Pipe Base

1. Gravel or crushed rock material shall contain less than 1% asbestos by weight or volume and conform to the Standard Specifications for Public Works Construction, Section 200-1.2. and shall meet the following gradation:

Sieve Sizes	Designated Gravel Size			
	1-1/2-Inch	1-Inch	3/4-Inch	3/8-Inch
	Percent Passing	Percent Passing	Percent Passing	Percent Passing
2 inches	100	-	-	-
1 1/2 inches	90 to 100	100	-	-
1 inch	20 to 55	90 to 100	100	-
3/4 inch	0 to 15	30 to 60	90 to 100	-
1/2 inch	-	0 to 20	30 to 60	100
3/8 inch	0 to 5	-	0 to 20	90 to 100
No. 4	-	0 to 5	0 to 5	30 to 60
No. 8	-	-	-	0 to 10

E. Sand-Cement Slurry Backfill--Pipe Zone

Sand-cement slurry backfill shall consist of one sack (94 pounds) of Type I or II portland cement added per cubic yard of imported sand and sufficient water for workability.

F. Concrete for Pipe Encasement and Thrust Blocks

1. Concrete for unreinforced pipe encasement and thrust blocks shall be Class C per Section 030500 unless otherwise shown in the drawings.
2. Provide thrust blocks at fittings in pipe having rubber gasket bell-and-spigot or unrestrained mechanical joints. Do not provide thrust blocks for steel pipe having welded,

flanged, or butt-strap joints unless detailed in the drawings or required in the detailed piping specification.

3. See the details in the drawings for thrust block sizes. Install thrust blocks based on the test pressures given in Section 400515. Size thrust blocks in accordance with the following table:

Pipe Test Pressure (psi)	Use Thrust Block Sizing for
0 to 25	25 psi
26 to 50	50 psi
51 to 100	100 psi
101 to 150	150 psi
151 to 200	200 psi

G. Water for Compaction

See Section 312300. Water shall be free of organic materials injurious to the pipe coatings.

H. Underground Plastic Warning Tape for Metal Pipe

See Section 400775.

I. Underground Detectable Metallic Pipe Warning Tape

See Section 400775.

PART 3 - EXECUTION

A. Sloping, Sheeting, Shoring, and Bracing of Trenches

Trenches shall have sloping, sheeting, shoring, and bracing conforming with 29CFR1926, Subpart P--Excavations, CAL/OSHA requirements, and the General Provisions.

B. Trench Excavation

1. Excavate the trench to the lines and grades shown in the drawings with allowance for pipe thickness, sheeting and shoring if used, and for pipe base or special bedding. If the trench is excavated below the required grade, refill any part of the trench excavated below the grade at no additional cost to the Owner with granular material or imported sand. Place the refilling material over the full width of trench in compacted layers not exceeding 6 inches deep to the established grade with allowance for the pipe base or special bedding.
2. Trench widths in the pipe zone shall be as shown in the drawings. If no details are shown, maximum width shall be 18 inches greater than the pipe outside diameter. Comply with

29CFR Part 1926 Subpart P--Excavations. Trench width at the top of the trench will not be limited except where width of excavation would undercut adjacent structures and footings. In such case, width of trench shall be such that there is at least 2 feet between the top edge of the trench and the structure or footing.

C. Location of Excavated Material

1. During trench excavation, place the excavated material only within the working area. Do not obstruct any roadways or streets. Do not place trench spoil over pipe, buried utilities, manholes, or vaults. Conform to federal, state, and local codes governing the safe loading of trenches with excavated material.

D. Dewatering

Provide and maintain means and devices to remove and dispose of water entering the trench excavation during the time the trench is being prepared for the pipelaying, during the laying of the pipe, and until the backfill at the pipe zone has been completed. These provisions shall apply during both working and nonworking hours, including lunch time, evenings, weekends, and holidays. Dispose of the water in a manner to prevent damage to adjacent property and in accordance with regulatory agency requirements. Do not drain trench water through the pipeline under construction. Do not allow groundwater to rise around the pipe until jointing compound has set hard.

E. Foundation Stabilization

1. After the required excavation has been completed, the Owner will inspect the exposed subgrade to determine the need for any additional excavation. It is the intent that additional excavation be conducted in all areas within the influence of the pipeline where unacceptable materials exist at the exposed subgrade. Overexcavation shall include the removal of all such unacceptable material that exist directly beneath the pipeline to a width 24 inches greater than the pipe outside diameter and to the depth required.
2. Place filter fabric on the bottom of the trench and up the sides a sufficient height to retain rock refill material. Backfill the trench to subgrade of pipe base with rock refill material for foundation stabilization. Place the foundation stabilization material over the full width of the trench and compact in layers not exceeding 6 inches deep to the required grade. Foundation stabilization work shall be executed in accordance with a change order.
3. Rock refill used by the Contractor for his convenience will not be cause for any additional payment.

F. Installing Buried Piping

1. Grade the bottom of the trench to the line and grade to which the pipe is to be laid, with allowance for pipe thickness. Remove hard spots that would prevent a uniform thickness of bedding. Place the specified thickness of pipe base material over the full width of trench. Grade the top of the pipe base ahead of the pipelaying to provide firm, continuous, uniform support along the full length of pipe, and compact to the relative compaction specified

herein. Before laying each section of the pipe, check the grade and correct any irregularities.

2. Excavate bell holes at each joint to permit proper assembly and inspection of the entire joint. Fill the area excavated for the joints with the bedding material specified or indicated in the drawings for use in the pipe zone. If no bedding material is specified or indicated, use imported sand.
3. Inspect each pipe and fitting before lowering the buried pipe or fitting into the trench. Inspect the interior and exterior protective coatings. Patch damaged areas in the field with material recommended by the protective coating manufacturer. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after installation.
4. Handle pipe in such a manner as to avoid damage to the pipe. Do not drop or dump pipe into trenches under any circumstances.
5. When installing pipe, do not deviate more than 1 inch from line or 1/4 inch from grade. Measure elevation at the pipe center line and/or invert.
6. After pipe has been bedded, place pipe zone material simultaneously on both sides of the pipe, in maximum 6-inch lifts, keeping the level of backfill the same on each side. If no pipe zone material is specified or indicated, use imported sand. Carefully place the material around the pipe so that the pipe barrel is completely supported and no voids or uncompacted areas are left beneath the pipe. Use particular care in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling.
7. Compact each lift to the relative compaction specified herein.
8. Push the backfill material carefully onto the backfill previously placed in the pipe zone. If no backfill material is otherwise specified or indicated, use granular material for backfill. Do not permit free-fall of the material until at least 2 feet of cover is provided over the top of the pipe. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe. Do not operate heavy equipment or a sheepsfoot wheel mounted on a backhoe over the pipe until at least 3 feet or one-half of the internal diameter, whichever is greater, of backfill has been placed and compacted over the pipe.
9. When the pipelaying is not in progress, including the noon hours, close the open ends of pipe. Do not allow trench water, animals, or foreign material to enter the pipe.
10. Keep the trench dry until the pipelaying and jointing are completed.

G. Backfill Compaction

1. Unless otherwise shown in the drawings or otherwise described in the specifications for the particular type of pipe installed, relative compaction in pipe trenches shall be as follows:
 - a. Pipe Zone: 90% relative compaction.

- b. Backfill in Trench Zone Not Beneath Paving: 90% relative compaction.
 - c. Backfill in Trench Zone to Street Zone in Paved Areas: 90% relative compaction.
 - d. Backfill in Street Zone in Paved Areas: 95% relative compaction.
2. Compact trench backfill to the specified relative compaction. Compact by using mechanical compaction or hand tamping. Do not use high-impact hammer-type equipment except where the pipe manufacturer warrants in writing that such use will not damage the pipe.
 3. Compact material placed within 12 inches of the outer surface of the pipe by hand tamping only.
 4. Do not use any axle-driven or tractor-drawn compaction equipment within 5 feet of building walls, foundations, and other structures.

H. Material Replacement

Remove and replace any trenching and backfilling material that does not meet the specifications, at the Contractor's expense.

SECTION 312323
GRAVEL AND CRUSHED ROCK BASE FOR STRUCTURES

PART 1 - GENERAL

A. Description

This includes materials, testing, and installation of gravel and crushed rock bases for structures such as manholes and vaults.

B. Related Work Specified Elsewhere

1. General Concrete Construction: 030500.
2. Earthwork: 312300.
3. Western Hills Water District Standard Drawings and Specifications.

C. Testing for Compaction

1. The Owner will test for compaction or relative density as described in Section 312300.

PART 2 - MATERIALS

A. Crushed Rock and Gravel

1. Crushed rock base and gravel are defined as natural or crushed rock, free from organic matter and containing less than 1% asbestos by weight or volume, and meeting the following gradation:

Sieve Size	Percent Passing By Weight
1 1/2 inches	100
3/4 inch	90 to 100
No. 4	35 to 55
No. 30	10 to 30
No. 200	0 to 5

2. Durability Index shall be at least 40 per ASTM D3744.

B. Crushed Rock

Crushed rock base shall conform to ASTM C33, coarse aggregate, size number 57. Durability Index shall be at least 40 per ASTM D3744.

PART 3 - EXECUTION

A. Placement of Crushed Rock or Gravel

1. Place crushed rock or gravel base beneath structures where shown in the drawings, 12 inches thick unless otherwise indicated. Excavate below the required grade for the bottom of the structure and refill with crushed rock or gravel as specified above. The rock base shall extend a minimum of 12 inches beyond the structure base, floor slab, or footing.
2. Compact base as follows unless otherwise indicated:
 - a. Lower Lift: 80% relative density.
 - b. Upper Lifts: 85% relative density.
3. Place base material in maximum lifts of 8 inches.

END OF SECTION

SECTION 321216
ASPHALT CONCRETE PAVING (CALIFORNIA)

PART 1 - GENERAL

A. Description

This section includes materials, testing, and installation of asphalt concrete pavement, aggregate base course, herbicide, prime coat, tack coat, and seal coat.

B. Related Work Specified Elsewhere

1. Earthwork: 312300.
2. Western Hills Water District Standard Drawings and Specifications

C. Testing for Compaction

1. The Owner will test for compaction as described in Section 312300.

D. Standard Specifications

Wherever reference is made to the State Specifications such reference shall mean the State of California, Business, Transportation, and Housing Agency, Department of Transportation Standard Specifications, latest edition.

E. Measurement and Payment

1. Include allowances for pavement removal in the lump sum or unit prices bid for the work. No extra compensation will be made should the existing pavement sections vary from the conditions as listed or described.

PART 2 - MATERIALS

A. Asphalt Concrete Paving

Asphalt concrete paving shall conform to Type A or B in Section 39 of the State Specifications, having 12.5-mm-maximum medium grading.

B. Aggregate Base Course

Aggregate base shall be Class 2 aggregate base, 19-mm-maximum size per Section 26 of the State Specifications. Aggregate shall contain less than 1% asbestos by weight or volume.

C. Prime Coat

All areas to be paved shall receive prime coat. Prime coat shall be per Section 39-4.02 in the State Specifications.

D. Tack Coat

Tack coat shall conform with Section 94, in the State Specifications and shall be AR1000 paving asphalt.

E. Asphalt

Asphalt shall be Performance Grade PG 64-10 per Section 92 in the State Specifications.

F. Aggregate for Asphalt Concrete

Aggregate shall be Type A or B per Section 39-2.02 in the State Specifications. Aggregate shall contain less than 1% asbestos by weight or volume.

G. Wood Headers

Size of wood headers shall be 2 inches by the depth of the asphalt concrete paving; minimum size shall be 2 inches by 4 inches. Wood shall be Douglas fir No. 1. Wood shall comply with Section 57 of the State Specifications.

H. Herbicide or Weed Killer

Use Gallery (Isoxaben) by Dow AgroSciences, Pre-M (Pendimethalin) by American Cyanamid Co., Surflan (Orizalin) by Dow Chemical, or equal.

PART 3 - EXECUTION

A. Pavement Removal

1. Cut asphalt concrete pavement with pneumatic pavement cutter or other equipment at the limits of the excavation and remove the pavement. After backfilling the excavation, saw cut asphalt concrete pavement to a minimum depth of 2 inches at a point not less than 9 inches outside the limits of the excavation or the previous pavement cut, whichever is greater, and remove the additional pavement.
2. Make arrangements for and dispose of the removed pavement.
3. Final pavement saw cuts shall be straight along both sides of trenches, parallel to the pipeline alignment, and provide clean, solid, vertical faces free from loose material. Saw cut and remove damaged or disturbed adjoining pavement. Saw cuts shall be parallel to the pipeline alignment or the roadway centerline or perpendicular to same.

B. Installation

Producing, hauling, placing, compacting, and finishing of asphalt concrete shall conform to Section 39 of the State Specifications. Apply seal coat to all paving except open asphalt concrete.

C. Installing Wood Headers

Provide wood header at edges of paving except where paving is adjacent to concrete slabs, gutters, walks, existing paving, or structures.

D. Placing Aggregate Base Course

Install in accordance with Section 26 of the State Specifications.

E. Compaction of Aggregate Base and Leveling Courses

Compaction and rolling shall begin at the outer edges of the surfacing and continue toward the center. Apply water uniformly throughout the material to provide moisture for obtaining the specified compaction. Compact each layer to the specified relative compaction before placing the next layer.

F. Applying Herbicide or Weed Killer

Apply weed killer or herbicide on base prior to placing pavement. Apply at the rate recommended by the manufacturer to control dawny brome grass, puncture vine, and plaintain. Apply from outside of curb to opposite outside of curb and for the full width of roadways and parking areas.

G. Placing Prime Coat

Apply prime coat to the surface of the leveling course of aggregate base at the rate of 0.25 gallon per square yard per Section 39-4.02 in the State Specifications.

H. Placing Tack Coat

Apply tack coat on surfaces to receive finish pavement per Section 39-4.02 in the State Specifications. Apply tack coat to metal or concrete surfaces that will be in contact with the asphalt concrete paving.

I. Placing Asphalt Paving

Install in accordance with Section 39-6 in the State Specifications.

J. Compaction of Asphalt Concrete Paving

Compact until roller marks are eliminated and a density of 92% minimum to 98% maximum has been attained per ASTM D2041.

K. Surface Tolerance

1. Finished grade shall not deviate more than 0.02 foot in elevation from the grade indicated in the drawings. Slopes shall not vary more than 1/4 inch in 10 feet from the slopes shown in the drawings.
2. After paving has been installed and compacted, spray water over the entire paved area. Correct any areas where water collects and does not drain away.

END OF SECTION

SECTION 331300
DISINFECTION OF PIPING AND STRUCTURES

PART 1 - GENERAL

A. Description

This section includes materials and procedures for disinfection of water mains by the continuous feed method and by the slug method and disinfection of structures. Disinfect piping in accordance with AWWA C651-05 and disinfect structures in accordance with AWWA C652-02, except as modified below.

B. Related Work Described Elsewhere

1. Pressure Testing of Piping: 400515.
2. Western Hills Water District Standard Drawings and Specifications

C. Job Conditions

1. Discharge of chlorinated water into watercourses or surface waters is regulated by the National Pollutant Discharge Elimination System (NPDES). Disposal of the chlorinated disinfection water and the flushing water is the Contractor's responsibility.
 - a. Schedule the rate of flow and locations of discharges in advance to permit review and coordination with Owner and cognizant regulatory authorities.
2. Use potable water for chlorination.
3. Submit request for use of water from waterlines of Owner 48 hours in advance.

PART 2 - MATERIALS

A. Liquid Chlorine

Inject with a solution feed chlorinator and a water booster pump. Follow the instructions of the chlorinator manufacturer.

B. Calcium Hypochlorite (Dry)

Dissolve in water to a known concentration in a drum and pump into the pipeline at a metered rate.

C. Sodium Hypochlorite (Solution)

Further dilute in water to desired concentration and pump into the pipeline at a metered rate.

D. Chlorine Residual Test Kit

For measuring chlorine concentration, supply and use a medium range, drop count, DPD drop dilution method kit per AWWA C651, Appendix A.1. Maintain kits in good working order available for immediate test of residuals at point of sampling.

PART 3 - EXECUTION

A. Continuous Feed Method for Pipelines

Introduce potable water into the pipeline at a constant measured rate. Feed the chlorine solution into the same water at a measured rate. Proportion the two rates so that the chlorine concentration in the pipeline is maintained at a minimum concentration of 25 mg/L. Check the concentration at points downstream during the filling to ascertain that sufficient chlorine is being added.

B. Slug Method for Pipelines

Introduce the water in the pipeline at a constant measured rate. At the start of the test section, feed the chlorine solution into the pipeline at a measured rate so that the chlorine concentration created in the pipeline is 100 mg/L. Feed the chlorine for a sufficient period to develop a solid column or "slug" of chlorinated water that will, as it passes along the line, expose all interior surfaces to a concentration of at least 100 mg/L for at least three hours.

C. Disinfection of Valves, Blind Flanges, and Appurtenances

During the period that the chlorine solution or slug is in the section of pipeline, open and close valves to obtain a chlorine residual at hydrants and other pipeline appurtenances. Swab exposed faces of valves and blind flanges prior to bolting flanges in place with a 1% sodium hypochlorite solution.

D. Disinfection of Connections to Existing Pipelines

Disinfect isolation valves, pipe, and appurtenances per AWWA C651, Section 4.7. Flush with potable water until discolored water, mud, and debris are eliminated. Swab interior of pipe and fittings with a 1% sodium hypochlorite solution. After disinfection, flush with potable water again until water is free of chlorine odor.

E. Confirmation of Residual

1. After the chlorine solution applied by the continuous feed method has been retained in the pipeline for 24 hours, confirm that a chlorine residual of 10 mg/L minimum exists along the pipeline by sampling at air valves and other points of access.
2. With the slug method, confirm by sampling as the slug passes each access point and as it leaves the pipeline that the chlorine concentration in the slug is at least 50 mg/L.

F. Pipeline Flushing

After confirming the chlorine residual, flush the excess chlorine solution from the pipeline until the chlorine concentration in the water leaving the pipe is within 0.5 mg/L of the replacement water.

G. Bacteriologic Tests

Collect two sets of samples per AWWA C651, Section 5.1, deliver to a certified laboratory within six hours of obtaining the samples, and obtain a bacteriologic quality test to demonstrate the absence of coliform organisms in each separate section of the pipeline and in surge tank after chlorination and refilling. Collect at least one set of samples from the new water main, plus one set from the end of the line and at least one set from each branch. At each connection to an existing pipeline, take two additional samples.

H. Repetition of Procedure

If the initial chlorination fails to produce required residuals and bacteriologic tests, repeat the chlorination and retesting until satisfactory results are obtained.

I. Test Facility Removal

After satisfactory disinfection, disinfect and replace air valves, restore the pipe coating, and complete the pipeline where temporary disinfection or test facilities were installed.

