FAIRFIELD-SUISUN SEWER DISTRICT PUMP STATION AND COLLECTION SYSTEM DESIGN STANDARDS

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I. INTRODUCTION

1.01 Purpose and Scope

These design standards have been developed by the Fairfield-Suisun Sewer District (District or FSSD) to be used by developers, design engineers, consultants, contractors, and others that are designing improvements for, interconnections with, modifications to, and/ or new facilities to be accepted by the District, for ownership, operation, and/ or maintenance. Adherence to, and compliance with, these standards is required for approval and acceptance of all new, modified, and/ or replaced facilities that will be owned, operated, and/ or maintained by the District. This is needed to provide the District with consistent, functional, reliable, safe, regulatory-compliant, and maintainable facilities.

These Design Standards shall govern sewer design and construction work by private individuals, public agencies, and businesses within the boundaries of the District. Attention is drawn to the fact that gravity-flow collection is the only acceptable choice for all new mains and laterals. Pump stations (force mains and lift stations) are only permitted when site topography makes gravity conveyance infeasible, and then only with District approval and full design submittals.

More stringent requirements may be imposed by the District Engineer based on specific project conditions. Any items that are not included in these standards and details shall be designed and constructed as required by the District Engineer.

Where used, the term “Design Engineer” shall refer to the entity preparing the design and construction Contract Documents for the developers, design engineers, consultants, contractors, and/ or others that are constructing the improvements for, interconnections with, modifications to, and/ or new facilities to be accepted by the District for ownership, operation, and/ or maintenance.

In addition to the design standards outlined herein, all work shall meet the requirements set forth by the City of Fairfield/ City of Suisun City/ Solano County (as applicable). Standard specifications and details for design shall be obtained from the appropriate agencies.

All work, including plans and specifications, shall be submitted to the City of Fairfield/ City of Suisun City/ Solano County (as applicable) for review and approval, including any architectural approvals. If the City of Fairfield's/ City of Suisun City's/ Solano County's (as applicable) comments conflict with the District's design standards outlined herein, such conflicts shall be called out and discussed with the District and the City of Fairfield/ City of Suisun City/ Solano County.

The goal of this document is to provide sufficient standards to allow each infrastructure project to be designed to meet the District's requirements, while allowing the Design Engineer to design facilities that are project specific and meet each project's unique requirements. Use of the design standards will allow Design Engineers to prepare Contract Documents that incorporate all standards and provide for stand-alone Contract Documents for use by Contractors and District inspection staff.

The purpose of these design standards is to provide the Design Engineer, Developer, and/ or Others, with information on the minimum requirements and standards for facilities to be owned by, maintained by, operated by, and/ or connected to facilities owned, operated, or maintained by the District. These design standards provide information on the type of facilities and equipment that are acceptable to the District. Information presented herein shall be incorporated into the design and construction Contract Documents. It is understood that each facility is unique and not

all design standards outlined herein may be applicable. In such cases, the Design Engineer, Developer, and/ or Others, shall submit questions and proposed deviations to the District for clarification and/or acceptance. Nothing within these standards shall relieve the Design Engineer, Developer, and/ or Others, from full responsibility for the design, preparation, and content of the design and construction Contract Documents.

All final Contract Documents for construction shall be signed and stamped by a registered engineer(s) of the appropriate discipline and licensed in the State of California.

The information contained within these standards is intended to provide the District with facilities meeting its regulatory, safety, standardization, operating, and maintenance requirements and to minimize comments and changes during the design submittal process. However, all projects are unique and not every District requirement may be imposed. The District reserves the right to add, delete, or change any requirement or standard contained within this document.

Prior to the study or design of any facilities that will be operated and maintained by the FSSD, the Design Engineer shall obtain the latest version of this document on the District's website at http://www.fssd.com.

1.02 About Fairfield-Suisun Sewer District

Fairfield-Suisun Sewer District (FSSD, District) is a special district, established under the Fairfield-Suisun Sewer District Act (Chapter 303 of the Statutes of 1951, as amended, "Enabling Act"), and serves the cities of Fairfield and Suisun City. The requirements set forth herein have been established as design standards for facilities that currently are, and/ or will be connected to, and/ or operated and maintained by the District.

The Fairfield-Suisun Sewer District was established by an act of the California Legislature in 1951 (Enabling Act, Act). This legislation provided for the formation of the District and granted the District broad powers to own, operate, construct and finance necessary infrastructure to provide for wastewater and stormwater disposal for the cities of Fairfield and Suisun City.

The District is governed by a 10-member Board of Directors composed of five city council members from each of Fairfield and Suisun City. Management of the District is the responsibility of the District's General Manager, who is hired by the Board.

1.03 Authority

The authority of Fairfield-Suisun Sewer District to establish and enforce these Specifications is provided in District's Enabling Act Section 48(e) and Section 59.

II. ADMINISTRATIVE REQUIREMENTS

2.01 PLAN PREPARATION, REVIEW, AND DRAFTING STANDARDS

(1) Plan preparation, review, and design submittals shall conform to the requirements outlined in Section III - Plan Review and as indicated herein.

(2) All design and construction documents shall be prepared in accordance with the equipment, materials, and installation requirements outlined in the latest version of these Standard Specifications.

(3) Design Engineer shall obtain from the City of Fairfield and/ or City of Suisun City, the latest version of its Standard Specifications, including Standards for grease interceptors and incorporate such requirements into its design and construction documents and requirements.

(4) District signature block shall be provided on title sheet of Drawings. The signature block must be signed and dated by District's approved designee prior to bid and/or commencement of construction of any facilities. See Appendix B for sample.

(5) **The Developer/ Designer/ Contract Documents shall require that the Contractor keep and maintain, at the job site, one set of District-approved (District-signed) Plans (Drawings).**

(6) Specification standards (if applicable).

(i) Specifications shall be prepared in CSI MasterFormat (Divisions 0 - 17) format in latest version of Microsoft Word and compiled into a single set in Adobe PDF.

(7) Furnish two (2) full size (22" x 34") sets of scalable Final plans for construction, fully stamped and signed by all agencies, in addition to digital files.

(8) Drafting standards. Refer to Appendix B for requirements.

(i) All Drawings shall be prepared on AutoCAD 2020 or later and shall show all sewer utility, water, storm, gas, electric, and other utility infrastructure as exists in the field.

(ii) Prior to permit issuance, the Final Plans shall be submitted compiled into a single set in Adobe PDF and in AutoCAD file (DWG format) in units of feet which shall be tied to the California State Plane Coordinate System, Zone 2, NAD 83.

(iii) The drawing files containing all layers, illustrating all improvements within the project area, including all existing and proposed offsite improvements, tract boundaries, street centerlines, outfall sewers, etc.

Descriptive information (i.e. text) may be included in the same layer and the feature, or added as a separate layer.

(iv) All externally referenced files used shall be "bound" into the drawings.

B. RECORD DRAWINGS

The Design Engineer shall prepare record drawings upon the completion of construction. The requirements for preparation of record drawings shall include the following:

(1) The Construction Contractor shall mark all project conditions, locations, configurations, and any other changes or deviations which may vary from the details represented on the original Contract Drawings, including buried or concealed construction and utility features which are revealed during construction. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated, or which were not indicated on the Contract Drawings. Record drawings shall be supplemented by any detailed sketches as necessary or directed to indicate, fully, the work as actually constructed. The Contractor's record drawings of as-built conditions, including all revisions made necessary by any changes during construction shall be maintained up-to-date during the progress of the work.

(2) In the case of those drawings which depict the detail requirement for equipment to be assembled and wired in the factory, such as motor control centers, the record drawings shall be updated by indicating those portions which are superseded by final shop drawings, and by including appropriate reference information describing the change by number and the shop drawings by manufacturer, drawing, and revision numbers.

(3) Record drawings shall be accessible to the District at all times during the construction period and shall be delivered to the Design Engineer upon completion of the work.

(4) Upon substantial completion of the work and prior to final acceptance by the District, the Design Engineer shall complete and deliver a complete set of record drawings to the District, conforming to the construction records of the Contractor. This set of drawings shall consist of corrected drawings showing the reported location of the work. The information submitted by the Contractor and will be assumed to be reliable, but shall be verified as much as possible by the Design Engineer. The Design Engineer shall revise the original contract drawings to produce electronic and hardcopy record drawings. Record drawings shall meet all drafting requirements set forth in this document.

(5) The Design Engineer shall follow the District's standard procedures listed below for record drawing preparation and submittal to the District.

(6) Project deliverables shall include:

(i) The Contractor's check set with field redlines, signed by the Contractor's superintendent or foreman who oversaw construction of District facilities.

(ii) Furnish one (1) AutoCAD set, one (1) compiled Adobe PDF set, and two (2) full size (22" x 34") hardcopy sets of scalable Record Drawings indicating all final As-Built conditions. All As-Built conditions shall be drawn on AutoCAD and clearly labeled an As-Built condition.

(iii) One copy of Record Drawing files in AutoCAD, delivered electronically, in a version compatible with the District's current software version. Include fonts, customized line types, pen weight convention, reference files, CTB files, etc., that will assist with plotting. Files shall be files delivered electronically, in text-searchable Adobe PDF format, as individual sheets and a single multiple sheet, compiled PDF file. The file name shall be derived from the FSSD project number, sheet code and in same order as the drawing set. See Appendix B, Section C, Drawings Set-up.

(iv) One set of real-time kinematic (RTK) Survey data for all new FSSD-owned mains and manholes in accordance with City of Fairfield standards.

(7) Digital files shall be submitted via a secure corporate-recognized cloud-based service such as Dropbox, Google Drive, or Microsoft OneDrive.

(8) Digital method of Record Drawing revisions shall meet the following requirements:

(i) Revisions shall appear as if they were part of the original contract drawings, therefore new text will be in the same annotation layer, new features will be in the appropriate layer.

(ii) Revisions shall NOT be clouded nor represented with deltas. All previous deltas and clouds shall be frozen.

(iii) When a task is deleted from the contract, it is represented by the text "DELETED FROM CONTRACT". When a detail is deleted from the contract, it is not erased from the drawing, rather place an "X" in bold pen weight in the center of the detail with the text "DELETED FROM CONTRACT".

(iv) Complete the record drawing revision by inserting the revision information in the revision block of the drawing. This data consists of a delta with a dash, the date of the revision, a description "record drawings", and the initials of the CAD Operator. The entire package shall be updated with the revision information.

RECORD DRAWING
"Prepared By: _____"
"Date"

(v) Insert a Record Drawings stamp on all sheets, similar to the one below. It should be located at the bottom right of the drawing, close to the title block, and shall include the current date

C. CONSTRUCTION ENGINEERING

All changes and/ or questions related to District facilities shall be submitted to District's Project Manager for review and discussion a minimum of 10 days in advance before issuing comments and/or approvals to the Contractor. All shop drawing/product submittals related to District facilities shall be submitted to District's Project Manager for review and discussion a minimum of 14 days in advance before issuing comments and/or approvals to the Contractor. PM and inspector shall be notified of all pre-construction meetings, construction meetings, etc., as relevant to the construction of District facilities, a minimum of 14 days in advance.

D. PERMITS

The Project Documents (design and construction Contract Documents) shall identify all permits required for the project, with the responsibility for obtaining each permit clearly defined (e.g., developer, contractor, District, etc.) A copy of all required permit applications and permits related to District facilities (e.g., air permit for permanent standby generator) shall be prepared and submitted to the District's Project Manager a minimum of 30 calendar days in advance of commencing construction.

E. ENVIRONMENTAL DOCUMENTATION

1. All required environmental documentation (e.g., legal obligation under the California Environmental Quality Act (CEQA), i.e. Environmental Impact Report (EIR), Negative Declaration (ND), etc.) shall be prepared by the Developer's qualified Design Engineer, unless the City of Fairfield, City of Suisun City, or FSSD have explicitly agreed to lead the CEQA process and take on the Lead Agency role. In all circumstances, CEQA shall be reviewed and coordinated with the City of Fairfield, City of Suisun City, or Solano County, as appropriate.