J. Piping to be Disinfected

1. Disinfect all piping.

K. Disinfection of Structures

1. Disinfect the interior of the surge control tank
2. The Owner will provide potable water at no cost to the Contractor for the first disinfection effort. If bacteriological testing shows that the first disinfection effort was not successful, the Contractor will be charged the cost of additional water at the Owner's current rates.

SECTION 400500
GENERAL PIPING REQUIREMENTS

PART 1 - GENERAL

See Western Hills Water District Standard Drawings and Specifications for requirements.

A. Description

This section describes the general requirements for selecting piping materials; selecting the associated bolts, nuts, and gaskets for flanges for the various piping services in the project; and miscellaneous piping items.

B. Submittals

1. Submit shop drawings in accordance with the General Provisions and Section 013300.
2. Submit affidavit of compliance with referenced standards (e.g., AWWA, ANSI, ASTM, etc.).

Submit manufacturer's data sheet for gaskets supplied showing dimensions and bolting recommendations.

END OF SECTION

SECTION 400515
PRESSURE TESTING OF PIPING

PART 1 - GENERAL

A. Description

This section specifies the cleaning and hydrostatic, pneumatic, and leakage testing of pressure piping for pumping stations, water distribution and transmission mains; and air piping.

B. Related Work Specified Elsewhere

1. Disinfection of Piping and Structures: 331300.
2. Manual, Check, and Process Valves: 400520.
3. Western Hills Water District Standard Drawings and Specifications

C. Submittals

1. Submit shop drawings in accordance with the General Provisions and Section 013300.
2. Submit test bulkhead locations and design calculations, pipe attachment details, and methods to prevent excessive pipe wall stresses.
3. Submit six copies of the test records to the Owner's Representative upon completion of the testing.

D. Test Pressures

Test pressures for the various services and types of piping are shown in the subsection on "Test Pressure and Test Fluids" in Part 3.

E. Testing Records

Provide records of each piping installation during the testing. These records shall include:

1. Date and times of test.
2. Identification of pipeline, or pipeline section tested or retested.
3. Identification of which piping was tested per the requirements of the Uniform Plumbing Code or NFPA 24.
4. Identification of pipeline material.
5. Identification of pipe specification.

6. Test fluid.
7. Test pressure at low point in pipeline, or pipeline section.
8. Remarks: Leaks identified (type and location), types of repairs, or corrections made.
9. Certification by Contractor that the leakage rate measured conformed to the specifications.

PART 2 - MATERIALS

A. Manual Air-Release Valves for Buried Piping

Provide temporary manual air-release valves for pipeline test. Construct the pipe outlet in the same manner as for a permanent air valve and after use, seal with a blind flange, pipe cap, or plug and coat the same as the adjacent pipe.

B. Test Bulkheads

Design and fabricate test bulkheads per Section VIII of the ASME Boiler and Pressure Vessel Code. Materials shall comply with Part UCS of said code. Design pressure shall be at least 2.0 times the specified test pressure for the section of pipe containing the bulkhead. Limit stresses to 70% of yield strength of the bulkhead material at the bulkhead design pressure. Include air-release and water drainage connections.

C. Testing Fluid

1. Testing fluid shall be water unless a pneumatic test is shown in the following subsections.
2. For potable water pipelines, obtain and use only potable water for hydrostatic testing.
3. Submit request for use of water from waterlines of Owner 48 hours in advance.
4. The Contractor may obtain the water from the Owner at the Owner's rate of charges.

D. Testing Equipment

Provide calibrated pressure gauges, pipes, bulkheads, pumps, compressors, chart recorder, and meters to perform the hydrostatic and pneumatic testing.

PART 3 - EXECUTION

A. Testing Preparation

1. Pipes shall be in place, backfilled, and anchored before commencing pressure testing.

2. Conduct pressure tests on exposed and aboveground piping after the piping has been installed and attached to the pipe supports, hangers, anchors, expansion joints, valves, and meters.
3. For buried piping, the pipe may be partially backfilled and the joints left exposed for inspection during an initial leakage test. Perform the final pressure test, however, after completely backfilling and compacting the trench.
4. Provide any temporary piping needed to carry the test fluid to the piping that is to be tested. After the test has been completed and demonstrated to comply with the specifications, disconnect and remove temporary piping. Do not remove exposed vent and drain valves at the high and low points in the tested piping; remove any temporary buried valves and cap the associated outlets. Plug taps or connections to the existing piping from which the test fluid was obtained.
5. Provide temporary drain lines needed to carry testing fluid away from the pipe being tested. Remove such temporary drain lines after completing the pressure testing. Drain the pipes after they have been tested.
6. Prior to starting the test, the Contractor shall notify the Owner's Representative.

B. Cleaning

1. Before conducting hydrostatic tests, flush pipes with water to remove dirt and debris. For pneumatic tests, blow air through the pipes. Maintain a flushing velocity of at least 3 fps for water testing and at least 2,000 fpm for pneumatic testing. Flush pipes for time period as given by the formula

$$T = \frac{2L}{3}$$

in which:

T = flushing time (seconds)

L = pipe length (feet)

C. Testing and Disinfection Sequence for Potable Water Piping

1. Perform required disinfection after hydrostatic testing, except when pipeline being tested is connected to a potable waterline.
2. Locate and install test bulkheads, valves, connections to existing pipelines, and other appurtenances in a manner to provide an air gap separation between existing potable water pipelines and the pipeline being tested. Disinfect water and pipeline being tested before hydrostatic testing when connected to a potable waterline.

D. Initial Pipeline Filling for Hydrostatic Testing

Maximum rate of filling shall not cause water velocity in pipeline to exceed 1 fps. Filling may be facilitated by removing automatic air valves and releasing air manually.

E. Testing New Pipe Which Connects to Existing Pipe

Prior to testing new pipelines that are to be connected to existing pipelines, isolate the new line from the existing line by means of test bulkheads, spectacle flanges, or blind flanges. After successfully testing the new line, remove test bulkheads or flanges and connect to the existing piping.

F. Hydrostatic Testing of Aboveground or Exposed Piping

1. Open vents at high points of the piping system to purge air while filling the pipe with water. Venting during system filling may also be provided by temporarily loosening flanges.
2. Subject the piping system to the test pressure indicated. Maintain the test pressure for a minimum of four hours. Examine joints, fittings, valves, and connections for leaks. The piping system shall show zero leakage or weeping. Correct leaks and retest until zero leakage is obtained.

G. Hydrostatic Testing of Buried Piping

1. Where any section of the piping contains concrete thrust blocks or encasement, do not perform the pressure test until at least 10 days after placing the concrete. When testing mortar-lined or PVC piping, fill the pipe to be tested with water and allow it to soak for at least 48 hours to absorb water before conducting the pressure test.
2. Apply and maintain the test pressure by means of a positive displacement hydraulic force pump.
3. Maintain the test pressure for the following duration by restoring it whenever it falls an amount of 5 psi:

Pipe Diameter (inches)	Hours
18 and less	4

4. After the test pressure is reached, use a meter to measure the additional water added to maintain the pressure. This amount of water is the loss due to leakage in the piping system. The allowable leakage volume is defined by the formula

$$L = \frac{HND(P)^{1/2}}{C}$$

in which:

- L = allowable leakage (gallons)
- H = specified test period (hours)
- N = number of rubber-gasketed joints in the pipe tested
- D = diameter of the pipe (inches)
- P = specified test pressure (psig)
- C = 7,400

5. Test piping subject to the Fire Code requirements per NFPA 24. Test such piping hydrostatically at not less than 200-psi pressure for two hours or at 50 psi in excess of the maximum static pressure when the maximum static pressure is in excess of 150 psi. The amount of leakage in piping shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints shall not exceed 2 quarts per hour per 100 gaskets or joints irrespective of pipe diameter. The piping subject to this testing requirement is listed below.
6. The allowable leakage for buried piping having threaded, brazed, or welded (including solvent welded) joints shall be zero.
7. Repair and retest any pipes showing leakage rates greater than that allowed in the above criteria.

H. Pneumatic Testing

1. Perform pneumatic testing using dry air or nitrogen. Perform tests only after the piping has been completely installed including supports, hangers, and anchors. Protect test personnel and Owner's operating personnel. Secure piping to be tested to prevent the pipe from moving and to prevent damage to adjacent piping and equipment. Remove or isolate from the piping any appurtenant instruments or devices that could be damaged by the test prior to applying the test.
2. Apply an initial pneumatic leakage test of 25 psig to the piping system prior to final leak testing. Examine for leakage, detected by soap bubbles, at joints and connections. After correcting visible leaks, gradually increase the pressure in the system to not more than one-half of the test pressure. Then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure has been reached. Continuously maintain the pneumatic test pressure for a minimum time of four hours and for such additional time as may be necessary to conduct a soap bubble examination for leakage. The piping system shall show no leakage. Correct any visible leakage and retest.

I. Pressure Testing of Double-Walled Containment Piping

1. Test the primary pipe as described for buried and aboveground or exposed piping.
2. Test the secondary containment piping by performing a pneumatic test as described above of the annular space between the primary and secondary pipes at a pressure of 5 psi.

J. Repetition of Test

If the actual leakage exceeds the allowable, locate and correct the faulty work and repeat the test. Restore the work and all damage resulting from the leak and its repair. Eliminate visible leakage.

K. Bulkhead and Test Facility Removal

After a satisfactory test, remove the testing fluid, remove test bulkheads and other test facilities, and restore the pipe coatings.

L. Test Pressure and Test Fluids

1. Testing and design pressures (psig) shall be as listed below:

Pipe Service	Pipe Material	Testing Fluid	Design Pressure	Test Pressure
Water	DIP	Water	150	225
Air	Copper	Water		

SECTION 400520
MANUAL, CHECK, AND PROCESS VALVES

PART 1 - GENERAL

A. Description

This section includes materials, testing, and installation of manually operated valves, check valves, and process valves including gate, butterfly, and ball valves

B. Related Work Specified Elsewhere

1. Connections to Existing Buried Pipelines: 020130.
2. Painting and Coating: 099000.
3. Cold-Applied Wax Tape Coating: 099752.
4. Polyethylene Sheet Encasement (AWWA C105): 099754.
5. Fusion-Bonded Epoxy Linings and Coatings: 099761.
6. Miscellaneous Electrical Devices: 260590.
7. General Piping Requirements: 400500.
8. Pressure Testing of Piping: 400515.
9. Air-Release and Vacuum-Relief Valves: 400560.
10. Globe Pattern Control Valves (AWWA C530): 400570.
11. Spring-Actuated Control Valves: 400574.
12. Equipment, Piping, Duct, and Valve Identification: 400775.
13. Electric Motor Actuators for Valves: 409210.
14. Western Hills Water District Standard Drawings and Specifications

C. Submittals

1. Submit shop drawings in accordance with the General Provisions and Section 013300.
2. Submit manufacturer's catalog data and detail construction sheets showing all valve parts. Describe each part by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type.

3. Show valve dimensions including laying lengths. Show port sizes. Show dimensions and orientation of valve actuators, as installed on the valves. Show location of internal stops for gear actuators. State differential pressure and fluid velocity used to size actuators. For worm-gear actuators, state the radius of the gear sector in contact with the worm and state the hand wheel diameter.
4. Show valve linings and coatings. Submit manufacturer's catalog data and descriptive literature.
5. Submit six copies of a report verifying that the valve interior linings and exterior coatings have been tested for holidays and lining thickness. Describe test results and repair procedures for each valve. Do not ship valves to project site until the reports have been returned by the Owner's Representative and marked "Resubmittal not required."
6. For butterfly and eccentric plug valves, show the clear diameter or size of the port. Show the actual area of the port as a percentage of the area as calculated for the nominal valve size.

D. Proof of Design Test for Eccentric Plug Valves (Types 500, 510, 520, and 525)

1. The Contractor shall require the valve manufacturer to furnish six certified copies of reports covering the design tests for the eccentric plug valves as described in AWWA C517 and the following. One prototype valve of each size and class of a manufacturer's design shall be tested for leakage at the specified design pressure and hydrostatically tested with twice the specified design pressure. The hydrostatic test shall be performed with the plug in the open position. The leakage test shall be performed with the plug in the closed position. The duration of each test shall be 10 minutes minimum. During the leakage test, there shall be no indication of leakage past the valve plug. Valves specified to have bi-directional seats shall be leak tight in both directions. In the case of flanged valves, the valve body shall be bolted to a flanged test head.
2. No part of the valve or plug shall be permanently deformed by the hydrostatic test. During the hydrostatic test, there shall be no leakage through the metal, the end joints, or the shaft seal.
3. It is the intent that the valve manufacturer provide evidence of the adequacy of each type offered to perform under design pressures within the applicable rating for a sufficient number of test cycles simulating a full service life. The adequacy is to be proven by tests, made on one or more valves selected to represent each basic type of seat design of a size within each applicable group, in a pressure class or classes equal to or greater than that specified. The required number of test cycles appears in the following table:

TEST CYCLES REQUIRED		
Size Group (inches)	No. of Cycles	Minimum Differential Pressure (psig)
3 to 20	10,000	150

Every test cycle shall consist of applying the specified differential pressure to the plug in the closed position, then opening the plug (which will relieve the pressure) to the wide-open position and then closing the plug.

4. The valve shall be leak tight under the specified pressure differential upon completion of the cycle test without having to stop during the test to repair the valve, modify or reinforce the seat, or install shims or wedges around the seat.
5. The plug shall not be rotated past the center position to jam the plug onto the seat during the hydrostatic test, the leakage test, or the cycle test.

PART 2 - MATERIALS

A. General

1. Valves are identified in the drawings by size and number. For Following is a tabulation of the valve type numbers assigned to the various valve specification sections:
2. In addition, valves are further described by a suffix letter on the type number:

Suffix Letter	Description
M	Motorized actuator per Section 409210

3. Install valves complete with operating handwheels or levers, chainwheels, extension stems, floor stands, gear actuators, operating nuts, chains, and wrenches required for operation.
4. Valves shall have the name of the manufacturer and the size of the valve cast or molded onto the valve body or bonnet or shown on a permanently attached plate.
5. For buried locations, valves with mechanical joint ends may be substituted for the flanged ends specified provided the mechanical joint ends are compatible with the pipe ends.

B. Valve Actuators

1. Provide lever or wrench actuators for exposed valves 6 inches and smaller.
2. Where manually operated valves (size 4 inches and larger) are installed with their centerlines more than 6 feet 9 inches above the floor, provide chainwheel and guide actuators.

3. Provide 2-inch AWWA operating nuts for buried and submerged valves.
4. Provide enclosed gear actuators on butterfly and ball valves 6 inches and larger, unless electric motorized valve actuators are shown in the drawings. Gear actuators for valves 6 through 14 inches shall be of the worm and gear, or of the traveling nut type. Gear actuators for motorized valves shall be of the worm and gear type, regardless of size.
5. Design gear actuators assuming that the differential pressure across the plug, gate, or disc is equal to the pressure rating of the valve and assuming a fluid velocity of 16 fps for valves in liquid service and 80 fps for valves in air service and a line fluid temperature range of 50°F to 100°F unless otherwise required in the detailed valve specifications. Size actuators using a minimum safety factor of 1.5 for valves in open/close service and 2.0 in modulating service.
6. Gear actuators shall be enclosed, oil lubricated, with seals provided on shafts to prevent entry of dirt and water into the actuator. Gear actuators for valves located above ground or in vaults and structures shall have handwheels. The actuators for valves in exposed service shall contain a dial indicating the position of the valve disc or plug. Gear actuators for buried or submerged valves shall have 2-inch-square AWWA operating nuts.
7. For buried or submerged service, provide watertight shaft seals and watertight valve and actuator cover gaskets. Provide totally enclosed actuators designed for buried or submerged service.
8. Traveling nut and worm and gear actuators shall be of the totally enclosed design so proportioned as to permit operation of the valve under full differential pressure rating of the valve with a maximum pull of 80 pounds on the handwheel or crank. Provide stop limiting devices in the actuators in the open and closed positions. Actuators shall be of the self-locking type to prevent the disc or plug from creeping. Design actuator components between the input and the stop-limiting devices to withstand without damage a pull of 200 pounds for handwheel or chainwheel actuators and an input torque of 300 foot-pounds for operating nuts when operating against the stops.
9. Self-locking worm gear shall be a one-piece design of gear bronze material (ASTM B427; or ASTM B84, Alloy C86200), accurately machine cut. Actuators for eccentric and lubricated plug valves may use ductile-iron gears provided the gearing is totally enclosed with spring-loaded rubber lip seals on the shafts. The worm shall be hardened alloy steel (ASTM A322, Grade G41500 or G41400; or ASTM A148, Grade 105-85), with thread ground and polished. Support worm-gear shaft at each end by ball or tapered roller bearings. The reduction gearing shall run in a proper lubricant. The handwheel diameter shall be no more than twice the radius of the gear sector in contact with the worm. Worm-gear actuators shall be Limitorque Model HBC, EIM Series W, or equal.
10. Design actuators on buried valves to produce the required torque on the operating nut with a maximum input of 150 foot-pounds.
11. Valve actuators, handwheels, or levers shall open by turning counterclockwise.

C. Cast-Iron Valve Boxes for Buried Valves

1. Valve boxes shall be two-piece sliding type, cast iron, with extension shafts. Units shall be as manufactured by Tyler Pipe, Geneco, Star Pipe Products, or equal. Extension pipes shall be cast iron.
2. Coat buried cast-iron pieces per Section 099000, System No. 21 or with fusion-bonded epoxy per Section 099761.

D. Extension Stems for Buried and Submerged Valve Actuators

1. Where the depth of the valve is such that its centerline is more than 4 feet below grade, provide operating extension stems to bring the operating nut to a point 6 inches below the surface of the ground and/or box cover. Where the valve is submerged, provide operating extension stems to bring the operating nut to 6 inches above the water surface. Extension stems shall be Type 316 stainless steel, solid core, and shall be complete with 2-inch-square operating nut. The connections of the extension stems to the operating nuts and to the valves shall withstand without damage a pull of 300 foot-pounds.
2. Extension stem diameters shall be as tabulated below:

Valve Size (inches)	Minimum Extension Stem Diameter (inches)
2	3/4
3, 4	7/8
6	1
8	1 1/8
10, 12	1 1/4
14	1 3/8
16, 18	1 1/2

E. Valve Tagging and Identification

Provide identifying valve tags per Section 400775.

F. Bolts and Nuts for Flanged Valves

Bolts and nuts for flanged valves shall be as described in Section 400500.

G. Gaskets for Flanges

Gaskets for flanged end valves shall be as described in Section 400500.

H. Limit Switches for Check Valves

See Section 260590.

I. Painting and Coating

1. Coat metal valves located above ground or in vaults and structures the same as the adjacent piping. If the adjacent piping is not coated, then coat valves per Section 099000, System No.15. Apply the specified prime coat at the place of manufacture. Apply intermediate and finish coats in field. Finish coat shall match the color of the adjacent piping.
2. Coat buried metal valves at the place of manufacture per Section 099000, System No. 21.
3. Coat submerged metal valves, stem guides, extension stems, and bonnets at the place of manufacture per Section 099000, System No. 7.
4. Line the interior metal parts of metal valves 4 inches and larger, excluding seating areas and bronze and stainless steel pieces, per Section 099000, System No. 7. Apply lining at the place of manufacture.
5. Alternatively, line and coat valves with fusion-bonded epoxy per Section 099761.
6. Test the valve interior linings and exterior coatings at the factory with a low-voltage (22.5 to 80 volts, with approximately 80,000-ohm resistance) holiday detector, using a sponge saturated with a 0.5% sodium chloride solution. The lining shall be holiday free.
7. Measure the thickness of the valve interior linings per Section 099000. Repair areas having insufficient film thickness per Section 099000.

J. Packing, O-Rings, and Gaskets

Unless otherwise stated in the detailed valve specifications, packing, O-rings, and gaskets shall be one of the following nonasbestos materials:

1. Teflon.
2. Kevlar aramid fiber.
3. Acrylic or aramid fiber bound by nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or equal.
4. Buna-N (nitrile).

K. Rubber Seats

Rubber seats shall be made of a rubber compound that is resistant to free chlorine and monochloramine concentrations up to 10 mg/L in the fluid conveyed.

L. Valves

1. Gate Valves:

a. Type 100--Aboveground Bronze Gate Valves 3 Inches and Smaller:

Aboveground threaded end or solder end gate valves, 1/4 through 3 inches, for water and air service shall be rising stem, screwed bonnet, solid wedge disc type, Class 125, having a minimum working pressure of 200 WOG psi at a temperature of 150°F. Ends shall be female threaded, ASME B1.20.1 or solder ends. Materials of construction shall be as follows:

Component	Material	Specification
Body and bonnet	Bronze	ASTM B61 or B62
Disc	Bronze	ASTM B61, B62, or B584 (Alloy C97600)
Stem	Bronze or copper silicon	B99 (Alloy 651), B584 (Alloy C87600), B371 (Alloy C69400)
Seat rings (Classes 200 and 300 only)	Stainless steel	AISI Type 410

Handwheels shall be aluminum, brass, or malleable iron. Packing shall be Teflon or Kevlar aramid fiber. Valves shall be Crane 428, Stockham, or equal.

b. Type 120--2- and 3-Inch Cast-Iron Buried Gate Valves:

Buried gate valves of sizes 2 through 3 inches for water service shall be iron body, bronze mounted, nonrising stem type, double disc, parallel seat, and shall have a working pressure of at least 200 psi. Valves shall have flanged, PVC, or threaded ends to match the pipe ends. Valves shall have a 2-inch AWWA operating nut. Materials of construction shall be as follows:

Component	Material	Specification
Body, bonnet, operating nut, and stuffing box	Cast iron	ASTM A126, Class B or C
Bonnet bolts and stuffing box bolts	Stainless steel	ASTM A193, Grade B8M
Discs, disc nut, disc ring, and seat ring	Bronze	ASTM B62
O-ring	Synthetic rubber	

Stem	Copper silicon or manganese bronze	ASTM B584, Alloy C87600, C86200, C86300, C86400, C87500
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Valves shall be Kennedy Figure 597X or 561X, Mueller Gate Valves, Clow F-5070 or F-5085, or equal.

c. Type 180—Cast-Iron Resilient Wedge Gate Valves 3 Through 20 Inches (AWWA C509):

Valves shall comply with AWWA C509 and the following. Valves shall be of the bolted-bonnet type with nonrising stems. Valve stems shall be Type 304 or 316 stainless steel or cast, forged, or rolled bronze. Provide operating nut for buried valves. Provide handwheel for exposed valves. Stem nuts shall be made of solid bronze. Bronze for internal working parts, including stems, shall not contain more than 2% aluminum or more than 7% zinc. Bronze shall conform to ASTM B62 or ASTM B584 (Alloy C83600), except the stem bronze shall have a minimum tensile strength of 60,000 psi, a minimum yield strength of 30,000 psi, and a minimum of 10% elongation in 2 inches (ASTM B584 or B763, Alloy C87600 or C99500). Body bolts shall be Type 316 stainless steel. End connections for exposed valves shall be flanged. End connections for buried valves shall be mechanical joint type.

Provide reduction thrust bearings above the stem collar. Stuffing boxes shall be O-ring seal type with two rings located in stem above thrust collar. Each valve shall have a smooth unobstructed waterway free from any sediment pockets.

Valves shall be lined and coated at the place of manufacture with either fusion-bonded epoxy or heat-cured liquid epoxy. Minimum epoxy thickness shall be 8 mils.

Manufacturers: Clow R/W, AVK, American Flow Control CRS-80, Waterous Series 500, Kennedy Ken-Seal, or equal.

Type 185 valves may be substituted for Type 180 valves.

d. Type 185—Ductile-Iron Resilient Wedge Gate Valves 4 Through 36 Inches (AWWA C515):

Valves shall comply with AWWA C515 and the following. Valves shall be of the bolted-bonnet type with nonrising stems. Valve stems shall be Type 304 or 316 stainless steel or cast, forged, or rolled bronze. Provide operating nut for buried valves. Provide handwheel for exposed valves. Stem nuts shall be made of solid bronze. Bronze for internal working parts, including stems, shall not contain more than 2% aluminum or more than 7% zinc. Bronze shall conform to ASTM B62 or ASTM B584 (Alloy C83600), except the stem bronze shall have a minimum tensile strength of 60,000 psi, a minimum yield strength of 30,000 psi, and a minimum of 10% elongation in 2 inches (ASTM B584 or B763, Alloy C87600 or C99500). Body

bolts shall be Type 316 stainless steel. End connections for exposed valves shall be flanged. End connections for buried valves shall be mechanical joint type.

Provide reduction thrust bearings above the stem collar. Stuffing boxes shall be O-ring seal type with two rings located in stem above thrust collar. Each valve shall have a smooth unobstructed waterway free from any sediment pockets.

Valves shall be lined and coated at the place of manufacture with either fusion-bonded epoxy or heat-cured liquid epoxy. Minimum epoxy thickness shall be 8 mils.

Manufacturers: Clow, AVK, American Flow Control, Waterous, Kennedy, or equal.

2. Butterfly Valves:

a. Thrust Bearings for Butterfly Valves (Types 200):

Provide thrust bearings to hold the valve disc in the center of the valve seat. No bearings shall be mounted inside the valve body within the waterway. Do not use thrust bearings in which a metal bearing surface on the disc rubs in contact with an opposing metal surface on the inside of the body.

b. Bronze Components in Butterfly Valves (Types 200, 210, 220, 230, and 240):

Bronze components in contact with water shall comply with the following requirements:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum
Copper + Nickel + Silicon	83% minimum

c. Port Sizes for Butterfly Valves (Types 200):

For valves 24 inches and smaller, the actual port diameter shall be at least 93% of the nominal valve size. For valves larger than 24 inches, the port diameter shall not be more than 1.25 inches smaller than the nominal valve size. The dimension of the port diameter shall be the clear waterway diameter plus the thickness of the rubber seat.

d. Corrosion-Resistant Materials in Butterfly Valves (Types 200, 210, 220, 230, and 240):

Where AWWA C504 requires "corrosion resistant" material, such material shall be one of the following:

- (1) Bronze as described above.

- (2) Type 304 or 316 stainless steel.
- (3) Monel (UNS N04400).
- (4) Synthetic nonmetallic material.

e. Seating Surfaces in Butterfly Valves (Types 200):

Seating surfaces in valves having motorized actuators shall be stainless steel or nickel-copper per AWWA C504 or nickel-chromium alloy containing a minimum of 72% nickel and a minimum of 14% chromium.

f. Factory Leakage Testing (Types 200, 205, 210, 220, and 240):

Perform factory leakage tests per AWWA C504 on both sides of the seat.

g. Type 200--Flanged, Rubber-Seated Butterfly Valves 4 Through 72 Inches, Class 150B:

Butterfly valves shall be short body, flanged type for exposed valves and valves in vaults or structures, and either flanged or mechanical joint for buried valves. Valve shall conform to AWWA C504, Class 150B. Minimum working differential pressure across the valve disc shall be 150 psi. Flanged ends shall be Class 125, ASME B16.1. Valve shafts shall be stub shaft or one-piece units extending completely through the valve disc. Materials of construction shall be as follows:

Component	Material	Specification
Body	Cast iron or ductile iron	AWWA C504
Exposed body cap screws and bolts and nuts	Stainless steel	ASTM A276, Type 304 or 316
Discs	Cast iron, ductile iron, or Ni-Resist	AWWA C504
Shafts, disc fasteners, seat retention segments, and seat fastening devices	Stainless steel	ASTM A276, Type 304 or 316
Seat material	Buna-N	--

Where the rubber seat is applied to the disc, it shall be bonded to a stainless steel seat retaining ring which is clamped to the disc by Type 304 or 316 stainless steel screw fasteners or secured to a stainless steel seat by a combination of cap screws, a serrated disc retaining ring, and molded shoulders in the seat mating with machined registers in the disc. The rubber valve seat shall be secured to or retained in the valve body. Valves shall be Pratt, DeZurik Series BAW, M&H, Val-Matic, or equal.

3. Ball Valves:

a. Type 310--Double Union PVC Ball Valves 3 Inches and Smaller:

Thermoplastic ball valves, 3 inches and smaller, for water and chemical service shall be rated at a pressure of 150 psi at a temperature of 105°F. Body, ball, and stem shall be PVC conforming to ASTM D1784, Type 1, Grade 1. Seats shall be Teflon. O-ring seals shall be Viton. Valve ends shall be of the double-union design. Ends shall be socket welded except where threaded or flanged-end valves are specifically shown in the drawings. Valves shall have handle for manual operation. Valves shall be as manufactured by Chemtrol, Hayward, R & G Sloan, Spears Manufacturing Company, Plast-O-Matic, IPEX Series VK or VKD, or equal.

b. Type 314--Double Union CPVC Ball Valves 3 Inches and Smaller:

CPVC ball valves, 3 inches and smaller, for water and chemical service shall be rated at a pressure of 150 psi at a temperature of 105°F and rated at a pressure of 100 psi at a temperature of 150°F. Body, ball, and stem shall be CPVC conforming to ASTM D1784, Type 4, Grade 1. Seats shall be Teflon. O-ring seals shall be Viton. Valve ends shall be of the double-union design. Ends shall be socket welded except where threaded or flanged-end valves are specifically shown in the drawings. Valves shall have handle for manual operation. Valves shall be as manufactured by Chemtrol, Hayward, R & G Sloan, Spears Manufacturing Company, Plast-O-Matic, IPEX Series VK or VKD, or equal.

c. Type 316--Double Union CPVC Ball Valves 3 Inches and Smaller with Vented Ball:

Vented CPVC ball valves, 3 inches and smaller, for chemical service shall be rated at a pressure of 150 psi at a temperature of 105°F and rated at a pressure of 85 psi at a temperature of 140°F. Provide machined vent hole, deburred, in the ball to allow gases to vent. Body, ball, and stem shall be CPVC conforming to ASTM D1784, Type 4, Grade 1. Seats shall be Teflon. O-ring seals shall be Viton. Valve ends shall be of the double-union design. Ends shall be socket welded except where threaded or flanged-end valves are specifically shown in the drawings. Valves shall have handle for manual operation. Valves shall be Plast-O-Matic "Z-MBV-Vent," Asahi/America Type 21, or equal.

4. Diaphragm Valves:

a. Type 620--PVC Diaphragm Valves 1/2 Through 4 Inches:

Diaphragm valves, sizes 1/2 through 4 inches, shall be of the weir type with PVC bodies and PVC or polypropylene bonnets. PVC shall comply with ASTM D1784, Cell Classification 12454. Polypropylene shall comply with ASTM D4101. Body wall thickness shall conform to Schedule 80 per ASTM D1785. Valve diaphragms shall be PTFE. Provide elastomer backing for PTFE diaphragms. O-rings shall be Viton. Body-bonnet bolting shall be Type 304 stainless steel (ASTM B193, Grade B8). Provide polypropylene manual handwheel actuator with rising indicator stem.

Minimum pressure rating shall be 150 psi at a temperature of 73°F and 135 psi at a temperature of 110°F. Ends for valves 2 inches and smaller shall be true union with socket weld connections. Ends for valves larger than 2 inches shall be flanged, Class 125, ASME B16.1. Products: Spears Manufacturing Company, ITT Dia-Flo, or equal.

- b. Type 625--PVC Diaphragm Valves 1/2 Through 4 Inches in Sodium Hypochlorite Service:

Diaphragm valves, sizes 1/2 through 4 inches, shall be of the weir type with PVC bodies and PVC or polypropylene bonnets. PVC shall comply with ASTM D1784, Cell Classification 12454. Polypropylene shall comply with ASTM D4101. Body wall thickness shall conform to Schedule 80 per ASTM D1785. Valve diaphragms shall be PTFE coated. Provide Buna-N elastomer backing for diaphragms. O-rings shall be Viton. Body-bonnet bolting shall be Hastelloy C (ASTM F468, Grade N10276). Provide polypropylene manual handwheel actuator with rising indicator stem. Minimum pressure rating shall be 150 psi at a temperature of 73°F and 135 psi at a temperature of 110°F. Ends for valves 2 inches and smaller shall be true union with socket weld connections. Ends for valves larger than 2 inches shall be flanged, Class 125, ASME B16.1. Products: Spears Manufacturing Company, ITT Dia-Flo, or equal.

5. Check Valves:

- a. Type 700--Bronze Check Valves 3 Inches and Smaller:

Check valves 3 inches and smaller shall be Class 125, wye pattern, bronze, ASTM B61, B62, or B584 (Alloy C83600). Ends shall be female threaded, ASME B1.20.1. Disc shall be bronze, swing type. Minimum working pressure shall be 200 psi WOG at a temperature of 150°F. Valves shall be Crane, Nibco, Stockham, or equal.

or equal.

- b. Type 708--Bronze Check Valves 2 Inches and Smaller for Reciprocating Air Compressors:

Check valves 2 inches and smaller shall be Class 300, bronze, ASTM B61. Ends shall be female threaded ASME B1.20.1. Disc shall be Type 420 stainless steel or bronze (ASTM B61). Minimum pressure rating shall be 300 psi at 150°F. The disc shall provide air cushioning action of the compressor. Provide a disc guide to prevent cocking of the disc. The caps shall anchor the disc guide in alignment with disc travel. The bodies shall have pipe threads and clearances at ends of threads sufficient to permit tight pipe connections, precluding the possibility of pipe ends jamming against diaphragms, distorting seats, or choking the flow. Valves shall be Midwest Control Devices, Lunkenheimer Figure 1616, Crane 3668, or equal.

- c. Type 730--PVC Ball Check Valves, 3 Inches and Smaller:

PVC check valves, 3 inches and smaller, shall be constructed of PVC per ASTM D1784, Type I, Grade 1. Ends shall be double union, socket welded. Seats and seals shall be PTFE. Valve shall have a pressure rating of 150 psi at a temperature of 73°F.

d. Type 731--PVC Diaphragm Check Valves 1 Inch and Smaller:

PVC diaphragm check valves, 1 inch and smaller, shall be constructed of PVC per ASTM D1784, Type I, Grade 1. Seats and seals shall be Viton. Provide a union nut in the valve body, containing the diaphragm seal and seat. Diaphragm shall be PTFE. The design of the valve shall be such that it is normally closed. Flow entering the valve shall open the diaphragm, pushing it off the seat until it rests against an internal stop. If the inlet flow ceases or if backflow occurs, the diaphragm shall reposition itself, closing off the valve seat. Products: Plast-O-Matic Series CKM or equal.

e. Type 790--Silent Check Valve 3 Inches and Larger:

Silent check valves, 3 inches and larger, shall be bronze mounted globe style. The seat and plug shall be hand replaceable in the field. Provide resilient seat. Flow area through valve shall be equal to or greater than the cross sectional area of the equivalent pipe size. Valve plug shall be center guided with a through integral shaft and spring loaded for silent shutoff operation. Ends shall be flanged, Class 125, per ASME B16.1. Minimum pressure rating shall be 150 psi. Materials of construction shall be as follows:

Component	Material	Specification
Body	Cast iron	ASTM A48, Class 30, or ASTM A126, Class B
Plug and seal	Bronze	ASTM B62 or B584 (Alloys C83600 or C87600)
Spring	Stainless steel	Type 316 stainless or UNS N04400
Seating	Buna-N or EPDM	

Design and construct valves to accommodate the following service conditions:

Valve Tag No.	Maximum Fluid Velocity (fps)	Maximum Pump Shutoff Head (upstream of valve, feet)	Normal Pump Operating and System Head (feet)	Minimum Pump Operating and System Head (feet)

Valve shall be APCO Series 600 or equal.

6. Solenoid Valves:

- a. Design and construct solenoid valves such that they can be used in both horizontal and vertical piping.
- b. Type 900--Metallic Solenoid Valves 1 1/2 Inches and Smaller:

Solenoid valves of sizes 1/4 through 1 1/2 inches for water and air service shall have forged brass (Alloy C23000) or bronze (ASTM B62) bodies with Teflon main seats. Internal plunger, core tube, plunger spring, and cage assembly shall be stainless steel (Types 302, 304, or 305). Solenoid enclosures shall be NEMA 4, except where explosion-proof is noted in the drawings. Valve actuators shall be 120-volt a-c. Seals shall be Teflon. Valves shall have a maximum operating pressure and a maximum differential pressure of 125 psi. Solenoid valves shall be energized to open. Valves shall be ASCO "Redhat", Parker Hannifin "Skinner", or equal.

- c. Type 910--Plastic Solenoid Valves 1/4 Through 1 Inch:

Solenoid valves of sizes 1/4 through 1 inch for water and chemical services shall have PVC bodies with Viton seals. Valve bodies shall be of the true union design with threaded end connections with the coil assembly contained in a molded polyester housing. Plunger or core tube shall be Teflon or polypropylene. Solenoid enclosures shall be NEMA 4X. Valve actuators shall be 120 volts a-c. Valves shall have a minimum operating pressure of 120 psi and a maximum differential pressure of 25 psi on either side of the valve, with the valve in the closed position. Solenoid valves shall be energized to open. Products: Hayward or equal.

PART 3 - EXECUTION

A. Joints

- 1. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing. Lubricate threads with oil and

graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

2. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.
3. Install lug-type valves with separate hex head machine bolts at each bolt hole and each flange (two bolts per valve bolt hole).
4. Install grooved-end couplings for valves in accordance with Section 400500.