F. REQUIREMENTS OF LAND RIGHTS AND EASEMENTS

1. FSSD requires access to all its pipelines and manholes 24 hours a day, 7 days a week, 365 days a year for proper maintenance of facilities, and to ensure access for immediate response and resolution during emergency events. To this effect:

    a. Sewer easements for all facilities to be owned, operated, and maintained by FSSD shall have a minimum width of 30 feet.

b. All-weather roadways shall be constructed to all structures along the pipeline alignment. Roadways shall be a minimum of 12-feet wide.

c. All-weather roadways shall be provided with a turnaround when back-up distance for any maintenance vehicle exceeds 100 feet.

d. All weather roadway shall be designed for the site's geotechnical conditions, or the following minimum requirements:

    i. Top layer (at grade) – 3-inch thick hot mix asphalt (final compacted, graded, leveled height set 1/8" above existing adjacent grade)

        1. For roadway adjacent to existing paved roadways, paving shall be placed with a "T-cut" as shown in the standard details.

    ii. Mid-layer – 24-inch thick Class 2 Aggregate Base, 95% compaction

    iii. Mid-layer – As shown on standard details.

    iv. Pipe zone – As shown on standard details.

    v. Alternately, all weather roadway may comprise:

        1. Top layer (at grade) – 4-inch thick asphalt millings from recent removal, screened, with all large aggregates and all debris removed. Place a non-hazardous millings preservative over compacted, graded, and leveled millings. Millings shall be compacted a minimum of 4 times in the first 24-hours.

        2. Mid-layer – 24-inch thick Class 2 Aggregate Base, 95% compaction.

        3. Mid-layer – As shown on standard details.

        4. Pipe zone – As shown on standard details.

e. All weather roadway shall be designed with adequate drainage to prevent damage and/ or ponding from runoff.

f. Roadway shall be designed with gates through any fences crossing the sewer easement boundary. Gate shall be a minimum 14' wide.

g. No structures (i.e. including detached units, sheds, gazebos, etc.) shall be constructed over any District easement.

h. No fixed features (i.e. fountains, canopies, statues, hardscape, etc.) shall be constructed over any District easement.

i. No specialty landscape, trees, bushes, plants, or vegetation of any kind shall be constructed over any District easement.

j. District manholes shall not be paved over, covered with concrete, destroyed, defaced, or otherwise obstructed or tampered with on any District easement.

2. Legally, FSSD requires that all facilities to be owned, operated, and maintained by FSSD (including pipelines, manholes, appurtenances, etc.) that are not located on FSSD property/ right-of-way are legally granted an easement deed.

   a. Easements shall be granted as dedicated "Sanitary Sewer Easements" to the Fairfield-Suisun Sewer District for unlimited surface and sub-surface access to FSSD's pipelines and facilities.

   b. Easement rights shall spell out Fairfield-Suisun Sewer District's right to ownership, operation, maintenance, repair, rehabilitation, reconstruction, modification alteration, replacement, expansion, evaluation, and assessment of facilities in the easement.

3. Easement review and approval process.

   a. Easements must be accepted by the District prior to approval of the Improvement Plans.

G. STORM WATER POLLUTION PREVENTION PLAN REQUIREMENTS (SWPPP)

1. The Developer and its Design Engineer shall spell out written requirements, and ensure that, its Contractor complies with the National Pollution Discharge Elimination System (NPDES) permits for Storm Water Discharges Associated with Construction Activity requirements (ORDER WQ 2022-0057-DWQ NPDES NO. CAS000002 and any amendments or replacements).

2. The Contractor shall prepare and implement a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP and proof of a Waste Discharge Identification Number (WDID) shall be submitted for review to the District prior to any field work. The SWPPP must be accepted by the District prior to mobilization. The SWPPP shall, at a minimum, include Best Management Practices (BMPs) conforming to the NPDES Permit requirements.

3. The Contractor shall be responsible for compliance with state and local permits and shall employ and utilize environmental protection methods,

obtain all necessary permits, and fully observe all applicable Laws and Regulations.

H. INSPECTION REQUIREMENTS AND DISTRICT ACCEPTANCE OF FACILITIES

1. The District retains the right to inspect, and approve or reject, any products, materials, preparation, installation, modifications interconnections with, etc., of District facilities. District staff shall be allowed safe, unimpeded access to the jobsites during construction.

I. CONSTRUCTION SEQUENCING AND CONSTRAINTS

All Project Documents shall clearly indicate that Contractor shall notify the District at least 2 working days in advance before starting any work on an existing or new force main, gravity sewer, or pump station. At least 2 working days advance notice is required for any District inspection requests.

Depending on the complexity of construction of the facilities under the given project, the District may require the Design Engineer to prepare a specification entitled, "Construction Sequencing and Constraints" to be included in the Project Documents. Such a specification may be deemed necessary by the District for projects that require tie-in to existing District facilities that cannot be permanently removed from service during the work, work on or within District facilities that must remain in service throughout construction, or work that is subject to constraints such as time of year or time of day restrictions. Any tie-ins to existing District facilities or outages to District facilities shall require a minimum of 14 calendar days advance notice in addition to a written, detailed tie-in/ outage plan prepared by the Contractor.

The District may require that work affecting active facilities be limited to the dry weather season or dry weather conditions or may impose other restrictions related to work on operational facilities.

The District reserves the sole right to require sequence and constraints plans, outage plans, and dictate any and all outage dates.

Construction Sequencing and Constraint specifications are intended to protect the community from possible sewage spill and to inform the Contractor of special requirements and constraints imposed for sequencing or construction of the facilities.

The Design Engineer should consult the District prior to the first submittal made to determine if the project requires preparation of a construction sequencing and constraint specification by the Design Engineer.

J. GEOTECHNICAL REQUIREMENTS

(1) A Geotechnical Engineering Investigation report shall be prepared by a registered Geotechnical Engineer in the State of California for the pump station, gravity sewer, and sewer forcemain facilities. All work and

research required to prepare a comprehensive geotechnical engineering report for the project shall be included, such as soil borings, soil testing, surface conditions, historic perspective, subsurface conditions, faults and seismicity, liquefaction, and corrosive soils. The report shall contain information on geotechnical challenges for the design and construction of the project and long-term performance. The geotechnical report shall provide recommendations for design of facilities including, but no limited to:

b) Shoring

c) Dewatering/groundwater depth

d) Trench dimensions

e) Foundation, embedment, and backfill requirements for pipes and structures

f) Settlement

g) Vertical pipeline loads

h) Lateral earth pressures

i) Allowable bearing capacity

j) Information for thrust block and restrained piping design

k) Information for structural design

l) Information for seismic design

m) Information for cathodic protection design for buried pipelines and facilities.

(1) Prior to commencement of the geotechnical work, the Design Engineer shall provide the Geotechnical Engineer information on the location of the work, specifics on below grade and above grade structures, and depth and piping materials.

(2) An electronic copy of the geotechnical report shall be provided to the District for record purposes.

(3) The geotechnical report is not intended to provide design of dewatering and shoring systems, but rather to provide sufficient information for design by the Contractor.

K. SURVEY REQUIREMENTS

1. Survey work shall be performed for the project. A topographic survey shall be performed for the pump station site and/or entire pipeline alignment showing all existing surface features including, but not limited to, roadways, pavement, trees, shrubs, landscaping, pavement markings, fences, property lines, easements, rights-of-way, curbs, gutters, manhole covers, catch basins, and all utility boxes. Survey shall include all labels for manholes and utility boxes, such as gas, water, sewer, storm drain, electrical, etc. Spot elevations shall be provided and contour lines developed. The contour interval shall be dependent upon the slope of the project site.

2. The survey work shall also include the elevations of rim and inverts for all catch basins and manholes for utilities that may conflict or affect the design of the project. For each manhole and catch basin, the survey shall indicate the size of the pipes entering/exiting, their direction, and their invert elevation.

3. The survey work shall be provided in electronic format for use on contract drawings by the Design Engineer.

4. Survey work shall be performed in accordance with the following District requirements.

    a) Horizontal Datum: NAD 83

    b) Coordinate System: California State Plane

    c) Zone: 2

    d) Linear Units: US survey feet

    e) Vertical Datum: NAVD 29 for wastewater treatment plant projects. For collection system facilities outside the wastewater treatment plant boundaries, the vertical datum to be used shall be consistent with City requirements, and shall be coordinated with the District.

    f) Drawings shall clearly state the horizontal and vertical datums that are used on the plans.

5. Provide survey control information on Project Documents for use by Contractor.

6. If temporary construction easements, permanent easements, or land acquisition is required for the project, contact the District for additional survey requirements.

L. DEWATERING

Construction documents shall require the following:

1. Excavations shall be maintained in a dry condition during the construction period. If groundwater or rainwater is encountered in excavations, then dewatering shall be employed to remove or control inflows. Water shall be lowered and maintained to levels below the bottoms of excavations. Dewatering for facilities shall commence when groundwater is first encountered, and shall be continuous until facilities are fully installed.

2. (For Manholes and Structures Only) No concrete or masonry, including foundations, or floors shall be laid in water, nor shall water be allowed to rise over them until the concrete or mortar has set for at least 24 hours. Water shall not be allowed to rise unequally against walls for a period of 28 days.

3. (For Pipelines Only) All pipelines shall be installed in trenches free from standing water and shall remain dry until completion of trench backfill.

4. Develop substantially dry and stable subgrades for subsequent earthwork compaction and construction operation.

5. Prevent the loss of fines, seepage, boils, quick conditions, or softening of the foundation soils.

6. Maintain stability of sides and bottoms of excavations.

7. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, the affected areas shall be excavated and replaced with suitable materials until stable bottom conditions are achieved.

8. Dewatering shall, at all times, be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at the proposed bottom of excavation. Dewatering shall lower the water outside the excavation to ensure that seepage and migration of soil particles do not occur through openings in the shoring.

9. Flotation of facilities shall be prevented by the CONTRACTOR by maintaining a positive and continuous removal of water. The CONTRACTOR shall adequately keep excavations dewatered.

10. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted backfill, and prevent floatation or movement of facilities.

11. Dewatering water shall not be discharged into sanitary sewer or storm drain systems without written authorization from the agencies having jurisdiction. Dewatering water shall be legally disposed of. Developer may inquire with FSSD about availability to discharge water to FSSD’s facilities.

III. PLAN REVIEW

Project Documents shall be prepared in accordance with these design standards. Design Engineer shall prepare specification and drawings for bid and/or construction of the facilities.

Project Documents shall be prepared to allow the District to provide input and comments. Such comments shall be incorporated into subsequent Documents for review.

Project Documents shall include electronic as well as three (3) complete sets of specifications and drawings, and any additional items outlined within the design standards to be submitted.

- Initial Submittal(s). The Initial Submittal(s) shall include, as a minimum, the following items:

  - Specifications for major project components.

  - Drawings with all required plan views, profiles, sections, and details for demolition, civil, mechanical, architectural, and electrical disciplines, as required.

  - Plan and profile drawings shall be provided that indicate sizes and locations of existing utilities and indicate horizontal and vertical clearance between new and existing utilities.

  - Electrical and instrumentation drawings shall include single line diagram; equipment elevations; process and instrumentation diagrams (P&ID), if applicable; site plan with equipment; building plan with equipment, if applicable; and PLC diagrams.

  - Any additional items listed within these design standards that are required to be submitted.

- Final Submittal

  - Two (2) wet-stamped, full-size hardcopy sets of construction drawings shall be provided to the District, as well as an electronic copy in both CAD-generated PDF format (with electronic stamp and signature) and District compatible version of AutoCAD. Three (3) sets of hardcopy Project Documents, other than drawings, shall be provided to the District, as well as an electronic copy in both PDF format and latest version of Microsoft Word. Project Documents shall be delivered to the District prior to construction activities.

Upon delivery of Project Documents, the District requires a minimum of thirty (30) days for review of the submittal to provide comments to the Design Engineer.

Prior to bid and/or commencement of construction of facilities, the District must provide written approval of the Final Project Documents. No changes are allowed to the Final Plans after District approval of the Project Documents without written approval by the District. Only Project Documents with cover sheets signed and dated by the District will be authorized for construction or connection to District facilities.

All Project Documents shall be prepared in accordance with the District's standards.