B. Installing Exposed Valves

1. Unless otherwise indicated in the drawings, install valves in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above the floor with their operating stems vertical. Install valves in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above the floor with their operating stems horizontal.
2. Install valves on vertical runs of pipe that are next to walls with their stems horizontal, away from the wall. Valves on vertical runs of pipe that are not located next to walls shall be installed with their stems horizontal, oriented to facilitate valve operation.

C. Installing Buried Valves

1. Connect the valve, coat the flanges, apply tape wrapping or polyethylene encasement, and place and compact the backfill to the height of the valve stem.
2. Place block pads under the extension pipe to maintain the valve box vertical during backfilling and repaving and to prevent the extension pipe from contacting the valve bonnet.
3. Mount the upper slip pipe of the extension in midposition and secure with backfill around the extension pipe. Pour the concrete ring allowing a depression so the valve box cap will be flush with the pavement surface.
4. Install debris cap as close as possible under the cast-iron cover without interfering with the cover operation. Trim flexible skirt to provide a smooth contact with the interior of the extension pipe.

D. Field Coating Buried Valves

1. Coat flanges of buried valves and the flanges of the adjacent piping, and the bolts and nuts of flanges and mechanical joints, per Section 099000, System No. 24.
2. Wrap buried metal valves smaller than 6 inches with cold-applied wax tape per Section 099752.

3. Wrap buried metal valves 6 inches and larger in two layers of polyethylene conforming to AWWA C105, 8 mils in thickness each. Pass the two sheets of polyethylene under the valve and the coated flanges or joints with the connecting pipe and draw the sheets around the valve body, the valve bonnet, and the connecting pipe. Secure the sheets with plastic adhesive tape about the valve stem below the operating nut and about the barrel of the connecting pipe to prevent the entrance of soil. Fold overlaps twice and tape. Backfill the valve with care to avoid damaging the polyethylene.

E. Installing Extension Stem Guide Brackets

Install at 6- to 8-foot centers. Provide at least two support brackets for stems longer than 10 feet, with one support near the bottom of the stem and one near the top.

F. Mounting Gear Actuators

The valve manufacturer shall select and mount the gear actuator and accessories on each valve and stroke the valve from fully open to fully closed prior to shipment.

G. Field Installation of Gear Actuator

Provide the actuator manufacturer's recommended lubricating oil in each actuator before commencing the field testing.

H. Valve Leakage Testing

Test valves for leakage at the same time that the connecting pipelines are tested. See Section 400515 for pressure testing requirements. Protect or isolate any parts of valves, actuators, or control and instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage. Repair or replace any leaking valves and retest.

I. Valve Field Testing

1. Operate manual valves through three full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. Do not backfill buried valves until after verifying that valves operate from full open to full closed. If valves stick or bind, or do not operate from full open to full closed, repair or replace the valve and repeat the tests.
2. Gear actuators shall operate valves from full open to full close through three cycles without binding or sticking. The pull required to operate handwheel- or chainwheel-operated valves shall not exceed 80 pounds. The torque required to operate valves having 2-inch AWWA nuts shall not exceed 150 ft-lbs. If actuators stick or bind or if pulling forces and torques exceed the values stated previously, repair or replace the actuators and repeat the tests. Operators shall be fully lubricated in accordance with the manufacturer's recommendations prior to operating.

END OF SECTION

SECTION 400574
SPRING-ACTUATED CONTROL VALVES

PART 1 - GENERAL

A. Description

This section includes requirements for materials and installation of spring-loaded, direct-actuated control valves acting as pressure-reducing, pressure-relief, backpressure, and regulating valves for water and chemical service.

B. Related Work Specified Elsewhere

1. Painting and Coating: 099000.
2. Pressure Testing of Piping: 400515.
3. Manual, Check, and Process Valves: 400520.
4. Equipment, Piping, Duct, and Valve Identification: 400775.
5. Western Hills Water District Standard Drawings and Specifications

C. Submittals

1. Submit shop drawings in accordance with the General Conditions and Section 013300.
2. Submit dimensional drawings for each size and type of valve provided.
3. Submit manufacturer's catalog data and detail drawings showing all valve parts and describe by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Show manufacturer's recommended maximum operating pressure and maximum recommended flow. Show linings and coatings.

PART 2 - MATERIALS

A. Valve Identification

Valves are identified in the drawings by size and type number. For example, a callout in the drawings of 1" V-1401 refers to a Type 1401 valve in these specifications which is a spring-actuated pressure regulator.

B. Valve End Connections

1. Unless otherwise specified, valves 2 inches and smaller shall have threaded ends. Valves larger than 2 inches shall have flanged ends.

2. Cast-iron flanges shall comply with ASME B16.1, Class 125. Carbon steel and stainless steel flanges shall comply with ASME B16.5, Class 150. Flanges shall be flat face.
3. Threaded ends shall comply with ASME B1.20.1.

C. Coating for Metallic Valves

Coat metal (other than stainless steel and bronze or brass) valves per Section 099000, System No. 10. Apply the specified prime coat at the place of manufacture. Apply intermediate and finish coats in the field. Finish coat shall match the color of the connecting piping. Do not coat aluminum or stainless steel valves.

D. Bronze

Bronze in contact with water shall have the following chemical constituents:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum
Copper + Nickel + Silicon	83% minimum

E. Valves

1. Type 1401 – Spring-Actuated Pressure Regulators for Water Service:
 - a. Spring-actuated regulators 2 inches and smaller shall automatically convert high, varying inlet water pressure to a lower, constant outlet pressure. Provide a valve design consisting of a spring in a chamber acting on a diaphragm that transmits motion to the valve. Outlet pressure shall be adjustable by turning an adjusting screw to vary spring tension. Body shall be bronze. Diaphragm shall be nitrile. Maximum inlet pressure shall be at least 200 psi.
 - b. Outlet pressure shall be field adjustable over a range of 25 to 75 psi. Valves shall be Cla-Val, Watts Series 223, Fisher Type 75A, or equal.
2. Type 1432 – Plastic Pressure-Relief or Backpressure Valves for Chemical Service:
 - a. Design shall use a Teflon diaphragm to isolate an externally adjustable spring from the fluid.
 - b. Provide a design incorporating a spring tensioning bolt which allows the pressure to be set in the field. When the pressure exceeds the setting, the diaphragm shall open allowing the fluid to flow through the orifice. Exposed external metal parts, including the spring tension bolt and body bolts, shall be Type 304 stainless steel. PVC compound shall comply with ASTM D1784, Cell Classification 13463A. Polypropylene material shall comply with ASTM D4101. PVDF material shall

conform to ASTM D3222, Type 2. PVC socket ends shall be Schedule 80 conforming to ASTM D2467.

- c. Butt fusion ends for polypropylene and PVDF shall be suitable for butt fusion connections to piping of the same material per ASTM D2657. Flanged ends shall conform to the bolting patterns per ASME B16.5, Class 150. Provide inlet and outlet pressure gauge.
- d. Valves' working pressure shall be at least 150 psig at a temperature of 68°F. Valves shall be manufactured by Griffco, Chemline Series SB, Milton Roy, or equal.

Service	Component Material ⁽¹⁾	Seat Materials ⁽²⁾	Press. Range (psi)	Over-pressure (psi)	Flow Rate (gpm)	End Connections
Ammonium Hydroxide	PVC	EPDM	7-150	15	5	True union
Sodium Hypochlorite	PVC	Viton	3-60	6	5	True union
Water	Metal housing	Nitrile	25-75 (outlet)	15	5	True union

⁽¹⁾Body, piston, seat retainer, union nut, and end connector.
⁽²⁾Including face O-ring.

F. Valve Tagging and Identification

Provide identifying valve tags per Section 400775.

PART 3 - EXECUTION

A. Valve Installation

Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be leaktight.

B. Field Testing

1. Test valves at the same time that the connecting pipelines are pressure tested. See Section 400515 for pressure testing requirements. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the test pressure. Valve bodies and joints shall have zero leakage.
2. Run water through liquid service valves and air through air or gas service valves and assure that valves regulate or sustain pressure to the specified setting. Duration of this test shall be at least 10 minutes.

SECTION 400711
MISCELLANEOUS PIPE FITTINGS AND ACCESSORIES

PART 1 - GENERAL

A. Description

This section includes materials and installation of miscellaneous piping specialties, such as rupture disk assemblies, and PVC calibration columns.

B. Related Work Specified Elsewhere

1. Painting and Coating: 099000.
2. General Piping Requirements: 400500.
3. Corporation Stops and Service Saddles: 402713.
4. Pressure Testing of Piping: 400515.
5. Western Hills Water District Standard Drawings and Specifications

C. Submittals

1. Submit shop drawings in accordance with the General Conditions and Section 013300.
2. Submit manufacturer's catalog data and descriptive literature showing dimensions and materials of construction by ASTM reference and grade. Show coatings.

PART 2 - MATERIALS

A. Rupture Disk Assemblies

1. Rupture disk assemblies shall be of the bolted type, consisting of two flat-faced insert flanges with a rupture disk between them. Provide full-faced inserts with bolt holes matching the bolt holes of ASME B16.5, Class 150, flanges. Inserts shall be Type 316 stainless steel. Rupture disks shall be Type 316 stainless steel or monel (UNS N04400). Disks shall rupture at a pressure of 75 ± 5 psig. Stud materials shall comply with ASTM A193, Grade B7. Nuts shall comply with ASTM A194, Grade 2H. Products: BS&B Safety Systems, Inc., Model FA-7; Continental Disk Corporation Assembly No. 7; Fike Assembly G; or equal.
2. Provide three spare rupture disks for each rupture disk assembly in the project. Pack spares in a wooden box; label with the manufacturer's name and local representative's name, address, and telephone number; and attach list of material contained within.

B. PVC and Polypropylene Calibration Columns

1. Calibration cylinder and fittings shall be made of inert clear PVC or translucent polypropylene, shall have a cap, and have calibration marks. Provide at least 10 calibration lines, with a minimum of one line every 100 mL.
2. Capacities shall be as follows:

Chemical Feed System	Column Volume (mL)
Ammonium Hydroxide	1,000

C. Heat Shrinkable Sleeves

See Section 400500.

PART 3 - EXECUTION

A. Installing Calibration Columns

1. Connect calibration columns to the piping by means of a tee connection.
2. The calibration column shall be isolated using a valve. The column shall vent gases back to the storage tank.

SECTION 400722
FLEXIBLE PIPE COUPLINGS AND EXPANSION JOINTS

PART 1 - GENERAL

A. Description

This section includes materials and installation of flexible gasketed sleeve-type compression pipe couplings for ductile-iron pipe; thermal expansion compensators and expansion joints 4 inches in diameter and smaller for PVC, and copper pipe; and couplings for connecting different pipe materials.

B. Related Work Specified Elsewhere

1. Painting and Coating: 099000.
2. Cold-Applied Wax Tape Coating: 099752.
3. Polyethylene Sheet Encasement (AWWA C105): 099754.
4. Fusion-Bonded Epoxy Linings and Coatings: 099761.
5. General Piping Requirements: 400500.
6. Pipe Hangers and Supports: 400764.
7. Pressure Testing of Piping: 400515.
8. Western Hills Water District Standard Drawings and Specifications.

C. Submittals

1. Submit shop drawings in accordance with the General Provisions and Section 013300.
2. Submit manufacturer's catalog data on flexible pipe couplings and thermal expansion compensators. Show manufacturer's model or figure number for each type of coupling or joint for each type of pipe material for which couplings and joints are used. Show coatings.
3. Submit manufacturer's recommended torques to which the coupling bolts shall be tightened for the flexible gasketed sleeve-type compression pipe couplings.
4. Show materials of construction by ASTM reference and grade. Show dimensions.
5. Show number, size, and material of construction of tie rods and lugs for each thrust harness on the project.

PART 2 - MATERIALS

A. Coupling System Design and Component Unit Responsibility

The coupling manufacturer shall furnish the gaskets, bolts, nuts, glands, end rings, and hardware for pipe couplings of all types and shall design these components as an integral system. Design the gaskets for the coupling and appropriately size to provide a watertight seal at the design pressure and temperature. Ship gaskets, bolts, nuts, glands, end rings, and hardware for pipe couplings with the pipe coupling and clearly label indicating the origin of the material, including place and date of manufacture. Package the manufacturer's printed installation instructions with each pipe coupling.

B. Steel Flexible Pipe Couplings

1. Steel couplings shall have center sleeves and end rings made of carbon steel conforming to AWWA C219, Section 4. Minimum center sleeve length shall be 5 inches for pipe sizes 3/4 inch through 4 1/2 inches, 7 inches for pipe sizes 5 inches through 24 inches.
2. Sleeve bolts in exposed service shall be carbon steel per AWWA C219, Section 4. Sleeve bolts in buried or submerged service shall be Type 316 stainless steel per AWWA C219, Section 4.
3. Steel end rings shall be cast, forged, or hot rolled in one piece. Do not use rings fabricated from two or more shapes.
4. Wall thickness of sleeve shall be at least that specified for the size of pipe in which the coupling is to be used.

C. Ductile-Iron Flexible Pipe Couplings

1. Couplings shall have center sleeves and end rings made of ductile iron conforming to AWWA C219, Section 4.
2. Sleeve bolts in exposed service shall be Type 316 stainless steel per AWWA C219, Section 4. Sleeve bolts in buried or submerged service shall be Type 316 stainless steel per AWWA C219, Section 4.

D. Joint Harnesses

1. Tie bolts or studs shall be as shown in the following table. Bolt or stud material shall conform to ASTM A193, Grade B7. Nuts shall conform to ASTM A194, Grade 2H. Lug material shall conform to ASTM A36, ASTM A283, Grade B, C, or D, or ASTM A285, Grade C. Lug dimensions for steel pipe shall be as shown in AWWA Manual M11 (2004 edition), Figure 13-20, using the number and size of lugs as tabulated below.
2. Lugs for steel pipe shall be Type P for pipes 6 through 10 inches and Type RR for pipes 12 inches and larger. Lug or ear dimensions for ductile-iron pipe shall be as shown in the drawings.

TIE BOLTS OR STUD REQUIREMENTS FOR FLEXIBLE PIPE COUPLINGS FOR STEEL PIPE				
Nominal Pipe Size (inches)	Tie Bolt or Stud Minimum Requirements			
	150 psi		300 psi	
	No. Bolts or Studs and Size (inches)	Minimum Pipe Wall Thickness (inches)	No. Bolts or Studs and Size (inches)	Minimum Pipe Wall Thickness (inches)
6	2 x 5/8	0.193	2 x 5/8	0.282
8	2 x 5/8	0.239	2 x 5/8	0.354
10	2 x 5/8	0.312	2 x 3/4	0.466
12	2 x 3/4	0.188	4 x 7/8	0.250
14	2 x 7/8	0.188	4 x 1	0.250
16	2 x 1	0.250	4 x 1 1/8	0.250
18	2 x 1 1/8	0.250	4 x 1 1/8	0.250

TIE BOLTS OR STUD REQUIREMENTS FOR FLEXIBLE PIPE COUPLINGS FOR DUCTILE IRON PIPE						
Nominal Pipe Size (inches)	Tie Bolt or Stud Minimum Requirements					
	150 psi ⁽¹⁾			300 psi ⁽²⁾ Pipe		
	No. Bolts or Studs	Size (inch)	Ear ⁽³⁾ Type	No. Bolts or Studs	Size (inch)	Ear ⁽³⁾ Type
4	2	5/8	A	2	5/8	A
6	2	5/8	A	2	5/8	A
8	2	5/8	A	2	5/8	A
10	2	5/8	A	4	5/8	A
12	2	5/8	A	4	5/8	A
14	4	5/8	A	5	3/4	A
16	4	5/8	A	5	3/4	B
18	4	3/4	B	8	3/4	B

(1) Use ASME B16.1 Class 125 flanges.
(2) Use ASME B16.1 Class 250 flanges.
(3) Ear type as shown in the detail on the last page of Section 400722.

3. Select number and size of bolts based on the test pressure shown in Section 400515. Use the following table to determine the number of bolts required around pipe circumference. Where odd number is tabulated, place

the table above. For test pressures between 150 and 300 psi, use the 300-psi design in the table above.

4. Provide washer for each nut. Washer material shall be the same as the nuts. Minimum washer thickness shall be 1/8 inch.

E. Flexible Pipe Couplings for Plain-End Steel Pipe

Couplings shall be steel, Dresser Style 38, Smith-Blair Type 411, Baker Series 200, or equal.

F. Flexible Pipe Couplings for Plain-End Ductile-Iron Pipe

1. Couplings for pipe 12 inches and smaller shall be cast iron, Dresser Style 253 or 253 long sleeve, Smith-Blair Type 441, Baker Series 228, or equal.
2. Couplings for pipe larger than 12 inches shall be cast iron or steel, Dresser Style 38 or 253, Smith-Blair Style 411, Baker Series 228, or equal.

G. Transition Couplings

Couplings for connecting different pipes having different outside diameters shall be steel: Dresser Style 62 or 162, Smith-Blair Series 413, Baker Series 212 or 220, or equal. Couplings shall have an internal full circumference ring pipe stop at the midpoint of the coupling. Inside diameter of coupling pipe stop shall equal inside diameter of smaller diameter pipe.

H. Flanged Coupling Adapters for Cast- and Ductile-Iron Pipe

1. Adapters for cast- and ductile-iron pipe 12 inches and smaller shall be cast iron: Dresser Style 127, Smith-Blair Series 912, or equal.
2. Adapters for cast- and ductile-iron pipe larger than 12 inches shall be steel: Dresser Style 128, Smith-Blair Type 913, or equal.
3. Flange ends shall match the flange of the connecting pipe; see detail piping specifications.

I. Bolts and Nuts for Flanges

See Section 400500.

J. Threaded Caps for Protection of Nuts and Bolt Threads

See Section 400500.