IV. REQUIRED CONSTRUCTION SUBMITTALS

The Project Documents shall require the Contractor to provide submittals for District review and approval prior to the construction of facilities. Each specification Section shall include a statement that all items within the specification Section shall be submitted in accordance with the requirements outlined herein to show compliance with the Contract Documents. In addition, contractors shall provide submittals for construction safety, schedule, dewatering, shoring, and tie-ins to existing District facilities. Work that is required by submittal shall not begin until the respective submittal is received and approved.

A. INITIAL SUBMITTALS

The Contractor shall submit the following items to the District for review:

1. A preliminary construction schedule for the work, showing the general plan for orderly completion of the work. The submitted construction schedule shall indicate the construction initiation and completion date, as well as the starting and completion dates of various stages of the work.

2. A preliminary schedule of Shop Drawings and Samples as applicable to District facilities

3. Equipment O&M manuals as required and detailed under Section V - Operation and Maintenance Manuals.

B. SHOP DRAWING SUBMITTALS

The Contractor shall furnish all shop drawing submittals related to District facilities to the District for review, in electronic format. The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop drawings, fabrication, and installation drawings, erection drawings, lists, graphs, operating instructions, catalog sheets, data sheets, and similar items for District facilities. Interconnection wiring diagrams (electrical, instrumentation, and controls) shall be submitted for review as a shop drawing submittal.

All Shop Drawing submittals shall be accompanied by the District's standard submittal transmittal form. Normally, a separate transmittal form shall be used for each specific item or class of material or equipment for which a submittal is required.

The District will return electronic copies of each submittal, including resubmittals, to the Contractor with its comments noted thereon, within 14 calendar days following their receipt by the District.

If a submittal is returned to the Contractor marked "NO EXCEPTIONS TAKEN," or "MAKE CORRECTIONS NOTED," formal revision and resubmission of said submittal will not be required.

If a submittal is returned to the Contractor marked "AMEND-RESUBMIT," the Contractor shall revise said submittal and shall resubmit the required number of copies of said revised submittal to the District.

If a submittal is returned to the Contractor marked "REJECTED-RESUBMIT," the Contractor shall revise said submittal and shall resubmit the required number of copies of said revised submittal to the District.

Fabrication of an item should commence only after the District has reviewed the pertinent submittals and returned copies to the Contractor marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED". Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis of claims for extra work.

All Contractor shop drawing submittals shall be carefully reviewed by an authorized representative of the Contractor, prior to submission to the District. Each submittal shall be dated, signed, and certified by the Contractor, as being correct and in strict conformance with the Contract Documents. In the case of shop drawings, each sheet shall be so dated, signed, and certified. No consideration for review by the District of any Contractor submittals will be made for any items that have not been so certified by the Contractor. All non-certified submittals will be returned to the Contractor without action taken by the District, and any delays caused thereby shall be the total responsibility of the Contractor.

Submittals shall be reviewed by the Developer and Design Engineer for completeness and conformance with these Standards, prior to submission to the District. **The Developer and Design Engineer shall immediately return to the Contractor for correction, any submittals that are incomplete or not in conformance with these Standards and the Final Plans accepted by the District. Such incomplete submittals shall not be submitted to the District.**

The District's review of Contractor shop drawing submittals shall not relieve the Contractor of the entire responsibility for the correctness of details and dimensions. The Contractor shall assume all responsibility and risk for any misfits due to any errors in Contractor Submittals. The Contractor shall be responsible for the dimensions and the design of adequate connections and details.

C. SAMPLES SUBMITTALS

Whenever samples are required in the Project Documents, the Contractor shall submit not less than 3 samples of each such item or material to the District for approval at no cost to the District.

Samples, as required herein, shall be submitted for approval a minimum of 21 days prior to ordering such material for delivery to the jobsite, and shall be submitted in an orderly sequence so that dependent materials or equipment can be assembled and reviewed without causing delays in the work.

All samples shall be individually and indelibly labeled or tagged, indicating thereon all specified physical characteristics and Supplier's names for identification and submitted to the District for approval. Upon receiving approval of the District, one set of the samples will be stamped and dated by the District and returned to the Contractor, and one set of samples will be retained by the District, and one set of samples shall remain at the job site until completion of the work.

Unless otherwise specified, all colors and textures of specified items will be selected by the District from the manufacturer's standard colors and standard materials, products, or equipment lines.

D. REQUESTS FOR CLARIFICATION AND PROPOSED CHANGES

The Design Engineer shall not alter the approved Project Documents during construction without written approval by the District.

Requests for clarification of the specifications and/or drawings (also known as Requests for Information) shall be directed to the Design Engineer using a Request for Clarification (RFC) form provided by the Design Engineer. The Request for Clarification form may be used by the Contractor to transmit additional information to supplement the request for clarification. The Design Engineer shall confer with the District for any changes proposed to District facilities.

A separate form shall be used for each specific item for which a clarification is required. Each Request for Clarification shall be numbered consecutively and the Contractor shall maintain a log noting the RFC number, subject, and date of transmittal.

A copy of each RFC related to District facilities, along with the Design Engineer’s response, shall be sent to the District. No change to the Contract Documents shall be granted without written approval by the District.

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V. FACILITY OPERATION AND MAINTENANCE MANUALS

The Developer shall submit complete facility and components Operations and Manuals including manufacturer's Specifications for pumps, electrical controllers, sumps, and alarms, and receive favorable review prior to facility acceptance, or facility connection. The Developer shall submit a copy of the electrical permit signed off as approved by PG&E prior to startup testing of the pumping system.

1. Developer shall submit Operation and Maintenance Manuals for all equipment supplied under the Contract Documents. At a minimum, Operation and Maintenance manuals shall be submitted for all items of equipment including mechanical, electrical, and instrumentation equipment. Equipment and items requiring operation and maintenance manuals shall include, but not be limited to:

    a. Standby generator and fuel system

    b. Sluice or slide gates

    c. Pumps

    d. Air compressors

    e. Odor control system

    f. Tanks

    g. Hoists and trolleys

    h. Valves

    i. Valve and gate operators

    j. Flowmeters

    k. pH monitoring systems

    l. Surge protection systems

    m. Electrical equipment (e.g., transformers, switchgear, motor control centers, transfer switches, etc.)

    n. Variable frequency drives

    o. Instrumentation systems/equipment (e.g., programmable logic controllers, instruments, gauges, transmitters, etc.)

p. Standby power systems including fuel tanks and controllers

2. The Project Documents shall include provisions for the following:

3. The Contractor shall deliver to the District two (2) initial copies for review and three (3) final sets of acceptable manufacturer's operation and maintenance instructions covering each item of mechanical, electrical, and instrumentation equipment or equipment assembly provided. All information shall be submitted, reviewed, and approved. Submittal and review of the above information shall be handled in a manner similar to shop drawings as specified herein. All operation and maintenance materials shall be original literature; no photocopied information shall be accepted. All information submitted shall be specific to the exact equipment supplied. Generic literature is unacceptable.

4. Before final acceptance of the project by the District, the Contractor shall bind all three (3) sets of operation and maintenance instructions in appropriately labeled, expanding post-type binders. Each completed binder shall contain only that material which can be held with the posts in the nonexpanded position. A complete table of contents listing all items and their location in the set shall be included in each binder. For ready reference, the Contractor shall compile a complete list of manufacturer's local representatives for each item provided.

5. In addition to hardcopy of O&M manuals, an electronic copy of each O&M manual shall be provided in PDF word-searchable format via DropBox, Microsoft OneDrive, or Microsoft SharePoint.

6. All information on attached Mechanical and Electrical Equipment Maintenance Summary Sheets shall be filled in and submitted to the District.

7. Operation and maintenance instructions shall include, as a minimum, the following data for each item of mechanical, electrical, and instrumentation equipment.

    1. An itemized list of all data provided.

    2. Name and location of the manufacturer, the manufacturer's local representative, the nearest suppliers, and spare parts warehouse.

    3. Recommended installation, adjustment, start up, calibration, and troubleshooting procedures.

    4. Recommended lubrication, lubrication intervals, and an estimate of yearly quantity needed.

    5. Recommended step-by-step procedures for all modes of operation.

6. Complete internal and connection wiring diagrams.

7. Recommended preventive maintenance procedures and schedule.

8. Complete parts lists, by generic title and identification/part number(s) with exploded views of each assembly.

9. Recommended spare parts, including part number(s) and special tools.

10. Disassembly, overhaul, and reassembly instructions.

11. Factory test pump curves, where applicable.

12. All approved submittal information, including all specification sheets and material data sheets.

13. All relevant drawings, including system schematics, single-line diagrams, elevation drawings, etc., updated to reflect as-built changes.

8. In addition, the following shall be provided for instruments.

1. An instrument data sheet shall be provided for each instrument. The instrument data sheet shall include the following items, at a minimum.

q. District project name and number.

r. Instrument tag number.

s. Supplier.

t. Manufacturer.

u. Model number.

v. Process specifications.

w. Line size and materials of construction.

x. Instrument specifications.

y. Options provided.

z. Manifold specifications.

2. An instrument list shall be provided for the project that includes each instrument, its associated tag number, description, manufacturer, part number, and quantity provided.

9. Following completion of the project, instruction and procedures shall be

modified by the Contractor to reflect field changes as applicable.

2. FACILITY OPERATIONS MANUAL

10. In addition to equipment O&M manuals to be prepared by equipment manufacturers and submitted by the Contractor, the Developer shall submit an operations manual for the complete facilities. The operations manual shall include the overall operational procedures to be employed at the facilities by the District to operate the facilities under all anticipated conditions. Information contained within the manufacturers' O&M manuals for operation and maintenance of specific items of equipment need not be duplicated. The operations manual shall include operations procedures and sequencing information required to operate the overall facility.

11. The Design Engineer shall deliver to the District two (2) initial copies for review and three (3) sets of the acceptable facility operation manual. All information shall be submitted, reviewed, and approved. Submittal and review of the above information shall be handled in a manner similar to shop drawings as specified herein.

12. Before final acceptance of the project by the District, the Design Engineer shall bind all sets of the facility operations manual. A complete table of contents listing all items and their location in the set shall be included.

13. In addition to hardcopy operations manual, an electronic copy of the manual shall be provided in PDF word-searchable format and the latest version of Microsoft Word format via DropBox, Microsoft OneDrive, Google Drive, or other corporate recognized cloud-service. Any figures shall be provided in PDF format and the latest version of AutoCAD.

FAIRFIELDSUISUN SEWER DISTRICT

MECHANICAL AND ELECTRICAL
EQUIPMENT MAINTENANCE SUMMARY SHEET

EQUIPMENT ITEM: _____

MANUFACTURER: _____

Name: _____

Address: _____

_____

Phone: _____ Fax: _____

CONTRACT IDENTIFICATION NUMBERS:

_____

LOCATION IN PLANT OR SYSTEM:

_____

MANUFACTURER'S LOCAL REPRESENTATIVE:

Name: _____

Address: _____

_____

Phone: _____ Fax: _____

PREVENTATIVE MAINTENANCE SUMMARY:

Preventative Maintenance Procedures:	Recommended Frequency	Lubricant Ref. Symbol	Technical Manual Page Reference

PREVENTATIVE MAINTENANCE SUMMARY (Continued):

Preventative Maintenance Procedures:	Recommended Frequency	Lubricant Ref. Symbol	Technical Manual Page Reference

NAME PLATE DATA: (TYPICAL)

Driver

Make _____

Model _____

Type _____

Serial No. _____

Code _____ Design _____

Frame _____ Svc. Factor _____

HP _____ RPM _____

Cycles _____ Phase _____

Volts _____ Amps _____

Efficiency FLA

Bearings (Mfr. and No.)

_____

_____

_____

_____

Driven Unit

Make _____

Model _____

Type _____

Serial No. _____

Size _____ RPM _____

GPM _____ TDH _____

Impeller _____ Material _____

Diameter _____

Mech. Seal (Mfr. Part No.) _____

Bearings (Mfr. and No.) _____

_____

_____

_____

_____

NAME PLATE DATA: (TYPICAL) (continued)

Intermediate Gear		Variable Speed	
Make	_____	Make	_____
Model	_____	Model	_____
Serial	_____	Serial	_____
Type	_____	Type	_____
Input/output ratio	_____		
Output RPM	_____		
AGMA Rating	_____		

Bearings (Mfr. and No.)