PART 3 - EXECUTION

A. Installation of Flexible Pipe Couplings, Segmented Sleeve Couplings, and Expansion Joints

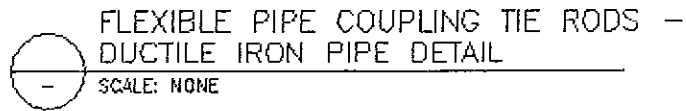
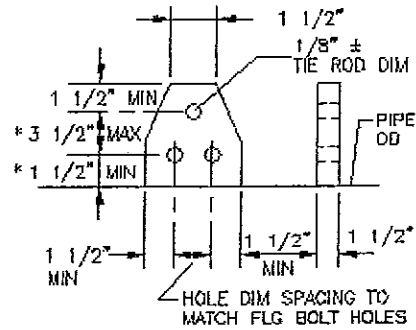
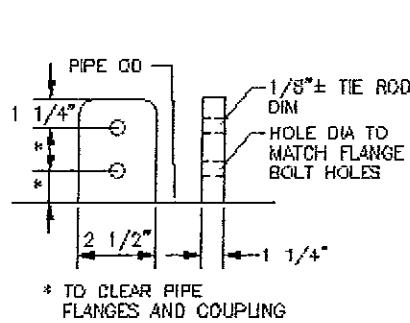
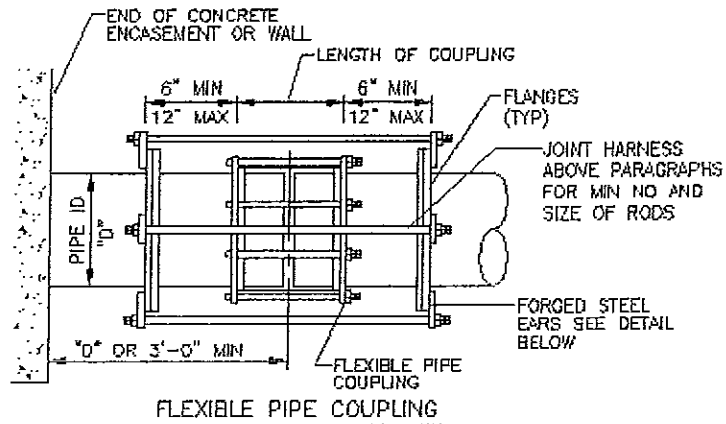
1. Clean oil, scale, rust, and dirt from pipe ends. Clean gaskets in flexible pipe couplings before installing.
2. Install expansion joints per manufacturer's recommendations, so that 50% of total travel is available for expansion and 50% is available for contraction.
3. Lubricate bolt threads with graphite and oil prior to installation.
4. Install threaded nut and bolt thread protection caps after completing the bolt, nut, and gasket installation. Install on exposed and buried flexible pipe couplings, transition couplings, flanged coupling adapters, dismantling joints, and segmented restrained sleeve couplings.

B. Painting and Coating

1. Coat buried flexible pipe couplings (including joint harness assemblies), transition couplings, segmented sleeve couplings, and flanged coupling adapters per Section 099000, System No. 21 on buried bolt threads, tie bolt threads, and nuts per Section 099000, System No. 24. Then wrap the couplings with polyethylene wrap per Section 099754.
2. Coat flexible pipe couplings (including joint harness assemblies), transition couplings, segmented sleeve couplings, and flanged coupling adapters located indoors, in vaults and structures, and above ground with the same coating system as specified for the adjacent pipe. If the adjacent pipe is not coated, coat couplings per Section 099000, System No. 10. Apply prime coat at factory.
3. Line carbon steel and iron flexible pipe couplings and segmented sleeve couplings per Section 099000, System No. 7.

C. Hydrostatic Testing

Hydrostatically test flexible pipe couplings, expansion joints, segmented sleeve couplings, and expansion compensators in place with the pipe being tested. Test in accordance with Section 400515.



END OF SECTION

SECTION 400764
PIPE HANGERS AND SUPPORTS

PART 1 - GENERAL

A. Description

This section includes materials and installation of pipe hangers and supports including accessory items, such as anchor bolts and screws.

B. Related Work Specified Elsewhere

1. Painting and Coating: 099000.
2. Fusion-Bonded Epoxy Linings and Coatings: 099761.
3. Wall Pipes, Seep Rings, and Penetrations: 400762.
4. Flexible Pipe Couplings and Expansion Joints: 400722.
5. Western Hills Water District Standard Drawings and Specifications.

C. Submittals

1. Submit shop drawings in accordance with the General Provisions and Section 013300.
2. Provide line drawings of each piping system to the scale shown in the drawings, locating each support or hanger. Identify each type of hanger or support by the manufacturer's catalog number or figure.
3. Provide installation drawings and manufacturer's catalog information on each type of hanger and support used. Clearly indicate the actual pipe outside diameter (not just nominal pipe size) that is used for the hangers and supports.

PART 2 - MATERIALS

A. Design Criteria

1. Not all pipe supports or hangers required are shown in the drawings. Provide pipe supports for every piping system installed. Support piping by pipe support where it connects to pumps or other mechanical equipment.
2. Pipe support and hanger components shall withstand the dead loads imposed by the weight of the pipes, fittings, and valves (all filled with water), plus valve actuators and any insulation, and shall have a minimum safety factor of five based on material ultimate strength.

B. Hanger and Support Systems

1. Pipe hangers and supports shall be as manufactured by Anvil, Unistrut, B-Line, Superstrut, or equal.
2. Pipe hangers and supports shall comply with MSS SP-58 for the standard types referenced in the drawings. Construct special hangers and supports if detailed in the drawings. Type numbers for standard hangers and supports shall be in accordance with MSS SP-58 as listed below:

Type Number	Description	Manufacturer and Model (or Equal)
1	Adjustable steel clevis	Anvil Fig. 590 or 260, B-Line B3100 or B3102
3	Steel double-bolt pipe clamp	Anvil Fig. 295A or 295H, B-Line B3144 or B3144A
4	Steel pipe clamp (pipes smaller than 3 inches)	Anvil Fig. 212, B-Line B3140
4	Steel pipe clamp (pipes 3 inches and larger)	Anvil Fig. 216, B-Line 3142
5	Pipe hanger	B-Line B6690
6	Adjustable swivel pipe ring	Anvil Superstrut 714, Anvil Fig. 104
7	Adjustable steel band hanger	B-Line B3172
8	Extension pipe or riser clamp	Anvil Fig. 261, B-Line B5573
9	Adjustable band hanger	Anvil Fig. 97
10	Adjustable swivel ring band hanger	Anvil Fig. 70, B-Line B3170 NF
11	Split pipe ring with adjustable turnbuckle	Anvil Fig. 108, B-Line B3173
13	Steel turnbuckle	Anvil Fig. 230, B-Line B3202
14	Steel clevis	Anvil Fig. 299, B-Line B3201
15	Swivel turnbuckle	Anvil Fig. 114, B-Line B3224
16	Malleable iron socket	Anvil Fig. 110R, B-Line B3222
17	Steel weldless eye nut	B-Line B3200
18	Steel or malleable iron concrete insert	Anvil Fig. 281, Superstrut 452
19	Top beam C-clamp	Anvil Fig. 92, B-Line B3033
20	Side I-beam or channel clamp	Anvil Fig. 14 or 217
21	Center I-beam clamp	Anvil Figure 134

Type Number	Description	Manufacturer and Model (or Equal)
22	Welded attachment type	Anvil Fig. 66 B-Line B3083
23	C-clamp	Anvil Fig. 86, B-Line B3036L
24	U-bolt	Anvil Fig. 137, B-Line B3188
26	Clip	Anvil Fig. 262, B-Line B3180
28	Steel I-beam clamp with eye nut	Anvil Fig. 228
29	Steel wide flange	Anvil Fig. 228 clamp with eye nut
30	Malleable iron beam clamp with extension piece	Superstrut CM-754, B-Line B3054
31	Light welded steel bracket	Anvil Fig. 194, B-Line B3063
32	Medium welded steel bracket	Anvil Fig. 195, B-Line B3066
33	Heavy welded steel bracket	Anvil Fig. 199, B-Line B3067
34	Side beam bracket	Anvil Fig. 202, B-Line B3062
36	Pipe saddle support	Anvil Fig. 258, B-Line B3095
37	Pipe stanchion saddle	Anvil Fig. 259, B-Line B3090
38	Adjustable pipe saddle support	Anvil Fig. 264, B-Line B3089
39	Steel pipe covering	Anvil Fig. 160, 161, 162, 163, 164, or 165; Superstrut A 789; B-Line B3160/B3165
40	Insulation protection shield	Anvil Fig. 167, B-Line B3151
41	Single pipe roll	Anvil Fig. 171, B-Line B3114
43	Adjustable roller hanger with swivel	Anvil Fig. 181, B-Line B3110
44	Pipe roll, complete	Anvil Fig. 271, B-Line B3117SL

3. Pipe hangers and supports shall be hot-dipped galvanized per ASTM A153. Bases, rollers, and anchors shall be steel as described above or may be cast iron (ASTM A48). Pipe clamps shall be steel as described above or may be malleable iron (ASTM A47).

C. Anchor Bolts and Screws

Anchor bolts and screws for attaching pipe supports and hangers to walls, floors, ceilings, and roof beams shall be hot-dipped galvanized steel, ASTM A307 or Type 316 stainless steel, ASTM A276 or F593. Nuts shall be galvanized steel, ASTM A563 or Type 316 stainless steel, ASTM A194, Grade 8M or ASTM F594, Type 316 stainless steel.

PART 3 - EXECUTION

A. Pipe Support Spacing for Supports on Top of Slabs or Grade

Install pipe supports on horizontal runs at the spacing shown or detailed in the drawings. Provide supports of the type shown or detailed in the drawings. If no spacings are given in the drawings or in the specifications for a particular piping system, use the following:

1. Pipe Support Spacing for Ductile-Iron Pipe (Sections 402040):

Pipe Size (inches)	Maximum Support Spacing (feet)
3/8 and smaller	4
1/2 through 1	6
1 1/4 through 2	8
2 1/2 and 3	10
3 1/2 and 4	10
6	12
8	12
10 and 12	14
14 and 16	16
18	16
20 through 24	18
30	18

2. Pipe support spacing for other pipe materials shall be the same as described above in paragraph entitled "Pipe Hanger and Wall Support Spacing."

B. Installing Pipe Hangers and Supports

1. Provide separate hangers or supports at each valve. Provide one hanger or support around each end of the valve body or on the adjacent connecting pipe within one pipe diameter of the valve end. Provide additional hangers or supports to relieve eccentric loadings imposed by offset valve actuators.
2. Provide separate hangers or supports at each pipe elbow, tee, or fitting. Provide separate hangers or supports on both sides of each nonrigid joint or flexible pipe coupling.
3. Adjust pipe hangers per MSS SP-89, paragraph 10.6.
4. Install leveling bolts beneath support baseplates. Provide 3/4-inch thick grout pad beneath each base.

5. Install piping without springing, forcing, or stressing the pipe or any connecting valves, pumps, and other equipment to which the pipe is connected.

C. Painting and Coating

1. Grind welds of fabricated steel pipe supports smooth, prepare surface by sandblasting, and apply coating system.
2. Paint exposed pipe hangers and supports to match the color of the adjacent wall using System No. 15 per Section 099000. If the adjacent wall is not painted, paint the hangers and supports to match color code of the largest pipe on the support.
3. Coat submerged pipe hangers and supports per Section 099000, System No. 7.

SECTION 400775
EQUIPMENT, PIPING, DUCT, AND VALVE IDENTIFICATION

PART 1 - GENERAL

A. Description

This section includes materials and installation of markers, labels, and signs for pipes, ducts, and valves; for mechanical equipment; for hazardous materials warnings; and for miscellaneous plant services.

B. Related Work Specified Elsewhere

1. Painting and Coating: 099000.
2. Room Designator and Hazardous Area Signs: 101470.

C. Submittals

1. Submit shop drawings in accordance with the General Conditions and Section 013300.
2. Submit manufacturer's catalog data and descriptive literature describing materials, colors, letter size, and size of labels.

PART 2 - MATERIALS

A. Labels for Exposed Piping

1. Labels for piping shall bear the full piping system name as shown in the drawings. Provide separate flow directional arrows next to each label. Color, size, and labeling shall conform to ANSI A13.1 and Z535.1. Labels for piping inside buildings shall be vinyl cloth: W. H. Brady Co. B-500 vinyl cloth, Seton Name Plate Corporation Pipe Markers, or equal. Labels for piping located outdoors shall be weather- and UV-resistant acrylic plastic and shall be W. H. Brady Co. B-946, Seton Name Plate Corporation Pipe Markers, or equal.
2. Alternatively, provide preprinted, semirigid, snap-on, color-coded pipe markers. Color, size, and labeling shall conform to ANSI A13.1 and Z535.1. Label shall cover 360 degrees (minimum). Labels shall be fabricated of weather- and UV-resistant acrylic plastic. Labels shall be Seton Nameplate Corporation SetMark pipe marks or equal.

B. Labels for Mechanical Equipment

Provide a label for each pump, blower, compressor, tank, feeder, flocculator, flash mixer, clarifier mechanism, or other piece of mechanical equipment. Label shall show the equipment name and tag number as shown in the drawings. Labels shall be 1 1/2 inches (minimum) by 4 inches (minimum) brass, aluminum, or 1/8-inch-thick fiberglass tags: Brady B-120 Fiber-Shield,

C. Labels for Exposed Tanks

Signs shall be weather- and UV-resistant. Labels shall be Brady B-946, Seton Name Plate Corporation PSPL, or equal. Minimum size shall be 7 inches by 10 inches. Provide a sign on each tank bearing the tank tag number and the name of the liquid stored.

D. Laminated Plastic Wall Signs

Wall signs shall be 1 1/2 inches by 4 inches (minimum dimensions), 1/16-inch-thick satin-surfaced material conforming to ASTM D709 (Grades ES-1, ES-2, or ES-3). Lettering shall be 1/2-inch-high white letters on black background. Do not provide mounting holes. Legends shall be as shown in the drawings.

E. Labels for Automatic Start/Stop Equipment

Provide a sign reading "CAUTION--EQUIPMENT STARTS AND STOPS AUTOMATICALLY" on each piece of equipment listed below. Signs shall be pressure-sensitive vinyl with adhesive for application to equipment. Signs mounted on adjacent walls are also acceptable. Size shall be 10 inches by 7 inches minimum. Products: Seton, Brady, or equal.

Equipment Type	Location	Tag Number
Ammonium hydroxide pump station	Ammonium hydroxide station	CP-011 CP-012
Recirculation pump	Recirculation pump station	RP-001

F. Hazardous Materials Warning and Danger Signs

1. Provide hazardous materials warning diamond signs complying with NFPA 704. Size shall be 12 inches square. Wall signs shall be 1/8-inch-thick fiberglass: Brady B-120 Fiber-Shield or equal. Signs attached to tanks, cabinets, or pieces of equipment shall be self-adhesive vinyl cloth: Brady B-946 or equal. Provide signs at the following locations:

Area No.	Tag Number	Tank or Equipment	
		Location	Chemical
001	CP-011 CP-012	Ammonium hydroxide pump station	NH ₄ OH
001	CT-011	Ammonium hydroxide dispensing tank	NH ₄ OH

See also specification Section 101470 for additional information on NFPA 704 labeling requirements.

2. Provide signs reading "DANGER" followed by the name of the chemical, gas, or hazard. Size shall be 10 inches by 14 inches. Signs shall be 1/8-inch-thick fiberglass: Brady B-120 or equal. Provide signs at the following locations:

Area No.	Sign Location	Name of Hazardous Material
001	On chemical tank	Ammonium hydroxide
001	On chemical pump housing	Ammonium hydroxide

See also specification Section 101470 for additional information on labeling requirements.

G. Underground Plastic Warning Tape for Metallic Pipe

Provide permanent, bright-colored, continuous-printed plastic tape, intended for direct burial service, not less than 6 inches wide by 3.5 mils thick. Provide tape with printing which most accurately indicates type of service of buried pipe. Provide the following colored tape for the various piping services:

Service	Color
Cable TV	Orange
Chemical	Yellow
Electric	Red
Fuel Oil, Gasoline	Yellow
Gas	Yellow
Reclaimed Water	Violet
Sewer	Green
Telephone	Orange
Water	Blue

H. Underground Detectable Metallic Pipe Warning Tape for Nonmetallic Pipe

Provide permanent, bright-colored, continuous-printed tape consisting of an aluminum or steel foil sheathed in a plastic laminate, not less than 2 inches wide by 3 mils thick. Provide tape with printing which most accurately indicates type of buried service. Provide the following colored tape for the various piping services:

Service	Color
Cable TV	Orange
Chemical	Yellow
Electric	Red
Fuel Oil, Gasoline	Yellow
Gas	Yellow
Reclaimed Water	Violet
Sewer	Green
Telephone	Orange
Water	Blue

I. No Smoking Signs

Provide a sign reading "NO SMOKING" at each location listed below. Signs shall be weather and UV resistant, minimum size 10 inches by 7 inches, 1/18-inch thick fiberglass. Products: Brady, Seton, or equal.

Area Number	Location
001	Ammonium hydroxide pump station

PART 3 - EXECUTION

A. Installing Pipe Labels

1. Provide label and flow arrow at each connection to pumps or other mechanical equipment, at wall boundaries, at tees and crosses, and at 20-foot centers on straight runs of piping.
2. On piping having external diameters less than 6 inches (including insulation, if any), provide full-band pipe markers, extending 360 degrees around pipe at each location.
3. On piping having external diameters of 6 inches and larger (including insulation, if any), provide either full-band or strip-type pipe markers but not narrower than three times letter height (and of required length), fastened by one of the following methods:
 - a. Laminated or bonded application of pipe marker to pipe or insulation.
 - b. Strapped-to-pipe or insulation application of semirigid type with Type 304 or 305 stainless steel bands.

B. Installing Valve and Equipment Labels

1. Attach labels to the valve or piece of equipment with Type 304 or 316 stainless steel chains or wires.
2. Attach valve labels to the valve handwheels. If the valve has no handwheel, attach the label to the valve by tying the tag wire or chain around the operating shaft or nut.

C. Installing Miscellaneous Signs

Attach per sign manufacturer's recommendations and per CAL/OSHA requirements.

D. Installing Wall and Door Signs

Attach to walls and doors using epoxy adhesive.

E. Installing Labels for Automatic Start/Stop Equipment and Hazardous Materials Warning Signs for Equipment

1. Attach signs for exposed equipment directly to the equipment.

F. Installing Underground Plastic Warning Tape for Metal Pipe

During backfilling of each exterior underground piping system, install continuous underground-type plastic line marker, located directly over buried line at 6 to 8 inches above the top of the pipe. Where multiple small lines are buried in common trench and do not exceed overall width of 16 inches, install single line marker.

G. Installing Underground Detectable Metallic Pipe Warning Tape

Install tape 4 to 6 inches below finished ground surface, located directly over buried pipelines. Where multiple small pipelines are buried in a common trench and do not exceed an overall width of 16 inches, install a single marker tape.

SECTION 402020
COPPER TUBING

PART 1 - GENERAL

A. Description

This section includes materials, installation, and testing of copper tubing and fittings for water and air service.