_____

_____

_____

_____

_____

_____

Auxiliary Equipment

Function_____

Make_____

Model_____

Serial_____

Type_____

Volts_____

Range_____

LIST OF SETTINGS for control devices, pressure relief valves, time delay relays, alarm switches, timers, etc.

Device Name	Adjustable Range	Initial Setting

INDICATE IF THE UNIT IS ASSEMBLED WITH METRIC OR S.A.E. BOLTS AND FASTENERS: Check the appropriate column:

	Metric	SAE	Other	(Specify)
Driver				
Driven Unit				
Gear Unit				
Aux. Equip.				
Other				

DATE OF INSTALLATION: _____

INSTRUMENTATION
Equipment Maintenance Summary Sheet

Type of Instrument _____ Description _____

Company Name _____ Contact Name _____
Address _____ Phone No. _____
Technical Assistance _____

Code _____
Model No. or other
Product Designation _____
Type _____
Part No. _____ Revision No. _____
Serial No. _____
Date of Manufacture _____
Manufacturer _____

Manufacturer's Local Representative:
Company Name _____ Contact Name _____
Address _____ Phone No. _____

Characteristics:

Input		Output	
Scale Range	_____	Max. Working Pressure	_____
Multiplier	_____		
Power Requirements	_____	Air Supply	_____
Materials of Const.	_____	Flange Size	_____
Software Version No.	_____	Bolt Size	_____
System Address	_____		
Frequency Descriptions	_____	Field Notes	_____
	_____	Safety Warnings	_____
			_____

INSTRUMENTATION
Equipment Maintenance Summary Sheet (continued)

Tag No. _____

Loop No. _____

Contract Spec. and
Drawing Label _____

Location on Plant Site _____

Reference Drawing(s) _____

The undersigned affirms that the information given on this form is accurate for the specific equipment furnished.

Signature _____

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VI. TRAINING OF DISTRICT STAFF

The Developer shall include within the Contract Documents requirements for the Contractor to provide District staff with training for all items of mechanical, electrical, and instrumentation equipment. The exact equipment items requiring training and the duration of training for each item shall be developed by the Design Engineer and Equipment Manufacturers, and submitted to the District for review and acceptance, and implementation into the Contract Documents to be provided by the Contractor at no cost to the District.

Requirements within the Contract Documents shall include the following as a minimum:

1. Operations and maintenance training of the District's personnel shall be provided for mechanical, electrical, and instrumentation equipment. These training services shall be conducted by the manufacturer's representative and shall include all necessary classroom and on-site instruction.

2. The District shall have the right to videotape all training sessions. The Contractor shall designate and provide one or more persons to be responsible for coordinating and expediting its training duties. The person or persons designated shall be present at all training coordination meetings with the District.

    a. Training Schedule:

        1) The Contractor's coordinator shall coordinate the training periods with District personnel and manufacturer's representatives and shall submit a training schedule, training outline, and associated training materials for District review and approval for each piece of equipment or system for which training is to be provided. Said training schedule, outline, and materials shall be submitted not less than twenty-one (21) calendar days prior to the time that the associated training is to be provided and shall be based on the then-current Plan of Operation. The Contractor shall not conduct any training without District approval of the outline and materials.

        2) Equipment and/or systems shall be deemed suitable for use in training upon satisfactory completion of all required testing.

        3) If a manufacturer's representative fails to conduct a scheduled training class, the Contractor hereby agrees to compensate the District for labor costs, including overhead, for all City personnel in attendance for the entire scheduled training period.

        4) The amount of training listed (by the Design Engineer within the Contract Documents) shall be considered the minimum

required. If, for any reason, the Contractor or the equipment manufacturer suggests that the period for training for operations or maintenance personnel may be inadequate for a thorough understanding of the Project systems, additional training shall be provided at no additional cost to the District so that continuous safe operation can be assured.

5) At a minimum, training shall include:

   a) Review of manufacturer's operation and maintenance literature.

   b) Discussion of preventative maintenance requirements of each system component.

   c) Recommended application of predictive maintenance techniques.

   d) Discussion of start-up and shutdown procedures.

   e) Discussion of the different modes of operating control available.

   f) Demonstration of each component and of each system as a whole.

   g) Assistance and advice on each system during actual initial operation by the District's operations personnel.

   h) Troubleshooting methods and techniques.

   i) Test equipment requirements.

   j) Disassembly and reassembly.

   k) Use of special tools and techniques.

6) Required Training:

7) The Contractor shall provide manufacturer/ suppliers' representatives for the training and assistance, at a minimum.

8) The cited training and assistance durations shall be exclusive of travel time.

9) A written schedule for the training required shall be submitted to the District a minimum of fourteen () working days prior to the proposed date for the session. Training sessions shall be given after the subject system is activated and immediately preceding its readiness for operation by District's operations personnel.

VII. DESIGN STANDARDS FOR WASTEWATER PUMP STATIONS

Pump stations are not acceptable under the District's standards unless it is demonstrated to the District Engineer that a gravity option is not feasible. If, at the determination of the District Engineer, a pump station is necessary to serve a proposed development, the developer shall enter into an Improvement Agreement with the District that outlines the responsibilities, procedures, and standards that will apply to design and construction of the pump station, to be established by the District based on the specific conditions applicable to the facility.

Appendix G of these Design Standards spell out the minimum features and requirements, for all pumping facilities, that the Designer, Contractor, and Developer are responsible for. The District reserves the right to specify additional requirements that the Developer and proposed development must satisfy as a condition of District approval.

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VIII. DESIGN STANDARDS FOR SEWER FORCEMAINS

Pump stations and force mains (pressurized mains) are not acceptable under the District's standards unless it is demonstrated to the District Engineer that a gravity option is not feasible. If, at the determination of the District Engineer, a pump station and force main are necessary to serve a proposed development, the developer shall enter into an Improvement Agreement with the District that outlines the responsibilities, procedures, and standards that will apply to design and construction of the pump station, to be established by the District based on the specific conditions applicable to the facility.

Appendix G of these Design Standards spell out the minimum features and requirements, for all force main facilities, that the Designer, Contractor, and Developer are responsible for. The District reserves the right to specify additional requirements that the Developer and proposed development must satisfy as a condition of District approval.

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IX. DESIGN STANDARDS FOR GRAVITY SEWERS (12" DIAMETER OR LARGER)

This portion of the design standards shall be used by a Design Engineer who is preparing Contract Documents for gravity sewers which are 12 inches in diameter or larger to be owned and operated by the District. Gravity sewers less than 12 inches in diameter are not under the jurisdiction of the Fairfield-Suisun Sewer District (FSSD), and requirements of the City of Fairfield/City of Suisun City/Solano County (as applicable) shall apply.

For clarity, the District's Design Standards shall not be used as a substitute for the Design Engineer's calculations and design, and shall not be used as a substitute for the Designers' and/ or Developers' Project Documents for construction. These Design Standards spell out the minimum considerations and requirements for all District facilities that the Designer, Contractor, and Developer are responsible for.

Design standards outlined herein are to be used by the Design Engineer in preparation of Project Documents, namely specifications and drawings for use by a Contractor. All requirements that affect the Contractor shall be incorporated into the Project Documents by the Design Engineer.

The Developer shall indicate whether the proposed development conforms to the Cities' current land use and/or zoning designations. If the proposed development differs from current land use and/or zoning designations, the developer is responsible for the cost of computer modeling to determine potential impacts to the sewer system. The Developer is responsible for the cost to increase capacity within the collection system if improvements are necessary to serve the proposed development.

A. GRAVITY SEWER SIZING

Sizing of gravity sewers 12 inches in diameter and greater for design flows will be based on the Fairfield-Suisun Sewer District's sizing requirements outlined below. All calculations shall be submitted to both the District and City of Fairfield/City of Suisun City/Solano County (as applicable) for review and comment prior to detailed design.

1. FSSD's Sizing Requirements for Design Flows.

   1 The sizing of gravity sewers (≥ 12 inches) for new developments shall be accomplished using the District's Flow Estimating Procedure for New Developments as developed in the District's most current Collection System Master Plan. The Design Engineer shall calculate the estimated flow using the following procedure and submit the calculations to the District prior to any design work for approval of the sizing of the gravity sewer facilities.

2 If flows entering the gravity sewer will vary between startup and when the sewer's incoming flow reaches its buildout condition, then design flows for the two extreme conditions shall be determined.

3 For estimating the design flow rate, the wastewater flow from an area of new development can be divided into three components. Each component is determined individually, and then the design flow is calculated by summing the three components.

4 **Component 1 – Dry Weather Sanitary Flow.** This flow component represents sanitary flow generated from residential and/or commercial activity. It can be estimated using the following steps:

a) Determine the gross acres of development and the land use category.

b) Using Table 1, determine the design density of development for that land use category. The density will be in building square feet per acre or dwelling units per acre.

c) Multiply the gross acres by the density to get the building square feet or the number of dwelling units.

d) Using Table 2, determine the unit flow factor for that land use category. The flow factor will be in gallons per day per square foot, or gallons per day per dwelling unit.

e) Multiply the square footage or the number of dwelling units by the appropriate flow factor to determine the daily average sanitary flow in gallons per day and the maximum day sanitary flow in gallons per day.

f) Use a peaking factor to convert from daily average sanitary flow to peak hour sanitary flow. The following peaking factors shall be used: 1.8 for residential development and 1.5 for other land use categories.

5 **Component 2 – Groundwater Infiltration.** This flow component represents the additional flow that leaks into pipes during the high-groundwater season. It can be estimated by multiplying the gross acres of development by an assumed rate of 100 gallons per day per acre (gpad).

6 **Component 3 – Storm Related Inflow and Infiltration.** For new development at less than 100 acres, the inflow and infiltration that leaks into the sewer system can be estimated using the rate shown in Table 3. These rates range from 1,900 gpad to 2,200 gpad for a 20-year storm depending on the location of the development within the service area. This flow component is calculated by multiplying the appropriate rate by the gross acres of development.

Total Design Flow. The design flow or peak wet weather flow from the development is the sum of the three components listed above, each in gallons per day.

2. Gravity Sewer Sizing.

Once dry weather sanitary flow (average dry weather flow [ADWF]), peak hour sanitary flow, and design flow (peak wet weather flow [PWWF]) are determined, sizing of gravity sewers may commence. Initial flow conditions, as well as buildout flow conditions, shall be considered when designing facilities.

A number of parameters have been set for sizing gravity sewers. They include: maximum d/D ratio, minimum velocity, pipe friction factor and minimum and maximum slopes. Unless otherwise required or approved by the District Engineer, gravity sewers shall be sized for buildout PWWFs.

a) Maximum d/D Ratio.

Gravity sewers shall be sized to provide a maximum d/D ratio of 0.9 for buildout design flows. "d" is the maximum water depth within a pipeline under buildout design flow (peak wet weather flow [PWWF]). "d" is dependent upon the pipeline slope and pipe friction factor "n". "D" is the diameter of the pipeline.

b) Minimum Velocity.

The design should provide for a minimum velocity of 2.0 feet per second at peak dry weather sanitary flow. This minimum criterion is meant to provide a self-scouring velocity in the pipe. Low velocities are undesirable, causing sedimentation of grit, corrosion, and odor problems. If initial conditions at startup of the gravity pipeline facilities will result in lower flows and lower velocities within pipeline, the District should be notified since implementation of a comprehensive maintenance program may be necessary.

c) Pipe Friction Factor "n".

The friction factor for gravity pipelines shall be based on the Manning's friction factor "n". The friction factor is affected by the pipe material and condition of the pipe. Pipes with smoother interior surfaces have lower friction factors. The friction factor tends to increase with a pipe's age due to corrosion, grease buildup, solids deposition, etc. Table 4 shall be used to determine the pipe friction factors to be used when designing gravity sewer facilities.

Table 4. Pipe Friction Factors

Pipe Material	Manning's "n"
Reinforced Concrete (RCP)	0.013
Vitrified Clay (VCP)	0.013

d) Minimum and Maximum Slopes.