B. Related Work Specified Elsewhere

1. Painting and Coating: 099000.
2. Cold-Applied Wax Tape Coating: 099752.
3. Trenching, Backfilling, and Compacting: 312316.
4. Disinfection of Piping and Structures: 331300.
5. General Piping Requirements: 400500.
6. Pressure Testing of Piping: 400515.
7. Manual, Check, and Process Valves: 400520.
8. Pipe Hangers and Supports: 400764.
9. Equipment, Piping, Duct, and Valve Identification: 400775.
10. Western Hills Water District Standard Drawings and Specifications

C. Submittals

1. Submit shop drawings in accordance with the General Provisions and Section 013300.
2. Submit materials list showing material of tubing and fittings with ASTM reference and grade.
3. Submit manufacturer's catalog data and descriptive literature for wye strainers, unions, and coatings.
4. Submit manufacturer's catalog data and descriptive literature for solder.

PART 2 - MATERIALS

A. Tubing

Copper tubing shall conform to ASTM B88. Tubing located above floors or suspended from ceilings shall be Type L, hard drawn, except that tubing utilizing nut-and-ferrule fittings and joints shall be soft annealed (Temper O). Buried tubing or tubing located beneath floor slabs shall be Type K, annealed.

B. Pipe and Nipples

Short threaded nipples and pipe shall be brass conforming to ASTM B43 or copper conforming to ASTM B42, regular wall thickness, except that nipples and pipe of sizes 1 inch and smaller shall be extra strong. Threads shall conform to ASME B1.20.1.

C. Solder Joint Fittings

1. Wrought copper solder joint seamless fittings shall be designed for use with copper water tube and conform to ASTM B75 and ASME B16.22. Material shall be UNS C10200, C12000, or C12200.
2. Cast copper solder joint pressure fitting shall be designed for use with copper water tube and conform to ASME B16.18.

D. Threaded Fittings for Brass and Copper Pipe and Nipples

Cast bronze threaded fittings shall conform to ASME B16.15, Classes 125 and 250. Use Class 125 fittings for test pressures of 200 psi and less. Use Class 250 fittings for test pressures of greater than 200 psi but less than 400 psi.

E. Flanges and Flanged Fittings

Cast bronze pipe flanges and flanged fittings shall conform to ASME B16.24, Classes 150 and 300. Use Class 150 flanged fittings for test pressures of 225 psi and less. Use Class 300 flanged fittings for test pressures greater than 225 psi but less than 500 psi. Provide flat-faced flanges. Use solder joint or threaded end companion flanges. Companion flanges with solder joint or threaded end shall be limited to the pressure rating of the pipe connection and not the flanged joint.

F. Nut and Ferrule Fittings

Fittings shall be brass and of the Swagelok type as manufactured by Crawford Fitting Company, utilizing a nut and dual ferrule design to connect to tubing. End connections shall be of the union type.

G. Solder

Solder shall be 95-5 (95% tin, 5% antimony) conforming to ASTM B32, Grade Sb5 or silver solder conforming to AMS 4773C.

H. Soldering Flux

Soldering flux shall comply with ASTM B813.

I. Bolts and Nuts for Flanges

See Section 400500.

J. Gaskets for Flanges

See Section 400500.

K. Wye Strainers

Wye strainers shall be bronze, ASTM B61 or B62, with 60-mesh Type 304 or 316 stainless steel screens. Working pressure shall be at least 150 psi. Provide bronze plug on the tapped blowoff outlet. Provide one spare screen for each strainer. Strainers shall be Walworth Figure 3699-1/2, Muessco No. 351, or equal.

L. Unions

Unions shall be the same size as the pipe or tube, three part, with copper flare end connections. Unions shall be bronze, ASTM B61 or B62. Unions shall be Mueller H-15400, Jones J-1528, or equal.

M. Insulating Unions

See Section 264213.

PART 3 - EXECUTION

A. General

1. Piping and tubing penetrations through walls, slabs, and floors shall be as detailed in the drawings and as specified in Section 400762.
2. Pipe and tube hangers and supports shall be as detailed in the drawings and as specified in Section 400764.
3. Do not allow piping and tubing to come in contact with wood treated with ammonium sulfate fire retardant. Provide hangers or supports.

B. Joint and Fitting Selection

1. Use soldered joints and fittings in exposed tubing service. Use soldered joints and fittings in buried service.
2. Fittings and joints 3/8 inch and smaller in exposed service may be of the nut-and-ferrule type with flared end connections or compression joint connections.
3. Use threaded joints and fittings in buried and exposed copper and brass piping.

C. Pressure Testing

Test copper tubing and piping for leakage in accordance with Section 400515. See Section 400515 for test pressures.

D. Installing Flange Bolts and Nuts

See Section 400500.

E. Making Soldered Joints

1. Tube cutters shall always be sharp. Do not take too deep a cut with each turn of the cutter or back and forth motion of a saw blade.
2. Cut tubing square and remove burrs. Clean both the inside and outside of fitting and pipe ends with steel wool and muriatic acid before soldering. Prevent annealing of fittings and tubing when making connections. Do not miter joints for elbows or notch straight runs of pipe for tees.
3. Make soldered joints in accordance with ASTM B828. Solder shall penetrate to the full depth of the cup in joints and fittings. Solders shall comply with ASME B31.3, paragraph 333.

F. Installing Tubing and Pipe

1. Do not drag tubing out of tubing rack. Do not drag tubing across cement, asphalt, gravel, or any other surface that could scratch it.
2. Bends in soft copper tubing shall be long sweep. Shape bends with shaping tools. Form bends without flattening, buckling, or thinning the tubing wall at any point.
3. Install tube and pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment.
4. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to male pipe threads before installing threaded fitting. Joints shall be watertight.

6. Install aboveground or exposed tubing per Section 400500.

G. Connecting Copper Tubing to Steel and Ductile-Iron Pipe

Provide an insulating union per Section 264213 at the point of transition from copper tubing or piping to ferrous piping.

H. Installing Unions

Provide unions on exposed piping and tubing 3 inches and smaller as follows:

1. At every change in direction (horizontal and vertical).
2. Downstream of valves, 6 to 12 inches.
3. Every 40 feet in straight tubing and piping runs.
4. Where shown in the drawings.

I. Coating Pipe and Tubing

1. Coat tubing and fittings that are exposed or in vaults and structures per Section 099000, System No. 52.
2. Coat buried pipe and tubing per Section 099000, System No. 25.

J. Chlorination of Potable Waterlines

See Section 331300.

SECTION 402035
RUBBER AND PLASTIC HOSE AND TUBING

PART 1 - GENERAL

A. Description

This section includes materials and accessories for rubber and plastic hoses and tubing:

1. Teflon hose for chemical service (Type 2).
2. Flexible nylon-reinforced clear PVC tubing for water and chemical service (Type 8).
3. Flexible PVC tubing for chemical and non-potable water service (Type 10).
4. Flexible white translucent polypropylene tubing (Type 14).
5. Flexible translucent fluoropolymer (PTFE) tubing (Type 17).

B. Related Work Specified Elsewhere

1. Painting and Coating: 099000.
2. Fusion-Bonded Epoxy Linings and Coatings: 099761.
3. Pressure Testing of Piping: 400515.
4. Miscellaneous Pipefittings and Accessories: 400711.
5. Pipe Hangers and Supports: 400764.
6. Equipment, Piping, Duct, and Valve Identification: 400775.

C. Submittals

1. Submit shop drawings in accordance with the General Conditions and Section 013300.
2. Submit manufacturer's catalog data and descriptive literature for hoses, tubing, and couplings. Show pressure rating and materials of construction for tube, carcass, and cover. Show design of hose and tubing ends.
3. Submit procedures for making up insert fittings and joints and compression fittings and joints.

PART 2 - MATERIALS

A. Hose and Tubing Identification

Hoses and tubing are identified in the drawings by size, type number, and in some cases (Types 1 through 5 hoses) by a suffix letter denoting the type of end connection. For example, a callout of 2" Type 1A means a 2-inch, abrasive slurry service hose, with grooved-end nipples at both ends.

B. Hose Design (Types 1 Through 5)

Design hose for the material conveyed as described in the subsection on "Service Conditions." Provide hose design consisting of cover, carcass, and tube. Design carcass reinforcement to provide a minimum 4:1 safety factor for the working pressure specified in the subsection on "Service Conditions."

C. Type 2: Teflon Hose for Chemical Service

1. Cover: Teflon or EPDM.
2. Carcass: Minimum two plies of helical-wound wire-reinforced high-tensile synthetic fiber.
3. Tube: Teflon.
4. Pressure Rating: 200 psi for hoses 2 inches and smaller, 150 psi for 2 1/2 and 3 inches in size, and 125 psi for 4 inches in size.
5. Products: UNAFLEX Serpent Acid and Chemical Discharge Hose, Goodyear "HI-PER," Gates "Stallion," or equal.

D. Type 7: Flexible Wire-Reinforced PVC Tubing (1/4 Through 2 Inches)

1. Provide wire-reinforced PVC tubing with a nylon or steel braid reinforcement embedded in the wall of the tubing. Tubing shall be resistant to dry chlorine gas and 6,000 ppm of chlorine solution. Minimum operating pressure shall be 150 psi for tubing 3/4 inch and smaller and 100 psi for tubing 1 through 2 inches. Burst pressure shall be at least 4.0 times the specified operating pressure. Minimum design vacuum rating shall be 29-inch Hg vacuum. Minimum bending radius shall be 4 inches for tubing 1 inch and smaller and 8 inches for tubing 1 1/4 through 2 inches. Tubing shall be NSF approved for potable water service. Join tubing to pipe with a single-barb male adapter fitting. Secure tubing to the fitting with a stainless steel hose clamp. Connect tubing sections by means of single-barb insert couplings with a stainless steel hose clamp.
2. Products: Ryan-Herco "Herco-Flex Wire-Reinforced PVC Hose (Heavy Wall)" or equal.

E. Type 8: Flexible Nylon-Reinforced Clear PVC Tubing (1/8 Through 2 Inches)

1. Provide clear PVC tubing with nylon braid reinforcement embedded in the wall of the tubing with smooth inside bore and smooth outside. Minimum operating pressure shall be

200 psi for tubing 3/4 inch and smaller, 150 psi for 1 inch, 100 psi for 1 1/4 and 1 1/2 inches, and 75 psi for 2 inches. Burst pressure shall be at least 4.0 times the specified operating pressure. Join tubing to pipe with a single-barb male adapter fitting. Secure tubing to the fitting with a stainless steel hose clamp. Connect tubing sections by means of single-barb couplings with a stainless steel clamp.

2. Products: Ryan-Herco "Herco-Braid Clear PVC Tubing" or equal.

F. Type 10: Flexible PVC Pipe--Size Tubing for Liquid Chemical and Nonpotable Water Services (1/2 Through 2 Inches)

1. Provide cream-colored PVC flexible tubing with smooth inside bore and smooth outside. Outside diameter shall be the same as PVC pipe of the same nominal size. Minimum operating pressure shall be 125 psi for tubing 3/4 inch and smaller; 100 psi for 1 inch; and 70 psi for 1 1/4, 1 1/2, and 2 inches. Minimum bending radius shall be 8 inches for tubing 1 inch and smaller and 18 inches for tubing 1 1/4 through 2 inches. Join tubing to pipe by means of the same solvent welding or cementing as for the PVC pipe. Connect tubing sections by means of solvent-cemented PVC couplings.
2. Products: Ryan-Herco Flexible PVC Pipe Size Tubing or equal.

G. Type 14: Flexible White Translucent Polypropylene Tubing (1/4 Through 1 Inch)

1. Provide odorless and tasteless flexible white translucent polypropylene tubing with smooth inside bore and smooth outside. Minimum operating pressures shall be 280 psi for 1/4 inch; 210 psi for 5/16 inch; 170 psi for 3/8 inch; 120 psi for 1/2 inch; and 90 psi for 5/8, 3/4, and 1 inch. Joints and fittings shall be of the compression type utilizing a ferrule nut.
2. Products: Ryan-Herco "Herco-Pro Polypropylene Tubing" or equal.

H. Type 17: Flexible Translucent Fluoropolymer (PTFE) Tubing (1/8 Through 3/4 Inch)

1. Provide flexible translucent PTFE fluoropolymer tubing with smooth inside bore and smooth outside. Shore Durometer hardness shall be 55 to 62, "D" scale. Minimum operating pressures shall be 325 psi for 1/8 and 1/4 inch, 225 psi for 5/16 inch, 170 psi for 3/8 inch, 110 psi for 1/2 inch, 80 psi for 5/8 inch, and 70 psi for 3/4 inch. Joints and fittings shall be of the molded compression type utilizing a ferrule nut or flared type.
2. Products: Chemflour PTFE tubing with Chemflour molded PFA Teflon fittings or equal.

I. End Connections for Types 1 Through 5 Hoses

1. Type A: Schedule 80S, Type 316 stainless steel grooved-end nipples built into the hose. Grooved-end nipples shall be flexible, square cut grooved, per AWWA C606, Table 3. Connect hoses to each other with grooved-end couplings.
2. Type B: Schedule 80S, Type 316 stainless steel nipples built into the hose. Ends shall be male threaded, per ASME B1.20.1. Connect hose sections to each other with unions

3. Type C: Hose shank couplings of the quick-connect type. Fasten couplers and adapters to the hose with clamps. The couplers, adapters, and clamps shall be Type 316 stainless steel. Couplers shall be Evertite Part C, Civicon 633-C, Parker-Hannifin Style C, or equal. Adapters shall be Evertite Part E, Civicon 633-E, Parker-Hannifin Style E, or equal. Where hoses connect to piping, fasten hose shank adapters to the hose end and female couplers to the pipe end. Where hoses are connected in series, fasten one female coupler and one male adaptor to each hose. Fasten male adapters to both ends of a hose only where necessary to accommodate connections with pipes. Do not fasten female couplers to both ends of any hose.
4. Type D: Shaped to the dimensions of Class 125, ASME B16.1, flanges. Construct as an integral part of the hose utilizing the same tube, cover, and carcass material as the hose. Provide Type 316 stainless steel retaining ring for each flange. Bolts and nuts: ASTM A193 (Grade B8M) for bolts and ASTM A194 (Grade 8M) for nuts. Provide washer under each nut and bolthead. Washers shall be of the same material as the nuts.
5. Type E: Hose shank couplings shall be of the quick-connect type. Fasten couplers and hose adapters to the hose with clamps. Coupler and adapters shall be polypropylene: Dixon or equal. Clamps shall be Type 316 stainless steel. Where hoses connect to piping, fasten hose shank adapters to the hose end and female couplers to the pipe end. Where hoses are connected in series, fasten one female coupler by hose shank on one end and one male adapter by hose shank on the other end. Fasten male adapters to both ends of hose only where necessary to accommodate connections with pipes. Do not fasten female couplers to both ends of any hose.

J. Unions for Types 1 Through 5 Hoses

Unions shall be 3,000-pound WOG forged stainless steel, with dimensions conforming to MSS SP-83. Material shall conform to ASTM A182, Grade F316. Ends shall be threaded per ASME B1.20.1.

K. Insert Fittings for Tubing

1. When insert fittings are specified, they shall be of the single-barb type. The completed tubing and fitting system shall have the same operating pressure ratings as specified for the tubing.
2. Rigid PVC pipe to PVC tubing transition fittings shall be solvent cement socket by single barb fittings with stainless steel clamps.

L. Quantities

1. See drawings for total hose lengths or quantities. Provide hoses in maximum 50-foot-long sections.

PART 3 - EXECUTION

A. Storage

Store hoses in a protected room or building at a temperature range of 50°F to 70°F. Do not store hoses near sources of heat such as radiators or base heaters. Do not store hoses so that they are exposed to sunlight; provide covers to protect hoses from sunlight and from fluorescent or mercury lamps. Storage areas shall be cool and dark, free of dampness and mildew. Protect hoses from rodents and insects. Store hose that is shipped in coils so that the coils are in a horizontal plane.

B. Hose Installation

Prior to assembling hose and components such as fittings and connectors, carefully examine components for correct material, style, size, catalog number, and length. Examine hoses for cleanliness, obstructions, blisters, cover looseness or damage, kinks, cracks, cuts, or any other visible defects. Inspect the fitting and sealing surfaces for burrs, nicks, corrosion, or other imperfections. Do not use any components that display such signs of nonconformance.

C. Service Conditions

1. Service and design conditions for hoses and tubing shall be as follows:
 - a. Minimum Working Pressure: 150 psig.
 - b. Material Conveyed:
 - c. Hose or Tubing Size: See drawings.

D. Painting and Coating of Grooved-End Couplings

Line and coat grooved-end couplings with fusion-bonded epoxy per Section 099761.

E. Field Testing

1. Hydrostatically test hose for leakage in accordance with Section 400515. Leakage shall be zero. Perform pressure testing using water. Fill hoses with water with the outlet ends raised and any outlet valves open to allow the complete removal of air. When the air has been expelled, close outlet valves or install blind flanges or plugs on the outlets and lower the raised ends. Raise the pressure to the specified test pressure. Examine hose for leaks at couplings, fitting slippage, or any indication of weakness in the hose structure. Remove and replace the hose or couplings or fittings if there are any signs of leakage, fitting slippage, or weakness in the hose. Drain the water from the hoses after completion of the pressure tests. Test pressure shall be 200 psi.

END OF SECTION

SECTION 402040
DUCTILE-IRON PIPE

PART 1 - GENERAL

SEE WESTERN HILLS WATER DISTRICT STANDARD DRAWINGS AND SPECIFICATIONS FOR REQUIREMENTS.

A. Description

This section describes materials, testing, and installation of ductile-iron pipe and fittings 36 inches and smaller.

B. Related Work Specified Elsewhere

1. Painting and Coating: 099000.
2. Cold-Applied Wax Tape Coating: 099752.
3. Polyethylene Sheet Encasement (AWWA C105): 099754.
4. Fusion-Bonded Epoxy Linings and Coatings: 099761.
5. Trenching, Backfilling, and Compacting: 312316.
6. Disinfection of Piping and Structures: 331300.
7. General Piping Requirements: 400500.
8. Pressure Testing of Piping: 400515.
9. Pipe Hangers and Supports: 400764.
10. Equipment, Piping, Duct, and Valve Identification: 400775.
11. Flexible Pipe Couplings and Expansion Joints: 400722.

C. Submittals

1. Submit shop drawings in accordance with the General Provisions Section 013300.
2. Provide an affidavit of compliance with standards referenced in this specification, e.g., AWWA C151. Submit copy of report of pressure tests for qualifying the designs of all sizes and types of AWWA C153 fittings that are being used in the project. The pressure test shall demonstrate that the minimum safety factor described in AWWA C153, Section 5.5 is met.

3. Provide the following information:
 - a. Mortar lining thickness.
 - b. Wall thickness.
 - c. Show deflections at push-on and mechanical joints.
 - d. Submit joint and fitting details and manufacturer's data sheets.
4. Submit calculations and test data proving that the proposed restrained joint arrangement can transmit the required forces with a minimum safety factor of 1.5.
5. Submit certificate that cement for mortar lining complies with ASTM C150, designating type.
6. Submit test report on physical properties of rubber compound used in the gaskets.