Table 5 outlines minimum and maximum slopes for gravity sewers between 12 and 60 inches in diameter.

If the minimum and maximum slopes of any of the design criteria indicated cannot be accomplished for any reason, the Design Engineer shall contact the District immediately to obtain further direction. In cases where maximum slopes are exceeded, the District may impose special design requirements for manholes and pipelines to protect the facilities from sulfide corrosion.

Table 5. Minimum and Maximum Slopes for Gravity Sewers

Pipe Inside Diameter (in)	Minimum Slope (ft/ft)	Maximum Slope (ft/ft)
12	0.0022	0.04
15	0.0015	0.03
18	0.0012	0.026
21	0.0010	0.020
24	0.0009	0.018
27	0.0008	0.015
30	0.0008	0.013
33	0.0008	0.012
36	0.0008	0.010
39 to 60	0.0008	0.009

B. GEOTECHNICAL

1. A Geotechnical Engineering Investigation Report shall be prepared by a registered Geotechnical Engineer in the State of California for the gravity sewer facilities. Refer to Section II - General Requirements, for geotechnical requirements.

C. SURVEY WORK

1. Survey work shall be performed during the design phase for the project. See Survey Requirements outlined in Section II - General Requirements.

D. UTILITY COORDINATION

1. Design Engineer shall contact all utilities within the project vicinity to coordinate with existing utilities that need to be avoided, relocated, and/or required for service at the new facilities. This work shall include, but not be limited to, obtaining drawings of existing utilities for location and size, and coordinating the project design with improvements/activities that may be planned by each utility agency.

E. UTILITY LOCATING

1. Locating existing utilities in the vicinity of the new work shall include potholing of all existing utilities to determine their exact location during the design phase. Unless otherwise required by the District Engineer, potholing is not required for utilities where both end points have been surveyed, such as gravity sewers or storm drains. Potholing shall be performed in addition to obtaining utility maps from agencies. The utility

maps and surface features, such as valve boxes, etc. shall be used as guides to determine where to pothole.

F. SEPARATION OF WATER AND WASTEWATER PIPES

1. Design shall comply with all California Code of Regulations requirements and any other local requirements at the time of design regarding separation of gravity sewer pipelines from potable water pipelines. All requirements shall be complied with including, but not limited to, pipeline separation, pipeline location, pipeline materials, casing pipes, and joint location. If requirements conflict with the design standards outline within this document, consult the District.

G. CONTRACT DOCUMENTS FOR GRAVITY PIPELINES

1. Contract Documents for the design of gravity sewers 12 inches or larger in diameter shall be prepared, including specifications and drawings.

2. Drawings shall include plan and profile drawings for all pipelines. The drawings shall include the plan view across the top of the drawing and its associated profile across the bottom of the drawing. Plan and profile drawings shall, at a minimum, include the following elements.

    a) Plan view shall include:

        (1) Topographic survey of background as outlined under Survey Work, including contours, surface features, etc.

        (2) All existing utilities as obtained from Utility Coordination and Utility Locating, as outlined herein.

        (3) Plan location of all new facilities, including pipeline and manholes.

        (4) Stationing of new pipeline.

        (5) Geotechnical soil boring locations per the Geotechnical Report.

    b) Profile shall include:

        (1) Grid with stationing and elevations.

        (2) New pipeline(s) and manholes.

        (3) All existing utilities crossing the new pipeline alignment, as obtained from Utility Coordination and Utility Locating, outline herein. Show vertical and horizontal location, size, and type of utility.

        (4) Existing grade and proposed grade.

        (5) New pipeline inverts at manholes.

(6) New pipeline size, material, and slope.

(7) Manhole rim elevation.

3. Provide all required details including, but not limited to:

a) Manhole detail.

b) Trench detail.

c) Pavement detail.

H. PIPELINE MATERIALS

1. Gravity sewers 12 inches and larger in diameter shall be vitrified clay pipe.

2. If gravity sewers are to serve any non-residential customers, consult District to determine if vitrified clay pipe is an appropriate pipe material prior to proceeding with the design.

3. Alternate materials may be approved by the District on a case-by-case basis.

4. Vitrified Clay Pipe.

a) Use extra strength vitrified clay pipe, bell and spigot type meeting or exceeding the requirements of ASTM C700, except that minimum strengths shall be in accordance with Table 6.

Table 6. Minimum Test Loads
(Standard Specification for Public Works Construction)

Nominal Size Inches	Load lb./Linear Feet	Nominal Size Inches	Load lb./Linear Feet
12	2600	30	5500
15	3100	33	5800
18	3600	36	6300
21	4200	39	6600
24	4800	42	7000
27	5200		

b) Pipeline calculations shall be submitted to the District for review with the 50 percent design submittal. Such calculations shall account for dead and live loads subject to the pipeline, trench width, and trench material to be used. Calculations shall indicate that pipe to be used is suitable for the design conditions. Vitrified clay pipe requires suitable trench materials be used. Design Engineer shall consult the Geotechnical Engineer, pipe manufacturer, and ASTM C12, Standard Practice for Installing Vitrified Clay Pipe Lines, for appropriate trench material design.

c) Joints for vitrified clay pipe and fittings shall be factory applied, flexible-compression type. The joint seal shall be formed by the compression of the bead portion of the clay bell with the spigot casting when the joint is assembled. The joint shall conform in all respects to ASTM C425 clay bell type pipe.

d) All pipe and fittings shall be clearly marked with the name or trademark of the manufacturer, the location of manufacturing plant, date code, and strength (Extra Strength) designation.

e) At a minimum, couplings and adapters shall use Type 316 stainless steel clamps and bolts and nuts and oil-resistant rubber components conforming to ASTM C425. All repairs and connections must use a "Repair" type coupling. All couplings shall be provided with double Type 316 stainless steel shear band.

f) If precast manhole bases are used, vitrified clay pipe bells shall be cast into the precast bases. Design Engineer shall direct Contractor to coordinate with manhole supplier.

g) Where stubouts for vitrified clay pipe are required, vitrified clay rubber gasketed spigot plugs shall be installed into bell or a pre-approved plugging method shall be used. The method(s) must be approved in writing by the District prior to use.

I. PIPELINE DESIGN AND INSTALLATION

1. Design Considerations.

a) No joint deflection/curved sewers are allowed. A manhole is required at every bend.

b) All connections to new or existing sewer pipes shall be made at new or existing manholes.

c) Manhole spacing shall not exceed 500 feet.

d) Minimum depth of cover over any gravity sewer shall be 4 feet, or as required by the City of Fairfield/City of Suisun City/Solano. Minimum pipe cover and clearance shall be maintained in the design. If certain conditions exist which make it impractical to meet the minimum cover and clearance requirements, the conditions and locations shall be specifically noted above the profile on the drawings. Each location not meeting the minimum cover and clearance requirements will require special approval. Any planned condition being specially approved with less than minimum cover will require special pipe, bedding, and/or backfill as directed by the District and/or City of Fairfield/City of Suisun/Solano County (as applicable).

e) Where side sewer enters trunk sewers at a manhole, crowns of trunk and side sewers shall be at same elevation. No drop manholes are allowed.

f) Pipeline flexibility shall be provided where pipelines exit or enter structures, including, but not limited to, boxes/vaults and manholes. Flexibility shall be provided through use of flexible joints. The amount of flexibility required is dependent upon the amount of expected differential settlement between pipelines and structures or manholes. Expected settlement shall be obtained from the Geotechnical Report. At a minimum, a joint shall be provided within 2'-0" of any manhole base or structure.

g) At any structure other than a manhole, a pipe bell shall be cast into the structure for connection of the gravity sewer.

h) At manholes, pipe shall be cast within/through manhole base, for connection to adjoining sewer pipe at joint. Top of pipe shall be removed within manhole. For side sewers entering the manhole, a pipe bell shall be cast into the manhole for connection of the side sewer.

i) New sewer pipelines shall have a minimum clearance of 12 inches from all other utilities. Clearance shall be defined as a clear distance between the outside of each utility. Larger separation may be required by the Owner of the other utility. Design Engineer shall coordinate impacts with utility owners.

j) Parallel utilities shall have a minimum clearance of 10 feet from sewer lines. Clearance shall be defined as a clear distance between the outside of each utility.

k) Any bypass pumping of raw wastewater required to construct the facilities shall be specified by the Design Engineer for implementation by the Contractor.

l) All miscellaneous metallic items, including all hardware used on the project that are installed below grade or within a wastewater structure, shall be Type 316 stainless steel.

2. Pipeline Installation.

a) Pipeline installation shall be specified in the Contract Documents to meet the following design standards.

(1) Shoring, sheeting, bracing, or sloping of trenches shall meet the requirements outlined in "Geotechnical" in this section. Shoring, sheeting, bracing, or sloping of trenches shall be addressed in the Geotechnical Report.

(2) Dewatering shall meet the requirements outlined in "Geotechnical" in this section. Dewatering shall be addressed in the Geotechnical Report and shall meet the requirements in "Dewatering" of Section II – General Requirements.

(3) Trench. Trench detail(s) shall be developed specifically for pipelines on the project. The trench detail shall include trench dimensions and trench materials and shall conform to the basic requirements indicated within the trench detail included in Appendix A. Specifications shall include information on trench materials and compaction requirements. Trench design shall be addressed in the Geotechnical Report as outlined within "Geotechnical" in this section. Trench design for vitrified clay pipes shall be in accordance with Geotechnical Report requirements, pipe manufacturer's recommendations, and ASTM C12, Standard Practice for Installing Vitrified Clay Pipe Lines.

b) All pipelines and appurtenances shall have direct burial wire laid above the top of pipe before backfilling The wire shall be installed and spliced in accordance with the manufacturer's written instructions and the Standard Drawings to form a set of continuous electrical conductors throughout the pipe system. Wire shall be #10 AWG single strand wire with insulation.

c) Warning tape shall be provided on all buried piping. Warning tape shall indicate type of pipeline and shall be specifically designed for this use. Warning tape for all buried pipelines shall be detectable where indicated. Warning tape shall be 6 inches wide by 5 mils thick, with aluminum foil center. Wording shall be printed on both sides of tape every 16 to 36 inches along the tape. Warning tape shall read "CAUTION – BURIED SEWER". Refer to Trench Detail in Appendix A for location of warning tape.

d) Geotextile Filter Fabric

(1) The contractor shall install nonwoven geotextile filter fabric between the Bedding and Backfill material in such a manner to prevent migration of the backfill material into the bedding whenever Crushed Rock is used as bedding.

(2) Filter fabric shall meet or exceed the following specifications:

TRENCH FILTER FABRIC			
Property	**ASTM Test Method**	**Nonwoven Minimum Average Roll Value (English)**	**Nonwoven Minimum Average Roll Value (Metric)**
Grab Tensile Strength	D4632	112 lbs	500 newtons

Trapezoidal Tear Strength	D4533	40 lbs	180 newtons
Puncture Strength	D4833	40 lbs	180 newtons
Permittivity	D4491	1.5 sec^{-1}	1.5 sec^{-1}
Apparent Opening Size (AOS)	D4751	Maximum #70 sieve	Maximum 0.212 minimum
UV After 500 Hours	D4355	70%	70%
[1] All values in this table are the minimum values allowed in each direction except as noted, and are based on Minimum Average Roll Value (MARV).			

(3) Filter fabric installation requirements:

(a) Trench filter fabric shall be installed in such a manner to prevent migration of fines.

(b) Adjacent rolls shall be overlapped a minimum of 24" in the longitudinal and transverse directions.

e) Crushed Rock gradation requirements:

(a) 90% of the aggregate shall have at least one fractured face.

(b) 75% of the aggregate shall have at least two fractured faces.

(c) 50% of the aggregate shall have at least three fractured faces.

CRUSHED ROCK GRADATION REQUIREMENTS	
Sieve Size	**Percent Passing**
1 inch	100
¾ inch	90-100
½ inch	20-50
No. 4	0-5

f) The following shall be included within the Contract Documents. If sewer pipe other than vitrified clay pipe is specified for use by the District, the Design Engineer shall consult the District for installation standards.

(1) Vitrified Clay Pipe installation shall conform to ASTM C12 and to the manufacturer's recommendations, except as modified herein.