PART 2 - MATERIALS

A. Pipe

Pipe shall be cast ductile (nodular) iron, conforming to AWWA C151.

B. Pipe Marking

Plainly mark each length of straight pipe and each fitting at the bell end to identify the design pressure class, the ductile-iron wall thickness, and the date of manufacture. Mark the spigot end of restrained joint pipe to show clearly the required depth of insertion into the bell.

C. Design Criteria

1. Obtain the following information from the drawings:
 - a. Elevation of the pipe invert or centerline and of the completed ground.
 - b. Alignment of the pipeline.
 - c. Field test hydraulic gradient elevation (HGL).
 - d. Nominal internal diameter, ID.
 - e. Design internal pressure class and thickness class.
 - f. Joint types.

D. Pipe Wall Thickness

1. Minimum wall thicknesses for pipe having grooved-end joints shall be as shown in the following table:

Pipe and Fitting Sizes (inches)	Wall Thickness*
16 and smaller	Special Class 53
18	Special Class 54
20	Special Class 55
24 to 36	Special Class 56
*Special Class and Pressure Class per AWWA C151.	

2. Minimum wall thickness for pipe having push-on or mechanical joints, restrained joints, plain ends, or cast flange ends shall be Class 15, unless otherwise shown in the drawings.
3. Minimum wall thickness for pipe having threaded flanges shall be Special Class 53 or Pressure Class 350.
4. Minimum pipe wall thickness required for corporation stops and tapped outlets shall be in accordance with Table A.1 of AWWA C151 for three full threads for design pressures up to 250 psi and four full threads for design pressures over 250 to 350 psi.

E. Fittings

1. Fittings 48 inches and smaller shall conform to AWWA C110 with a minimum pressure rating of 250 psi. Material shall be ductile iron. Flanges shall be flat faced.
2. Mechanical joint fittings conforming to AWWA C153 may be used in lieu of AWWA C110 fittings. Mechanical joint ductile-iron fittings 18 through 48 inches conforming to AWWA C110 (except for laying length) with a minimum pressure rating of 250 psi may also be used.
3. Grooved-end fittings shall conform to AWWA C110 with grooved ends conforming to AWWA C606, radius cut rigid joints. Fitting material shall conform to ASTM A48, Class 30; ASTM A126, Class B; or ASTM A536, Grade 65-42-10. Wall thickness of ductile-iron (ASTM A536) fittings shall conform to AWWA C110 or C153; wall thickness of cast-iron fittings shall conform to AWWA C110. Fittings and couplings shall be furnished by the same manufacturer.
4. Material for fittings with welded-on bosses shall have a Charpy notch impact value of minimum 10 ft-lbs under the conditions defined in AWWA C151. Test completed welds by the liquid penetrant method per ASTM E165.

F. Flanges

1. Flanges shall be solid back, Class 125 per AWWA C115. Flanges on pipe shall be either cast or threaded. Material shall be ductile iron.
2. Flanged pipe and fittings shall be shop fabricated, not field fabricated. Threaded flanges shall comply with AWWA C115. Flanges shall be individually fitted and machine tightened in the shop, then machined flat and perpendicular to the pipe barrel. Flanges shall be backfaced parallel to the face of flange. Prior to assembly of the flange onto the pipe, apply a thread compound to the threads to provide a leak-free connection. There shall be zero leakage through the threads at a hydrostatic test pressure of 250 psi without the use of the gasket.

G. Pipe Lining--Cement Mortar

1. Line pipe interior and fittings with cement-mortar per AWWA C104. Lining thickness shall be the double thickness listed in AWWA C104, Section 4.7. Cement for lining material shall conform to ASTM C150, Type II.
2. Line fittings per Section 099000, System No. 7.
3. Line blind flanges per Section 099000, System No. 7.
4. Cement-mortar for pointing interior joints shall consist of one part cement to one and one-half parts of washed plaster sand conforming to ASTM C35, mixed with the minimum amount of water which will permit placing the mortar.
5. Maintain a moist environment inside the lined pipe and fittings by sealing the ends with polyethylene sheet.
6. Loose areas of cement-mortar lining are not acceptable. Remove and reconstruct lining in areas where quality is defective, such as sand pockets, voids over sanded areas, blisters, drummy areas, cracked areas, and thin spots. Longitudinal cracks in excess of 1/32 inch in width or where crack extends to metal shall be repaired with epoxy. Repair all cracks larger than 1/16 inch with epoxy.

H. Grooved-End Couplings

1. Grooved-end pipe couplings shall be ductile iron, ASTM A536 (Grade 65-45-12). Gaskets shall be halogenated butyl rubber or EPDM
2. Bolts in exposed service shall conform to ASTM A183, 110,000-psi tensile strength. Bolts in buried or submerged service shall be ASTM A193, Grade B8, Class 2.
3. Couplings for pipe 24 inches and smaller shall conform to AWWA C606 for flexible radius ductile-iron pipe, except where rigid radius couplings are required to connect to

manufacturer's published literature for tolerances and dimensions for flexible and rigid radius cut joints. Couplings shall be Victaulic Style 31, Gustin-Bacon No. 500, or equal.

4. Couplings for pipe larger than 36 inches shall conform to AWWA C606 for shouldered end pipe. Couplings shall be Victaulic Style 44 or equal.
5. Grooved-end adapter flanges for piping 24 inches and smaller having an operating pressure of 150 psi and less shall be Victaulic Style 341 or 342 or equal. Flange dimensions shall conform to ASME B16.1, Class 125.
6. Grooved-end transition couplings for connecting ductile-iron pipe 12 inches and smaller to steel pipe shall be Victaulic Style 307 or equal.

I. Gaskets for Flanges

See Section 400500.

J. Gaskets for Mechanical, Push-On, and Restrained Joints

Natural rubber in accordance with AWWA C111.

K. Bolts and Nuts for Flanges

See Section 400500.

L. Outlets and Nozzles

1. Provide outlets 2 inches and smaller by tapping the pipe and attaching a service clamp as specified in Section 402713 or use a threaded welded-on boss. Use Type 1 clamps for exposed piping. Use
2. For outlets larger than 2 inches in exposed piping, use a tee with a flanged outlet.
3. For outlets larger than 2 inches in buried piping, use a tee with a restrained joint outlet.

M. Joints

1. Joints in aboveground or submerged piping or piping located in vaults and structures shall be grooved end or flanged.
2. Joints in buried piping shall be of the restrained or mechanical-joint type per AWWA C111 except where flanged joints are required to connect to valves, meters, and other equipment.
3. Restrained joints for piping 6 inches and larger shall be American Cast Iron Pipe "Lok-Ring" or "Flex-Ring," U.S. Pipe "TR-Flex," or equal. Weldments for restrained joints shall be tested by the liquid penetrant method per ASTM E165. Restrained joints for field

4. Restrained joints in 4-inch-diameter buried piping shall be American Cast Iron Pipe Company "Fast-Grip," U.S. Pipe Field-lok gasket within Tyton joint pipe and fittings, or equal. Joint restraint shall be certified to four times rated pressure of 200 psi by Factory Mutual.
5. Where thrust restraint is called for in the drawings, provide pipe with restrained joints capable of transmitting 1.5 times the thrust, as calculated by the following equation:

$$T = 1.5 * (0.785 * P * D^2)$$

where:

- P = Pressure class of pipe in psi.
D = Outside diameter of pipe in inches.
T = Thrust in pounds.

N. Ductile-Iron Pipe Weldments

1. All welding to ductile-iron pipe, such as for bosses, joint restraint, and joint bond cables, shall be done at the place of manufacture of the pipe. Perform welding by skilled welders experienced in the method and materials to be used. Welders shall be qualified under the standard qualification procedures of the ASME Boiler and Pressure Vessel Code, Section IX, Welding Qualifications.
2. Welds shall be of uniform composition, neat, smooth, full strength, and ductile. Completely grind out porosity and cracks, trapped welding flux, and other defects in the welds in such a manner that will permit proper and complete repair by welding.
3. Completed welds shall be inspected at the place of manufacture by the liquid penetrant method. Conform to the requirements specified in ASTM E165, Method A, Type I or Type II. The materials used shall be water washable and nonflammable.

PART 3 - EXECUTION

A. Delivery, Unloading, and Temporary Storage of Pipe at Site

1. Use unloading and installation procedures that avoid cracking of the lining. If necessary, use plastic sheet bulkheads to close pipe ends and keep cement-mortar lining moist.
2. Deliver the pipe alongside the pipelaying access road over which the pipe trailer-tractors can travel under their own power. Place the pipe in the order in which it is to be installed and secure it from rolling.
3. Do not move pipe by inserting any devices or pieces of equipment into the pipe barrel. Field repair linings damaged by unloading or installation procedures.

B. Sanitation of Pipe Interior

1. During laying operations, do not place tools, clothing, or other materials in the pipe.
2. When pipelaying is not in progress, close the ends of the installed pipe by a child- and vermin-proof plug.

C. Installing Flanged Pipe and Fittings

Install in accordance with Section 400500. Cut the bore of the gaskets such that the gaskets do not protrude into the pipe when the flange bolts are tightened.

D. Installing Grooved-End Pipe and Fittings

See Section 400500.

E. Installing Buried Piping

1. Install in accordance with AWWA C600, Section 312316, and as follows.
2. When installing piping in trenches, do not deviate more than 1 inch from line or 1/4 inch from grade. Measure for grade at the pipe invert.
3. Provide thrust blocks at fittings per Section 312316.
4. Assemble restrained joints per manufacturer's instructions.

F. Joint Deflections for Buried Pipe

1. Do not exceed the following deflection angles for unrestrained buried pipe joints:

Pipe Size (inches)	Maximum Deflection (degrees)	
	Push-On Joint	Mechanical Joint
4	4	6 1/2
6	4	5 1/2
8	4	4
10	4	4
12	4	4
14	2 1/2	3
16	2 1/2	3
18	2 1/2	2 1/2
20	2 1/2	2 1/2
24	2 1/2	2

2. For restrained joints, do not exceed 80% of the manufacturer's recommended maximum deflections.
3. Small angular changes (less than 7 degrees) in horizontal alignment defined in the drawings by a point of inflection (PI) with no accompanying curve data shall be approximated as a curve by deflecting by equal amounts equal length pipe segments to create a curve equally distributed on both sides of the given PI. Accomplish a larger (greater than or equal to 7 degrees) change in horizontal alignment where a curve is not called for in the drawings through the use of an elbow placed at the station of the PI shown in the drawings. Provide thrust restraint as required in the drawings.
4. Small angular changes (less than 5 degrees) in vertical alignment may be accomplished by the use of pulled joints. For larger vertical deflections, place an elbow at the station and elevation of the vertical PI shown in the drawings. Provide thrust restraint as required in the drawings.
5. Assemble joints in accordance with AWWA C600 and the manufacturer's recommendations.

G. Installing Aboveground or Exposed Piping

See Section 400500.

H. Painting and Coating

1. Coat pipe located above ground and in vaults and structures per Section 099000, System No. 15. Apply prime coat in the shop before transporting pipe to the jobsite. Apply intermediate and finish coats in the field before installing the pipe, then touch up after installation.

2. Coat buried flanges and buried mechanical and restrained joint bolts, nuts, and glands per Section 099000, System No. 21.
3. Coat submerged pipe per Section 099000, System No. 7 or with fusion-bonded epoxy per Section 099761.
4. Line and coat exposed grooved-end couplings the same as the pipe exterior coating or with fusion-bonded epoxy per Section 099761.
5. Line and coat submerged and buried grooved-end couplings with fusion-bonded epoxy per Section 099761 or per Section 099000, System No. 7.

I. Polyethylene Encasement of Buried Pipe and Fittings

Wrap buried pipe, fittings, grooved-end couplings, and joints with polyethylene per Section 099754.

J. Cleaning Pipe

After interior joints have been pointed and mortar has hardened, sweep pipe clean of all dirt and debris. If hardened mud exists in the pipe, remove with the use of pressurized water hoses.

K. Field Hydrostatic Testing

Test pressures are shown in Section 400515. Test in accordance with Section 400515.

L. Pipe Labeling

Label exposed pipe above grade or in buried vaults per Section 400775.

M. Buried Warning and Identification Tape

Provide detectable warning tape per Section 400775. Warning and identification shall read "CAUTION BURIED WATER PIPING BELOW" or similar wording.

SECTION 402090
PVC PIPE, 3 INCHES AND SMALLER

PART 1 - GENERAL

SEE WESTERN HILLS WATER DISTRICT STANDARD DRAWINGS AND SPECIFICATIONS FOR REQUIREMENTS.

A. Description

This section includes materials, installation, and testing of PVC pipe and fittings of size 3 inches and smaller for use in process piping having a maximum design pressure of 150 psi and having a maximum design temperature of 105°F.

B. Related Work Specified Elsewhere

1. Painting and Coating: 099000.
2. Trenching, Backfilling, and Compacting: 312316.
3. General Piping Requirements: 400500.
4. Pressure Testing of Piping: 400515.
5. Manual, Check, and Process Valves: 400520.
6. Pipe Hangers and Supports: 400764.
7. Equipment, Piping, Duct, and Valve Identification: 400775.

C. Submittals

1. Submit shop drawings in accordance with the General Conditions and Section 013300.
2. Submit materials list showing materials of pipe and fittings with ASTM reference and grade. Submit manufacturer's certification of compliance with referenced standards, e.g., ASTM D1784, D1785, and D2467. Show wall thickness of pipe and fittings. Show fitting dimensions.
3. Submit data sheets for solvent cement demonstrating compliance with ASTM D2564 and F656.

PART 2 - MATERIALS

A. Pipe

Pipe shall be Schedule 80, Type I, Grade 1 (Class 12454-B), conforming to ASTM D1784 and D1785.

B. Fittings

Fittings shall be Schedule 80 and shall conform to ASTM D2464 for threaded fittings and ASTM D2467 for socket-type fittings.

C. Flanges

PVC flanges shall be of the one-piece solid socket design and shall be made of the same material as the pipe. Pressure rating shall be at least 150 psi at a temperature of 73°F. Minimum burst pressure shall be 500 psi. Flanges shall match the dimensions of ASME B16.5, Class 150, steel flanges for outside diameter, bolt circle, and bolt holes. Do not use Van Stone flanges.

D. Unions

1. For ammonium hydroxide service, unions shall have socket-type ends, EPDM O-rings, and shall be Schedule 80. Material shall be Type I, Grade 1 PVC, per ASTM D1784.
2. For sodium hypochlorite service, unions shall have socket-type ends, Viton O-rings, and shall be Schedule 80. Material shall be Type I, Grade 1 PVC, per ASTM D1784.
3. Union connections to other metal piping materials shall comply with MSS SP-107. The fitting end for connection to PVC pipe shall be a female socket. Provide wrought or cast copper tailpieces for connection to copper piping and tubing. Provide Type 316 stainless steel tailpieces for connection to steel piping.

E. Joints

Pipe and fitting joints shall be socket welded except where threaded and flanged joints are required to connect to valves and equipment.

F. Solvent Cement in Other Than Sodium Hypochlorite Service

Solvent cement for socket joints shall comply with ASTM D2564 and F656.

G. Solvent Cement in Sodium Hypochlorite Service

Solvent cement shall be free of silica. Products: IPS "Weld-On" PVC 724 or Oatey "Lo V.O.C. PVC Heavy Duty Gray."

H. Gaskets for Flanges

See Section 400500.

I. Bolts and Nuts for Flanges

See Section 400500.

J. Lubricant for Stainless Steel Bolts and Nuts

See Section 400500.

K. Wye Strainers

PVC wye strainers shall be manufactured of the same material as the pipe, with 30-mesh screens and Viton seals. Connecting ends shall be the socket type, solvent welded. Provide one spare screen for each strainer.

PART 3 - EXECUTION

A. General

1. Do not install PVC pipe when the temperature is below 40°F or above 90°F. Store loose pipes on racks with a maximum support spacing of 3 feet. Provide shades for pipe stored outdoors or installed outdoors until the pipe is filled with water.
2. Store fittings indoors in their original cartons.
3. Store solvent cement indoors or, if outdoors, shade from direct sunlight exposure. Do not use solvent cements that have exceeded the shelf life marked on the storage container.
4. Before installation, check pipe and fittings for cuts, scratches, gouges, buckling, kinking, or splitting on pipe ends. Remove any pipe section containing defects by cutting out the damaged section of pipe.
5. Do not drag PVC pipe over the ground, drop it onto the ground, or drop objects on it.

B. Solvent-Welded Joints

1. Prior to solvent welding, remove fittings and couplings from their cartons and expose them to the air at the same temperature conditions as the pipe for at least one hour.
2. Cut pipe ends square and remove all burrs, chips, and filings before joining pipe or fittings. Bevel solvent-welded pipe ends as recommended by the pipe manufacturer.
3. Wipe away loose dirt and moisture from the inside and outside of the pipe end and the inside of the fitting before applying solvent cement. Clean the surfaces of both pipes and fittings that are to be solvent welded with a clean cloth moistened with acetone or methylethyl ketone. Do not apply solvent cement to wet surfaces.

4. The pipe and fitting socket shall have an interference fit. Perform a dry fit test at each joint before applying solvent cement. The pipe shall enter the fitting socket between one-third and two-thirds of the full socket depth when assembled by hand.
5. Make up solvent-welded joints per ASTM D2855. Application of cement to both surfaces to be joined and assembly of these surfaces shall produce a continuous bond between them with visual evidence of cement at least flush with the outer end of the fitting bore around the entire joint perimeter.
6. Allow at least eight hours of drying time before moving solvent-welded joints or subjecting the joints to any internal or external loads or pressures.
7. Acceptance criteria for solvent-welded joints shall be as follows:
 - a. Unfilled Areas in Joint: None permitted.
 - b. Unbonded Areas in Joint: None permitted.
 - c. Protrusion of Material into Pipe Bore, Percent of Pipe Wall Thickness: Cement, 50%.

C. Flanged Joints

1. Lubricate carbon steel bolt threads with graphite and oil before installation.
2. Tighten bolts on PVC flanges by tightening the nuts diametrically opposite each other using a torque wrench. Complete tightening shall be accomplished in stages and the final torque values shall be as shown in the following table:

Pipe Size (inches)	Final Torque (foot-pounds)
1/2 to 1 1/2	10 to 15
2 to 3	20 to 30

D. Installation of Stainless Steel Bolts and Nuts

See Section 400500.