(2) Trenches shall be excavated to a width shown on the Contract Drawings, as determined by the Design Engineer, in conformance with the Geotechnical Report and the requirements of the District's Trench Detail in Appendix A. Trench walls shall not be undercut.

(3) The measured width at the top of the pipe shall not exceed the maximum design trench width as shown on the Contract Drawings.

(4) Uniform support shall be provided along the length of the barrel. Bell or coupling holes shall be excavated to prevent point loading of the bells or couplings.

(5) Where sheeting, shoring, or bracing is required, require Contractor to submit shop drawings of the sheeting, shoring, or bracing system, as required. Contractor shall sheet, shore, and brace trenches, as necessary, in accordance with approved shop drawings and requirements of the Contract Documents, to prevent caving or sliding of trench walls, to provide protection for workmen and the pipe, and to protect adjacent structures and facilities.

(6) Solid sheeting shall be removed in accordance with requirements of the Contract Documents.

(7) If a movable shield is used, the pipe already laid shall be securely blocked or braced to prevent opening of pipe joints when the shield is advanced in the trench.

(8) Line and Grade.

(a) All pipe shall be laid true to line and grade as presented on the requirements of the Contract Documents. The District shall be notified of clearance of less than 12 inches to any other utility. The owner of the other utility may also require notification. All new pipe shall be laid with no less than 12 inches clearance to existing utilities unless otherwise directed by the District. Each pipe length shall be checked for grade and alignment as it is placed.

(b) Pipe shall be laid upgrade without grade breaks, unless otherwise approved by the District. Maximum variation (after compaction) from true slope shown on the plans shall be less than .03 foot in 10 feet and deviation from true elevation shall be no more than .03 foot maximum at any point. Do not deviate more than 1 inch horizontally from line shown on Contract Drawings. The bell end shall be upgrade. When pipe laying is not in progress, the open end of any pipe shall be blocked and kept closed with a temporary plug or cap approved by the District to prevent any foreign material from entering the pipe.

(c) Measure for grade at the pipe invert, not at the top of the pipe.

(d) Establish line and grade for pipe by the use of lasers or by transferring the cut from offset stakes to batter boards set in the trench at maximum intervals of 25 feet. Maintain a minimum of three sets of batter boards with string line ahead of the pipe laying at all times. If batter boards in the trench prove impractical because of trench conditions, submit other methods of grade and alignment control to the District for approval.

(9) Laying and Joining Pipe.

(a) Pipe laying shall proceed upgrade with spigot ends pointing in direction of flow. After a section of pipe has been lowered into the prepared trench, clean the end of the pipe to be joined, the inside of the joint, and the rubber ring immediately before joining the pipe. Joints shall be assembled carefully to avoid damage to the gasket and bell end. All foreign matter in the socket must be removed and the gasket seat should be thoroughly inspected to be certain it is clean. Make assembly of the joint in accordance with the recommendations of the manufacturer. Provide all special tools and appliances required for the jointing assembly.

(b) A thin film of lubricant shall be applied to surface of gasket. Do not allow the pipe to touch the ground or trench side after lubricating. Use only the lubricant furnished with the pipe. The plain end of the pipe shall be aligned and carefully entered into the socket until it just makes contact with the gasket. Joint assembly shall then be completed by pushing the plain end of the entering pipe past the gasket until the plain end makes contact with the bottom of the socket. If assembly is not accomplished with the application of reasonable effort, the plain end of the pipe shall be removed to check for the proper positioning of the gasket, adequate lubrication, and removal of foreign matter in the joint.

(c) Joints shall be assembled without “stabbing”, or “swinging in”, or “popping on” the spigot ends of the pipe into bell ends. After joint assembly, bedding material shall be carefully placed and compacted against the haunch of the pipe to provide critical lateral support. Care shall be used to not displace or damage the pipe or bedding when compacting trench backfill.

(d) After the joint has been made, check pipe for alignment and grade. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between joints. Pipe shall be laid on compacted bedding

material, and shall have full bearing over its entire length between the bell holes, which must be excavated in the bedding to permit proper assembly of the bell and spigot joints. No blocking or wedging of the pipe to achieve proper grade will be permitted. Place and compact bedding to achieve proper grade. Apply sufficient pressure in making the joint to assure that the joint is "home" as defined in the standard installation instructions provided by the pipe manufacturer. To assure proper pipe alignment and joint makeup, place sufficient pipe zone material to secure the pipe from movement before the next joint is installed. Pipe shall be laid so the inside joint space does not exceed 1/2-inch in width.

(e) When pipe is laid within a movable trench shield, take all necessary precautions to prevent pipe joints from pulling apart when moving the shield ahead.

(f) Take the necessary precautions required to prevent excavated or other foreign material from getting into the pipe during the laying operation. At all times, when laying operations are not in progress, at the close of the day's work, or whenever the workers are absent from the job, close and block the open end of the last laid section of the pipe to prevent entry of foreign material or creep of the gasketed joints.

(g) Plug or close off pipes, which are stubbed off for manhole construction or for connection by others, with temporary plugs as specified.

(h) Backfilling shall not commence until the pipe installation has been visually inspected and accepted by the District. All sewer line connections to manholes, trunk sewers, main sewers, or side sewers shall be left uncovered until after the inspection has been made. After approval of the connection, the trench shall be backfilled as specified.

(i) Take all precautions necessary to prevent the "uplift" or floating of the line prior to the completion of the backfilling operation.

(j) Where pipe is connected to manholes or concrete structures, make connection so that the standard pipe joint is located within 2 feet from the outside edge of the structure. Flexibility of joints in or at the manhole base shall be preserved to prevent damage to the pipe from differential settlement.

(k) When cutting and/or machining the pipe is necessary, use only tools and methods recommended by the pipe manufacturer and approved by the District.

(l) Field joints (approved by the District) shall be accomplished through the use of Type 316 stainless steel shear bands and repairs for Vitrified Clay Pipe shall be made by tightening the Type 316 stainless steel nuts and bolts after the pipe has been properly assembled.

(m) Detectable warning tape shall be laid continuously over centerline of pipe at location shown in trench detail in Appendix A.

(10) Pipe Handling.

(a) Pipe and fittings shall be handled so as to protect them from damage, particularly due to impact, shocks, and free fall. Handle pipe so that pre-molded jointing surfaces or attached couplings do not support the weight of the pipe. Do not damage jointing surfaces or attached couplings by dragging, contact with hard materials, or by use of hooks.

(b) Carefully examine each pipe and fitting prior to installation for soundness and compliance with specifications. Damaged pipe shall be replaced with pipe that meets the specifications.

(c) No tie-ins shall be made or existing flows diverted into the new pipeline until the Contractor has an approved tie-in plan and all downstream pipeline and structures have been completed, tested, and accepted.

(d) The District shall be notified 48 hours in advance before starting any work on an existing sewer.

(e) All pipe openings shall be blocked and braced at the end of each day to prevent foreign material from entering the pipe.

(11) Inspection.

(a) All pipe shall be subject to inspection at the place of manufacture. During the manufacture of the pipe, the District shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.

(b) The Contractor shall notify the District of the production schedule in sufficient time so that factory inspection can be arranged.

(c) The manufacturer shall make available for the District's use such gauges as are necessary for inspection. The manufacturer shall provide the District with such assistance as is necessary for the handling of pipe and fittings.

(d) Approval of pipe at the factory only allows the manufacturer to ship the equipment to the site, and does not constitute final acceptance by the District.

(12) Delivery, Storage, and Handling.

(a) Delivery at Site. All materials which will not be installed the same day as delivered to the site shall be stored in the original manufacturer's packaging. Loose items with no original packaging shall be boxed to protect the products from scratches, abrasion, or breakage.

(b) Protection Prior to Installation.

(i) All products shall be protected from excessive heat and from moisture during storage and handling.

(ii) Store pipe and fittings on suitable supports to prevent damage, rolling, and contamination from dirt. Protect all machined surfaces exposed during shipment and storage from weather and dirt by bolting on plywood covers and covering with membrane covers. Protect all exposed gaskets from weather and dirt with membrane covers. Lose gaskets shall be properly stored in boxes to prevent them from damage and the sun.

(iii) Bedding materials may be stockpiled on the jobsite or may be arranged to be delivered as the need occurs. Project schedule shall not be impeded due to insufficient materials on the jobsite.

(iv) Damaged and unprotected or improperly stored materials will not be accepted for payment as materials on hand.

(13) Cleanup.

(a) After completion of the work, all remaining pipe cuttings, joining and wrapping materials, and other scattered debris,

shall be removed from the site. The entire piping system shall be handed over in a clean and functional condition.

(b) Following assembly and testing, but prior to final acceptance, all pipelines shall be flushed with high velocity water or flushed with a cleaning ball. All accumulated construction debris and other foreign matter shall be removed. Flushing velocities shall be a minimum of 3 feet per second. Accumulated debris shall be removed at the downstream manhole and shall not be allowed to travel downstream of the work.

3. Compaction Testing.

a) The Design Engineer shall include requirements within the Contract Documents for compaction testing of trench materials during construction in accordance with the requirements of trench detail(s) in Appendix A. Compaction testing shall be provided by an independent firm and compaction test reports shall show conformance with the requirements of the Contract Documents and shall be submitted to the District.

J. MANHOLES

1. Manhole requirements, including diameter, shall conform to manhole detail in Appendix A.

2. Manholes shall conform to the following:

a) Manholes shall be constructed of precast concrete manhole rings. Precast concrete rings shall be manufactured by a process that will produce a dense, homogeneous concrete ring of first quality. Precast concrete sections shall conform to ASTM C478 unless otherwise modified in the manhole detail in Appendix A. The rings shall have a minimum wall thickness of 1/12 of the inner diameter of the manhole. Manholes shall be constructed of 4000 psi reinforced concrete (min) at 28 days using cement Type II/V Portland cement as specified in ASTM C150. All manholes shall have concrete cast-in-place bases (unless otherwise approved by the District). All precast manhole components shall be H-20 load rated. All manholes shall be coated and lined with waterproofing (with Xypex) as specified herein unless indicated to be SewperCoat, or approved equal, in this document or by the District.

b) Manholes shall be of the size indicated on the Manhole Detail in Appendix A. Manholes shall never be less than 4 feet-0 inches inside diameter with 4 inch thick walls.

c) Forms shall be accurately made of steel sheets and shaped and made up of sufficient strength to form dense watertight walls to true dimensions.

d) Concrete shall be deposited in evenly distributed layers of about 18 inches, with each layer vibrated to bond it to the preceding layer or shall be continually poured and vibrated simultaneously.

e) If precast bases are submitted for approval, pipe stubs and bell ends shall be cast into the base to provide a tight seal between base and pipe. Method shall be approved by the District and concrete base manufacturer. Concrete base manufacturer shall coordinate with pipe supplier.

f) Concrete expansion rings. The manhole frame and cover shall be set to such an elevation that the top of the cover is placed at the proposed street grade or the elevation shown on the drawings, with a minimum of one 6-inch precast riser section placed between the top of the reducing slab section and the iron manhole frame. Maximum height of extension rings shall be 18 inches in paved areas, and in unpaved areas only one extension ring of 6-inch shall be used.

g) Manholes shall be as manufactured by, or approved equal:

(1) Associated Concrete Products, Costa Mesa, CA

(2) Hanson Concrete Products, Milpitas, CA

h) Castings for manhole frames and covers shall conform to the requirements of ASTM A48, Class 30B Heavy Duty cast iron construction. Cast-iron covers and frames shall be heavy traffic type, H-20 load rated with size, design, and lettering as shown on the Manhole Detail in Appendix A, to meet the requirements of the District. Castings shall be machined flat bearing surface, non-rocking removable lid, special non-skid cover design and dipped in asphalt paint. Manhole covers shall be sealed to prevent escape of odors.

i) Castings shall be manufactured by, or approved equal:

(1) D and L Foundry ph. (707) 557-4525 Model A 1024.

j) Joints. Joints between sections shall have <u>two</u> preformed flexible plastic sealing gaskets installed between each tongue and groove joint to make a watertight joint. After the shaft is in place, the joint shall be trimmed smooth with a sharp tool on the inside of the manhole. Compound shall conform to Federal Specification SS-S-00210 (GSA-FSS), Type 1, Rope Form, and hydrostatic pressure tests of ASTM C443. Joints shall be manufactured by, or approved equal:

(1) Ram-Nek as manufactured by K.T. Snyder Co. or equal.

k) Grout shall be placed in lift holes and in all horizontal joints, inside and outside, prior to manhole testing. If Contractor uses gasketed joint on barrel, only inside of the joint shall be grouted.