E. Assembling Threaded Joints

1. Cut threaded ends on PVC to the dimensions of ASTM F1498. Ends shall be square cut. Follow the pipe manufacturer's recommendations regarding pipe hold-down methods, saw cutting blade size, and saw cutting speed. Gauges, gauge tolerances, and gauging procedures shall comply with ASTM F1498, Sections 7 and 8. Perform field gauging on every field-cut threaded connection.
2. Pipe or tubing cutters shall be specifically designed for use on PVC pipe. Use cutters

3. If a hold-down vise is used when the pipe is cut, insert a rubber sheet between the vise jaws and the pipe to avoid scratching the pipe.
4. Thread cutting dies shall be clean and sharp and shall not be used to cut materials other than plastic.
5. Apply Teflon® thread compound or Teflon® tape lubricant to threads before screwing on the fitting.
6. Assemble threaded flanges and fittings per ASTM F1498, Sections 4, 7, and 8. Do not tighten threaded connections more than two turns past finger tightness for both internal and external threads.

F. Installing Buried Pipe

1. Install in accordance with Section 312316 and as follows.
2. Trench bottom shall be continuous, smooth, and free of rocks. See the details in the drawings for trench dimensions, pipe bedding, and backfill.
3. After the pipe has been solvent-welded and the joints have set, snake the pipe in the trench per the pipe manufacturer's recommendations in order to allow for thermal expansion and contraction of the pipe.
4. Do not backfill the pipe trench until the solvent-welded joints have set. Support the pipe uniformly and continuously over its entire length on firm, stable soil. Do not use blocking to change pipe grade or to support pipe in the trench.
5. Install buried PVC pipe in accordance with ASTM D2774 and the pipe manufacturer's recommendations. Backfill materials in the pipe zone shall be imported sand per Section 312316.

G. Installing Aboveground or Exposed Piping

1. See Section 400500.
2. Fill empty piping with water and provide temporary shading or other means to keep the surface temperature of the pipe below 100°F.

H. Painting and Coating

Coat piping per Section 099000, System No. 42.

I. Hydrostatic Testing

Perform hydrostatic testing for leakage in accordance with Section 400515.

END OF SECTION

SECTION 402713
CORPORATION STOPS AND SERVICE SADDLES

PART 1 - GENERAL

SEE WESTERN HILLS WATER DISTRICT STANDARD DRAWINGS AND SPECIFICATIONS FOR REQUIREMENTS.

A. Description

This section includes materials and installation of service saddles and corporation stops.

B. Related Work Specified Elsewhere

1. Painting and Coating: 099000.
2. Pressure Testing of Piping: 400515.

C. Submittals

1. Submit shop drawings in accordance with the General Provisions and Section 013300.
2. Submit manufacturer's catalog data and descriptive literature showing dimensions and materials of construction by ASTM reference and grade. Show coatings.

PART 2 - MATERIALS

A. Corporation Stops

Corporation stops shall be bronze (ASTM B62) with inlets and outlets as tabulated below:

Type	Inlet Connection	Outlet Connection	Manufacturer and Model
1	Outside I.P.	Inside I.P.	Less than 1 1/2 inches: Jones J-50, Mueller H-10046 For sizes 1 1/2 and 2 inches: Jones J-1931 Ford FB-1700
2	Outside Corp. Stop	Inside I.P.	Less than 1 1/2 inches: Jones J-51, Mueller H-10045 For sizes 1 1/2 and 2 inches: Jones J-1932, Ford FB-1600
3	Outside Corp. Stop	Outside Coupling Thread	Mueller H-9971, Ford F-200
4	Outside I.P.	Outside I.P.	Less than 1 1/2 inches: Jones J-41, Mueller H-10013 For sizes 1 1/2 and 2 inches: Jones J-1943, Ford FB-500
5	Outside I.P.	Copper Tubing	Less than 1 1/2 inches: Jones J-1505, Mueller H-15025 For sizes 1 1/2 and 2 inches: Jones J-1929, Ford FB-700
6	Outside Corp. Stop	Copper Tubing	Less than 1 1/2 inches: Jones J-1500, Mueller H-15050 For sizes 1 1/2 and 2 inches: Jones J-1930, Ford FB-600

B. Service Saddles for Ductile-Iron, Steel, and PVC (AWWA C900 and C909) Pipe

1. Type 1 service saddles shall be of the double-strap type. Bodies shall be malleable iron (ASTM A47 or A197). Straps shall be forged steel (ASTM A105, A181, or A182). Tap sizes on the outlet shall be 3/4 inch through 2 inches to accommodate the connecting piping or corporation stops. Service saddles shall be Dresser Style 91, Rockwell Type 313, or equal.
2. Type 2 service saddles shall be of the double-strap type. Straps and bodies shall be bronze or silicon bronze. Tap sizes on the outlet shall be 3/4 inch through 2 inches to accommodate the connecting piping or corporation stops. Service saddles shall be James Jones J-979 (for ductile-iron and steel pipe), James Jones J-996 (for PVC pipe), Mueller, or equal.
3. Use Type 1 saddles unless plans direct otherwise.

C. Service Saddles for Schedule 40 and 80 PVC Pipe

Service saddles shall be malleable iron (ASTM A47 or A197) or bronze (ASTM B61 or B62), using interlocking lugs and a single bolt to hold the saddle in place. Tap sizes on the outlet shall be 3/4 inch or 1 inch to accommodate the connecting piping or corporation stops. Service saddles shall be Dresser Style 194, Rockwell Models 395 or 397, or equal.

PART 3 - EXECUTION

A. Installation of Service Saddles

Install service saddles with the gaskets seated on the pipe so that zero leakage is obtained. Tighten bolts to the torque recommended by the manufacturer.

B. Painting and Coating of Service Saddles

1. Coat buried service saddles per Section 099000, System No. 21 with wax tape per Section 099752.
2. Coat service saddles located above ground or in vaults and structures the same as the piping to which they are attached. Apply prime coat at factory. Color of finish coat shall match the color of the pipe to which the service saddle is connected.

SECTION 405000
PROCESS CONTROL AND INSTRUMENTATION SYSTEM (PCIS) GENERAL REQUIREMENTS

PART 1 - GENERAL

SEE: ELECTRICAL AND CONTROLS - DIVISION 16

END OF SECTION

SECTION 409715
PRESSURE GAUGES AND PRESSURE SWITCHES

PART 1 - GENERAL

A. Description

This section includes materials and installation of pressure gauges, pressure switches, and accessories.

B. Related Work Specified Elsewhere

1. Pressure Testing of Piping: 400515.
2. Manual, Check, and Process Valves: 400520.
3. Electrical & Controls - Section 1600

C. Submittals

1. Submit shop drawings in accordance with the General Provisions and Section 013300.
2. Submit manufacturer's catalog data and descriptive literature. Call out materials of construction by ASTM reference and grade. Submit manufacturer's certificate of compliance with the referenced ANSI standards.

PART 2 - MATERIALS

A. Pressure Gauges

1. Pressure range shall be as designated by the following type numbers shown in the drawings:

Type Number	Description	Pressure Range
5	Pressure	0 to 100 psi
6	Pressure	0 to 150 psi
7	Pressure	0 to 300 psi

2. If no type number is shown in the drawings, use Type 6 gauges.
3. A suffix "F" on the type number means that the gauge shall be filled with glycerin or silicone. For example, a callout in the drawings of "Type 3F Pressure Gauge" means a 0- to 30-psi gauge, liquid filled.

4. Types 5 Through 7: Gauges 4 1/2 inches and larger shall comply with ASME B40.1, Grade 2A. Gauges shall incorporate the following features:
 - a. Solid or open front with side or rear blowout relief.
 - b. Pressure tight.
 - c. 270-degree arc with adjustable pointer.
 - d. Stem mounted.
 - e. Hermetically sealed unless specified to be liquid filled.

Size of gauge shall be 4 1/2 inches, unless otherwise indicated in the drawings. Stem or connection size shall be 1/2 inch, except that gauges connected to gauge protector spools or rings may have 1/4-inch connections.

5. Materials of construction for Types 5 through 7 gauges shall be as shown in the following table:

Item	Material	Specification
Case	Stainless steel, aluminum, polypropylene, or phenolic plastic	AISI 316, 6061-T6
Bourdon tube	Stainless steel	AISI 316
Windows	Acrylic plastic	---
Ring	Stainless steel	AISI 316
Stem	Stainless steel	AISI 316
Dial face	Aluminum with clear baked-on acrylic coating	ASTM B209, 6061-T6

B. Pressure Switches

1. Pressure switches shall be Type 403 stainless steel or Type 316 stainless steel bourdon tube type actuating an enclosed, metal contact snap-action switch. Switch shall have separate set point and reset point adjustments. Pressure switch range and number of switch contacts shall be as indicated in the table below. Provide the assembly with an indicating scale to show the trip setting of each switch. Provide cleanout-type, continuous-duty type diaphragm seals. Enclosure shall be general purpose NEMA 1. Provide Mercoird Series DA, United Electric H400 series, Ashcroft L series, or equal.
2. Two-stage pressure switches shall be as described above except with two independent switches, each with separate set point adjustments and fixed differential.
3. Differential pressure switches shall be as described above and shall have opposed-bellows type actuating an enclosed metal contact snap-on switch upon increase of pressure

difference. Switch shall have double external adjustment. Provide Mercoid Series DPA or equal.

4. In hazardous locations, provide explosion proof switches. Provide Mercoid DAH series or equal.

C. Gauge and Pressure Switch Protectors

1. Gauge and pressure switch protectors shall consist of three parts: a flexible, impermeable, elastomer cylinder; a captive sensing liquid; and a steel or stainless steel housing. The process liquid pressure shall be transmitted through the elastomer-lined cylinder wall and the sensing liquid to the pressure gauge. An attached 4-1/2-inch pressure gauge shall indicate the pressure. Gauge outlet in the spool or ring shall be threaded, 1/4- or 1/2-inch, per ASME B1.20.1. Spools shall be of either the isolation-spool type with flanged ends or of the isolation-ring type, fitting between two adjacent flanges. Determine the flange rating based on the test pressure shown in Section 400515. For test pressures 200 psi and less, use Class 150 flanges, ASME B16.5. For test pressures greater than 200 psi, use Class 300 flanges, ASME B16.5.
2. Materials of construction shall be as follows:

Item	Material	
	Type 1	Type 2
Housing, flanges	Type 316 stainless steel	Carbon steel
Flexible cylinder	Teflon	Buna N or neoprene
Sensing liquid	Silicone oil	Silicone oil

3. Use Type 1 gauge protectors if no type number is shown in the drawings.
4. Protectors shall be manufactured by Ronningen-Petter; Red Valve Company, Inc.; Onyx; or equal.

D. Pipe Nipples and Fittings

1. Nipples for connecting gauges and pressure switches to piping shall be brass, regular weight, per ASTM B43. Fittings shall be bronze, Class 150 or 250, per ASME B16.15. Use Class 250 where the test pressure exceeds 200 psi. Size of nipple shall match the gauge or pressure switch connection size.

E. Tools for Gauges

Provide two gauge tool kits, each containing a hand jack set, screwdriver, five reamers (minimum), two pin vise holders, wiggler, tweezers, and carrying case.

F. Gauge Cocks

Gauge cocks shall be two way. Gauge cocks shall be brass or bronze, ASTM B16 or B62. End connections shall be NPT, female. Cocks shall be Lunkenheimer or equal.

PART 3 - EXECUTION

A. Installation

Install gauges and pressure switches before conducting pressure tests. Do not disassemble gauges from the factory-assembled diaphragm seals or isolation sleeves or rings.

END OF SECTION

SPECIAL AND TECHNICAL PROVISIONS

SPECIAL PROVISIONS

PART I - GENERAL

All work shall be done in conformance with:

1. The Plans entitled "WESTERN HILLS WATER DISTRICT 2012 SYSTEM MODIFICATIONS AND IMPROVEMENTS".
2. The Contract Documents and Construction Specifications.
3. These Special and Technical Provisions.
4. The Standards:
 - a. The Western Hills Water District Standard Drawings and Specifications.
 - b. The Diablo Grande Standard Drawings and Specifications.
5. The Supplement to the General Provision (Section 007300).

1.0 CONTACTS

1. REGULATORY AGENCY
Diablo Grande Residential Association
9501 Morton Davis Dr.
Patterson, CA 95363
Phone: (209) 892-3466 Ext. 24
Fax: (209) 892-5045
Attn: Michele Fry, Community Administrator
2. OWNER
Western Hills Water District
9501 Morton Davis Dr.
Patterson, CA 95363
Phone: (209) 895-9493
Fax: (209) 892-5195
Attn: Patrick Garvey
3. DISTRICT ENGINEER
Western Hill Water District
9501 Morton Davis Dr.
Patterson, CA 95363
Phone: (209) 895-9493
Fax: (209) 892-5195
Attn: Patrick Garvey

4. ENGINEER
Benchmark Engineering Inc.
1121 Oakdale Rd. Suite 1
Modesto, CA 95355
Phone: (209) 548-9300
Fax: (209) 548-9305
Attn: Rick Mummert

5. ELECTRICAL ENGINEER
EETS
6060 Sunrise Vista Blvd. #3450
Citrus Heights, CA 95610
Phone: (916) 339-9691
Fax: (916) 242-9125
Attn: Mike Bregar

6. ISS (SCADA PROVIDER)
Tesco Controls
8440 Florin Road
Sacramento, CA 95828
Phone: (916) 395-8800
Fax: (916) 429-2817
Attn: Mike Flinn

7. GAS
JS West
820 H Street
Modesto, CA 95354
Phone: (209) 577-3221
Fax: (209) 527-5406
Attn: Jerri Sweatt

8. TELEPHONE
Frontier Communications
9324 West Stockton Blvd.
Elk Grove, CA 95758
Phone: (916) 688-7283
Fax: (916) 691-5199
Attn:

9. ELECTRIC
Turlock Irrigation District
333 East Canal Dr.
Turlock, CA 95381
Phone: (209) 883-8395
Fax: (209) 632-8181
Attn: Mark Selby

2.0 WORK SEQUENCE AND SCHEDULE

The Contractor shall prioritize the major items of work as follows:

1. Street Reconstructions on Diablo Grande Drive at Tee Box Court and on Morton Davis Drive at STA 10+00 to 11+00.
2. Construction of the Solids Storage Tank Decant 4" Gravity Drain Line to the Sanitary Sewer and Construction of the Clear Water Tank 4" Gravity Drain Line to the Equalization Tank.
3. Construct the remainder of the system modifications and improvements.

The contractor shall submit a schedule reflecting these 3 phases for approval. The contractor shall also schedule any required pipe shutdowns with the District Engineer and coordinate closely with WHWD staff to minimize any effects on the system. It will be required to make any shutdowns in the late fall/winter at night, if necessary.

All of the above shall be in conformance with Section 011100 (D).

3.0 TIME OF COMPLETION

The time of completion shall be 160 consecutive calendar days in conformance with Section 007300 (G).

4.0 GEOTECHNICAL REPORTS

The contractor shall be responsible for providing geotechnical investigations as specified in Section 007300 € at the time of the street excavations.

TECHNICAL PROVISIONS

1.0 - GENERAL

This section describes special and technical items of the work specific for this project not included or supplementary to other section of the Specifications.

A. Description

This section describes special and technical items of the work specific for this project not included or supplementary to other section of the Specifications.

B. Items of Work

Tideflex Valves

Hose and Camlock Connections

Stainless Steel Screens

Wafer Check Valves

Underground Utility Markers

1. Tideflex Valves shall be all rubber, insertable check valves, flow operated with slip-in cuff connections and shall be manufactured in the U.S.A. Tideflex Valves shall be CheckMate Inline Check Valve as manufactured by Tideflex Technologies, 600 N. Bell Ave., Carnegie, PA 15106, 412-279-0044.
2. Hose piping shall be 4" in diameter, reinforced rubber tubing capable of operating pressures of at least 75 psi. The tubing shall be natural or synthetic rubber and shall be reinforced with synthetic fabric and metal wire. The hose shall be permanently fitted with a Female, hose shank, camlock coupler fitting (item #3LX63). The outlet plumbing, to which the hose will be connected shall be fitted with a Male, threaded pipe adapter (item #3LX59) and shall be provided with a camlock dust cover cap (item #3LX67). The camlock fittings shall be aluminum with plated carbon steel arms, stainless steel pins and Buna rubber gaskets capable of a working pressure of not less than 100 psi. The completed assembly shall be rated for a working pressure of not less than 75 psi. The hose shall be Plicord Con-Ag Water S and D as manufactured by Goodyear products and the Camlock fittings shall meet ASTM C 38000 and MIL-C-27487F specifications and shall be as manufactured by Banjo Industries. (All are available through Grainger Industrial Supplies, 1910 Rockerfeller Dr., Ceres, CA, 209-541-1905.)
3. Screens shall be constructed from 18 Mesh T316 Stainless Steel with .009 inch minimum wire diameter strands and shall be part number 018X018T0090W36T as manufactured by TWP Inc., 2831 Tenthth St., Berkeley, CA, 510-548-4434 / 800-227-1570 or any approved equal. The screen shall be firmly affixed over the discharge piping and shall be secured between 2 flanges such that there is no opening over .046" in the finished connection.
4. Wafer Check Valves shall be wafer style split disk and shall be of the silent operating type suitable for use with steel (w/FCA) or (flanged) ductile iron pipe. The valve body shall be constructed of cast iron with fusion epoxy coating. The disc and torsion spring shall be constructed of 304 stainless steel. The valve body shall be one piece and shall incorporate a Nitrile/EPDM seal, which will seal at both high & low pressures with the disk overlapping the seal to prevent wear. The valve shall operate equally well in either the horizontal or vertical position. The Wafer Check Valve shall be model number 895 as manufactured by Flowmatic Corp., 15 Pruyne's Island, Glen Falls, New York 12801, 800-833-2040 / 518-761-9797.
5. Underground Utility Markers shall be marker posts suitable for long-term outdoor rural delineation and identification of underground pipelines. Marker posts shall be a minimum of 72" long and shall be a continuously reinforced, with marble and fiber glass, thermosetting composite which is ultraviolet light resistant. Marker posts shall be a minimum of 3.8" wide and shall have a constant cross sectional profile with a dual sided

flat central web section to which decals shall be applied by the manufacturer. The bottom edge shall be pointed to ease ground penetration. A special installation tool, as provided by the marker post manufacturer, shall be utilized for installation. Marker posts for potable water lines (Zone 3 reservoir site) shall be Blue with a blue factory applied decal with the words "CAUTION WATER PIPELINE". Marker posts for effluent (4" Discharge from the Solids Storage Tank) shall be Brown with the words "BURIED PIPELINE". All marker posts shall be model CIB-380 as manufactured by Carsonite Composites, 19845 U.S. Highway 76, Newberry, South Carolina 29108, 800-648-7916 or any approved equal. (Insert additional Carsonite specs if required)

C. Submittals

1. Submit shop drawings in accordance with the General Provisions and Section 013300.
2. Submit manufacturer's data sheets.

D. As-Builts

1. Records and As-Built drawings shall be neatly kept by contractor and shall be submitted and approved prior to final payment in accordance with articles 4-5 and 4-7 of Section 00700.