(1) Grout shall have minimum compression strength of 5000 PSI and shall be equal to Burke Non-Ferrous, Non-Shrink Grout damp pack mix. Outside grouted joints shall be allowed to dry in accordance with manufacturer's instructions prior to backfilling.

l) Mortar for finishing shall be Type S Mortar.

m) Manhole Bases. Manhole bases shall be either cast-in-place or precast concrete.

n) Reinforcement. Welded wire fabric conforming to ASTM A185 or A497, and Grade 60 steel reinforcing bars conforming to ASTM A615.

o) Waterproofing. Xypex Concentrate by the Xypex Chemical Corporation, or approved equal.

3. Manhole configuration shall conform to the following:

a) Shaft Construction: Concentric with eccentric cone top section; lipped male/female dry joints.

b) Shape. Cylindrical.

c) Clear Inside Dimensions. 48 inch diameter (min) or as indicated on Manhole Detail in Appendix A.

d) Design Depth. As required.

e) Clear Lid Opening. 24 inches diameter.

f) Pipe Entry. Provide openings as indicated on Manhole Detail in Appendix A.

4. Signs. NOT USED

5. Waterproofing of Manholes.

a) All precast manhole sections shall be pre-coated at the manufacturing plant, both on the inside (unless specified by the District to receive plastic lining) and outside surfaces, with one coat of waterproofing using Xypex Concentrate as specified herein, at the rate or two pounds per square yard to eliminate water infiltration. The inside of the base shall be field coated. All surfaces shall be moist (not wet) when coating/lining is applied. Mixing volumes of coating/lining when applied by semi-stiff bristle brush or broom shall be three powder to one water. Mixing volumes for spray application shall be five powder to three water. Spray applications may differ because of the type of equipment used and the pressures involved.

b) The use of Xypex Concentrate Admix C-2000 as an admixture in the concrete during manufacture of the precast sections to achieve waterproofing will not be considered.

c) Curing shall begin as soon as the waterproofing materials have set up sufficiently so as not to be damaged by a fine spray. Treated surfaces shall be fog-sprayed three times a day for a two day period, or may be covered with damp burlap for the prescribed period as recommended by the manufacturer's representative. In warm climates, more than three sprayings per day may be required to prevent excessive drying of coating/lining. Plastic sheeting may not be laid directly on the waterproofing coating/lining as air contact is required for proper curing.

d) Prior to applying the coating/lining, Contractor shall visually examine the manhole for structural defects such as cracks, faulty joints and honeycombing. Should any of such defects be detected, Contractor shall grind out the defect area to sound concrete and repair or patch with Patch 'N Plug, manufactured by Xypex Chemical Corporation, or an approved equal, in accordance with the manufacturer's recommendations.

e) The precast manhole supplier shall provide statement of qualifications for applying waterproofing materials. If the precast manhole supplier cannot show proof of experience with the application of indicated coating/lining, the Contractor shall have the manufacturer's representative present to advise and/or supervise the application of the coating/lining on the first three manholes and as necessary thereafter.

f) Backfilling cannot take place until 36 hours after application of the waterproofing material, or as recommended by the manufacturer. If backfilling takes place within seven days after application, the backfill material must be moist, so as not to draw moisture from the coating/lining.

g) All pipe entering or leaving a new concrete structure or manhole shall have a water tight rubber gasket, supplied by the pipe manufacturer, firmly clamped around the pipe exterior and cast into the structure base or the structure wall as a waterstop.

6. Plastic Lining for Manholes and Structures.

a) Plastic lining (PVC T-lock) shall be installed in:

(1) All gravity sewer structures, such as diversion structures, transition structures, etc. where structure contains waste-water, excluding manholes unless they meet condition (2) or (3) below.

(2) All manholes where upstream sewer slope exceeds the maximum slope indicated for gravity sewers within this

document or any manhole in which a forcemain discharges. Prior to installing gravity sewers where slope exceeds District standards, contact District for approval.

(3) Any manhole, when directed by the District.

b) Plastic lining shall be Ameron T-lock as manufactured by Ameron Protective Linings Division, or approved equal. All materials, adhesives, and incidentals necessary for proper application of plastic lining shall be furnished by the same manufacturer and shall be compatible with each other and the adhesive used.

c) The materials used in the manufacture of plastic line sheet, joint, corner, and welding strips shall be high molecular weight polyvinyl chloride resin and other necessary ingredients compounded to make permanently flexible sheet and strips for lining structures. Polyvinyl chloride resin shall constitute not less than 99 percent, by weight, of the resin used in the formulation. Copolymer resins will not be permitted. The material used in joint strips and in plain sheets of plastic liner shall be identical to that used in sheets having locking extensions. Changes in formulations will be permitted only after prior notification of the District and only if the manufacturer can demonstrate to the satisfaction of the District that the plastic line continues to meet or exceed all requirements for chemical and physical properties.

d) Plastic liner shall be resistant to oxidizing agents, ferric chlorides, sodium chlorides, lime, oils, fats, greases, and soaps. The plastic liner shall be impermeable to sewage gases and liquids and shall be nonconductive to bacterial or fungus growth. All liners shall be factory checked electrically to ensure freedom from any porosity.

e) The lining shall have good impact resistance, shall be flexible, and shall have an elongation sufficient to bridge up to 1/4 inch settling crack, which may take place after installation, without damage to the lining.

f) Once cast into the concrete, the lining shall be permanently and physically attached to the concrete by the T-lock mechanism and shall not rely on an adhesive bond unless otherwise specified at a specific location. The lining shall withstand a 15 pound per square inch back hydrostatic pressure applied to the under surface of the lining without losing anchorage and without rupture or leakage.

g) All material used in joint strip and in plain sheets of plastic liner shall be identical to that used in sheets having locking extensions.

h) Physical Properties.

(1) All plastic liner sheets, joint, corner, and welding strips shall have the following physical properties when tested at 77 degrees F, plus or minus 5 degrees F.

Property	Initial	After 112 Day Submersion in Specified Chemical Solutions**
Tensile strength	2,200 psi minimum	2,100 psi minimum
Elongation at break	200 percent minimum	200 percent minimum
Shore durometer, Type D	Within 1 second 50-60 at 10 seconds 35-50	Plus or minus 5 with respect to initial test result
Weight change		Plus or minus 1.5 percent maximum

**The material from which a specimen fails to meet the 112 day requirement before completion of the 112 day exposure will be rejected.

(2) Liner locking extension embedded in concrete shall withstand a test pull of at least 100 pounds per linear inch, applied perpendicularly to the concrete surface for a period of one minutes, without rupture of the locking extensions or withdrawal from embedment. This test shall be made at a temperature between 70 degrees F to 80 degrees F, inclusive.

(3) All plastic liner sheets, including locking extensions, all joint, corner and welding strips shall be free of cracks, cleavages, or defects adversely affecting the protective characteristics of the material. The District may authorize the repair of such defects by approved methods.

(4) Specimens taken from sheets and strips at any time prior to one year after final acceptance of the work, when tested as specified, shall meet the requirements set forth above.

i) Chemical Resistance.

(1) After conditioning to constant weight at 110 degrees F (43 degrees C), tensile specimens and weight change specimens shall be exposed to the following solutions for a period of 112 days at 77 degrees F ±5 degrees (25 degrees C ±3 degrees).

(2) At 28 day intervals, tensile specimens and weight change specimens shall be removed from each of the chemical solutions and tested as specified above. If any specimen fails to meet the 112 day requirement before completion of the 112 day exposure, the material will be subject to rejection.

Chemical Solution	Concentration
Sulfuric Acid	20%
Sodium Hydroxide	5%
Ammonium Hydroxide	5%
Nitric Acid	1%
Ferric Chloride	1%
Soap	0.1%
Detergent (linear alkyl benzyl sulfonate or LAS)	0.1%
Bacteriological	BOD not less than 700 ppm

j) Thickness of Material.

(1) Liner that is to be bonded to concrete by means of integral locking extensions embedded in the concrete shall have a minimum thickness of 0.065 inches. Locking extensions shall be approximately 2.5 inches apart and at least 0.375 inches high. Welding strips shall have a nominal thickness of 0.125 inches. Joint strips shall have a minimum thickness of 0.065 inches.

k) Testing.

(1) Prior to shipping and then again after field welding is complete, the liner shall be spark tested. The spark test shall be done with an approved electrical holiday detector (Turnhert Rasor, Model AP-W with power pack, or approved equal) with the instrument set at a minimum of 20,000 volts. Any imperfection shall be repaired in accordance with the manufacturer's recommendations and with the approval of the District.

l) The liner shall be installed on all interior surfaces, except bottom. The liner shall be continuous and free from any holes, defects, or other faults, and any joint welding and sealing shall be equally effective as the liner. All plastic liner furnished shall be white in color. All joints shall be field welded.

m) All material and work for an in connection with the furnishing and installation of liners and the field sealing and welding joints shall be done in accordance with the manufacturer's specifications and applicable published sections of the "Standard Specifications for Public Works Construction."

n) Liner shall be installed in the factory of the precast manufacturer.

7. Foundation and backfill requirements for manholes shall be provided within the Contract Documents in conformance with the recommendations outlined in the Geotechnical Report.

8. Constructing Manholes.

a) The following shall be included in the Contract Documents for the installation of manholes.

(1) Place the cast-in-place concrete base using proper forms and reinforcement. Call for inspection before placing concrete. Trim all lateral pipes as shown on the plans. Channelize and conform the base as shown on the plans. Use an approved metal ring to form the joint for the precast riser.

(2) Patch lift holes and finish any concrete voids with the approved non-shrink grout.

(3) All channels shall be checked with a template and shall form a smooth flowing channel at all flow depths. Only after approval of the Contractor's manhole tie-in plan, and approval by the District of the proposed breaking out of the top of pipe in a particular manhole shall the Contractor breakout the pipe as follows. After the base and precast sections have been placed and sufficient time has elapsed to allow all concrete and grout to set (minimum 24 hours), the top half of the pipe within the manhole shall be neatly sawcut and removed and the sides mortared.

(a) Place manhole section plumb and level, trim to correct elevations. All joint surfaces of precast sections and surface of manhole base shall be thoroughly cleaned prior to setting precast sections. The sections shall be set in performed plastic sealing gaskets.

(4) Apply one coat of primer to clean, dry joint surface (both tongue and groove) and allow to dry. Remove the paper wrapper from one side only of the two-piece wrapper on the gasket. The outside paper will protect the gasket and prevent stretching. Before setting the manhole section in the trench, attach the plastic gasket strips end-to-end to the tongue or groove of each joint, forming a continuous gasket around the entire circumference of the manhole joint.

(a) Handling of barrel sections after the plastic gasket has been affixed shall be carefully controlled to avoid bumping the gasket and thus displacing it or contaminating it with dirt or other foreign material. Any gaskets so disturbed shall be removed and replaced if damaged and repositioned if displaced.

(b) Care shall be taken to properly align the manhole section with the previously set section before it is lowered into position.

(c) During cold or wet weather, pass direct heat over the concrete joint surface lightly until ice, frost and moisture

are removed and surface to be primed is dry and warm immediately before application of primer. Direct heat shall also be passed over plastic gasket strips immediately prior to attaching them to joint surfaces and immediately prior to insertion of tongue into groove.

(d) Temporary covers of steel plate of sufficient size and strength to adequately cover the opening shall be placed on the cone until the base is complete and the manhole casting shall then be installed. Suitably located ribs shall be welded to the underside of the cover to hold it in place during any grading operations. For manholes located in ditch areas where final grade is below top of manhole, the manhole covers and frames shall be pinned to hold the covers in place.

(e) Grout shall be placed in all horizontal joints, inside and outside, prior to manhole testing. Outside grouted joints shall be allowed to dry (minimum of 3 days or per manufacturer's instructions) prior to backfilling.

(5) When adjusting the manhole frame and cover to grade, the frame shall be wired to a 2 X 4 inch lumber of sufficient length to span the excavation, and the throat completed to the right level. Whenever the space between the bottom of the frame and the top of a ring is less than 3 inches, the void may be filled with concrete, poured against a suitable form on the inside of the structure.

(6) When adjusting an existing manhole to grade and the total depth of the throat from the top of the frame to the bottom of the throat exceeds 18 inches, the upper portion of the manhole shall be removed to the first full-size manhole section. The upper portion shall then be reconstructed as outlined above.

(7) Before any work is started on adjusting or repairing a manhole, the channels in the base shall be covered with strips of wood and the entire base covered with a heavy piece of canvas. This cover shall be kept in place during all work. Upon completion of the work the wood strips and the canvas shall be removed from the manhole allowing no debris to fall or remain in the manhole.

(8) Dewatering shall meet the requirements as outlined within "Geotechnical" in this section. Dewatering shall be addressed in the Geotechnical Report and shall meet the requirements in "Dewatering" of Section II – General Requirements.

9. Manhole Testing.

a) Design Engineer shall include latest ASTM C1244 in Contract Documents. The following shall also be included in the Contract Documents for the field testing of manholes:

(1) The District shall be notified 72 hours in advance of testing and be present during testing.

(2) Each manhole shall be vacuum tested after assembly and inspection and prior to backfilling. All pipes entering the manhole shall be plugged, and the plugs shall be securely braced from being drawn into the manhole. The test head shall be placed at the inside of the top of the cone section and the seal inflated in accordance with the manufacturer's recommendations. Vacuum testing shall be performed in accordance with ASTM C1244. If the test fails, necessary repairs shall be made outside of the manhole with non-shrink grout while a vacuum is drawn and manhole shall be retested. The vacuum test requirements are:

(A) The test shall be performed after, completion of the manhole assembly, including mortaring of exterior joints, backfilling, and compaction, and just prior to placing asphalt concrete, installing the manhole frame and cover and concrete collar. The test may also be performed at the Contractor's option prior to installation of grade rings unless otherwise required by the District.

(B) The Contractor shall furnish the materials and equipment necessary to conduct the test.

(C) All lift holes shall be filled with non-shrink grout prior to testing.

(D) All pipes entering the manhole shall be temporarily plugged, taking care to securely brace the plugs to prevent being sucked into the manhole during testing. Unused channels shall be permanently plugged and eliminated with mortar. The plug shall not affect the flow characteristics of the remaining channel(s).

(E) A vacuum of ten (10) inches of mercury (or 5.0 psig) shall be drawn and the vacuum pump shall be shut off to start the test. The valve on the vacuum line of the test head shall be closed. The amount of time required to drop nine (9) inches of mercury (or 4.5 psig) shall be measured. The manhole shall pass the test if the elapsed time is equal to or greater than the minimum test times shown in the table below.

(F) If the manhole fails the test, repairs shall be made as necessary. Retesting shall proceed until the elapsed times are satisfactory.

(G) After passing the vacuum test all interior joints shall be mortared.

MINIMUM TEST TIME FOR MANHOLE VACUUM TEST		
DEPTH OF MANHOLE IN FEET MEASURED FROM THE TOP OF RIM	48 INCHES	60 INCHES
MINIMUM TEST TIME IN SECONDS		
<=24	60	78
26	64	85
28	69	91
30	74	98

K. GRAVITY SEWER STRUCTURES

1. All below grade structures, other than manholes, such as diversion structures, transition structures, etc. shall be constructed of precast concrete or cast-in-place concrete. The structure shall be rated for H-20 loading.

2. All structures shall be designed to meet all applicable codes and regulations and requirements of the City of Fairfield/City of Suisun City/Solano County (as applicable). All structures shall be designed, stamped, and signed by a Structural Engineer licensed in the State of California. All structures shall be designed for Seismic Zone 4.

3. Reinforced concrete shall be made with Type II or Type V Portland cement as appropriate, with a compressive strength of at least 4000 psi.

4. All interior surfaces, except bottom slab of structures containing wastewater, shall be PVC T-lock lined for corrosion protection. PVC T-lock shall be as outlined within Plastic Lining for Manholes and Structures under Manholes within this Section.

5. Structures shall be provided with Type 316 stainless steel padlockable hatches or manhole covers.

6. Structures shall be provided with warning signs.

7. Foundation and backfill requirements for structures shall be provided within the Contract Documents in conformance with the recommendations outlined in the Geotechnical Report.

8. Any metal work or hardware used within a below grade structure shall be entirely Type 316 stainless steel.

9. Exterior of structure shall be waterproofed as outlined for manholes within this document.

10. Hydraulic structures shall be tested as outlined for manholes within this document.

11. Dewatering shall meet the requirements as outlined within "Geotechnical" in this section. Dewatering shall be addressed in the Geotechnical Report and shall meet the requirements in "Dewatering" in Section II – General Requirements.

12. All pipe entering or leaving a new concrete structure or manhole shall have a water tight rubber gasket, as supplied by the pipe manufacturer, firmly clamped around the pipe exterior and cast into the structure base or the structure wall as a waterstop.

L. PROTECTIVE COATINGS

1. Based on the design standards outlined, protective coatings are not envisioned for the gravity sewer facilities. For any items that are susceptible to corrosion, refer to Appendix F for the appropriate protective coating.

M. CATHODIC PROTECTION

1. Based on the design standards outlined, cathodic protection is not envisioned for the gravity sewer facilities. If metallic materials are used for any reason, such as for a jack and boring casing pipe, etc., a cathodic protection study and cathodic protection system may be required as directed by the District. If required by the District, cathodic protection shall be implemented, as approved by the District.

N. TESTING OF FACILITIES

1. Requirements to be specified for the factory and field testing of vitrified clay pipe are outlined herein. If pipeline material other than vitrified clay pipe is directed to be used by the District, then Design Engineer shall contact the District for requirements. Design Engineer shall include the following testing requirements in the Contract Documents.

2. Field testing requirements for manholes are outlined under Manholes in this Section.

3. Factory Testing of Vitrified Clay Pipe.

    a) Pipe shall be tested in accordance with ASTM C301 for 3 edge bearing (i.e. strength). No less than 2 percent of the pipe lengths or each pipe diameter shall be randomly selected from the total pipe order to be

tested. Representative pipes from batches of pipe shall be tested before the batch is sent to the job. The Contractor shall furnish three certified copies of all test reports to the District for approval.

b) Written certification by the manufacturer indicating compliance with the requirements of ASTM C425 and ASTM C700 shall be submitted to the District for approval prior to delivery of the pipe. The certification shall include the test result data.

4. Flushing and Cleaning of Gravity Sewer Pipe.

a) Care shall be exercised during fabrication to prevent the accumulation of pipe cuttings and filings, gravel, cleaning rags, etc., within piping sections. All piping shall be examined to assure removal of these and other foreign objects prior to assembly. Shop cleaning may employ any conventional commercial cleaning method if it does not corrode, deform, swell, or otherwise alter the physical properties of the pipe being cleaned.

b) Prior to performing any testing, and after the pipeline installation has been completed to the satisfaction of the District, the Contractor shall clean all sewer installations, deemed necessary by the Inspector, in the presence of the Inspector. Cleaning shall be performed by the Contractor by means of a high pressure hydro. Hydroflush pressure shall be maintained below 2,000 psi. Contractor shall install a debris trap with screen at the manhole to prevent debris from collecting in the manhole or from being conveyed in other pipes. The Contractor shall remove all debris from the manhole prior to removing the trap. When a new sewer is connected to an existing line, cleaning and flushing shall be carried out to the first existing manhole downstream from the point of connection. Cleaning shall be performed from downstream extent to upstream extent, so as to prevent the transport of debris further downstream in the collection system.

c) Release of water during and/or after cleaning and testing has been completed, shall be performed in a manner approved by the Inspector. The Contractor shall be responsible for the proper disposal of water released.

d) The Contractor shall perform an additional cleaning of the pipeline after the installation of final paving, top block, frames and covers, and after all other required inspections, if required by the Inspector due to a reasonable determination that additional debris may have accumulated in the pipeline after initial cleaning. The additional cleaning may extend beyond the original limits of the work if it is determined that the Contractor’s workmanship caused the debris accumulation downstream of the work.

5. Acceptance Field Testing of Gravity Sewer Pipe.

a) After installation, backfilling, compaction, cleaning, and before paving, if any, acceptance testing shall be performed by hydrostatic infiltration or low pressure air test (as specified herein) and TV inspection.

b) The Contractor shall take all necessary precautions to prevent any joints from drawing while the pipes or their appurtenances are being tested. The Contractor shall correct any excess leakage and repair any damage to the pipe and their appurtenances or to any structures resulting from or caused by these tests, and retest the line as required by the District.

c) The Contractor shall correct any visible leaks in the pipeline, manholes, and structures.

d) The Contractor shall dispose of all water so as not to cause a public nuisance and as acceptable to the District.

e) Low Pressure Air Test

(1) When the ground water level is below the installed pipe, acceptance testing shall be performed by the low pressure air test method conforming to ASTM C828. All leakage tests shall be completed and approved after backfilling and prior to placing of permanent resurfacing.

(2) Each section between manholes or structures will be plugged. The length of line tested at one time shall be limited to the length between adjacent manholes. Air will be introduced into the plugged system. The system passes the test if the rate of air loss, as measured by pressure drop from 3.5 psi to 2.5 psi, is not less than the specified time as shown in the following table.

Table 7. Minimum Test Time for Various Pipe Sizes

Nominal Pipe Size, inches	T (time) min/100 feet	Nominal Pipe Size, inches	T (time) min/100 feet
12	1.8	30	4.8
15	2.1	33	5.5
18	2.4	36	6.0
21	3.0	39	6.6
24	3.6	42	7.3
27	4.2		

(3) If the installation fails to meet this requirement, the Contractor shall, at his/her own expense, determine the source of leakage. The Contractor shall then repair or replace all defective materials and/or workmanship and perform the air test as many times as necessary to achieve an acceptable test. If the test is not passed

in two trials, the leak shall be located and repaired to the satisfaction of the District, and the line shall be retested.

(4) The pressure gauge used shall be supplied by the Contractor and shall have minimum divisions of 0.10 psi, and shall have an accuracy of 0.04 psi. Accuracy and calibration of the gauge shall be certified by a reliable testing firm.

f) Hydrostatic Infiltration Testing

(1) Where the ground water level is above the top of the installed pipe, acceptance testing shall be done by the hydrostatic infiltration test conforming to ASTM C1091.

(2) The maximum allowable infiltration shall not exceed 100 gallons/inch diameter/mile/day.

(3) Unless otherwise specified, infiltration will be measured by the District using measuring devices furnished by the District.

If the installation fails to meet this requirement, the Contractor shall determine the source of leakage. He shall then repair or replace all defective materials and/or workmanship and perform the test as many times as necessary to achieve an acceptable test.

O. TELEVISION (TV) INSPECTION

1. TV inspection requirements as outlined below shall be incorporated into the Contract Documents by the Design Engineer.

2. Prior to acceptance of any sanitary sewer pipeline by the District, all pipelines shall be inspected internally by television as outlined below by the Contractor. Defects such as high and low spots, joint separations, offset joints, chipped ends, cracked or damaged pipe, infiltration points and debris in lines shall be corrected by the Contractor. For joint separations, low spots and chipped ends, the following maximum acceptable limits will apply.

a) Joint separations – 0.5 inch

b) Low Spots – 0.08 feet maximum depth, after backfill and compaction. A 1” target shall be used to determine low spots or sags when videoing lines.

c) Chipped ends – 0.25 inch

3. The complete job is ready for television inspection when the following work has been completed:

a) All sewer pipelines are installed and backfilled.

b) All structures are in place, all channeling is complete and pipelines are accessible from structures.

c) All other underground facilities, utility piping and conduits are installed.

d) Final street subgrading is complete and ready for asphaltic concrete surfacing.

e) Pipelines to be inspected have been flushed or cleaned with a high pressure cleaner.

4. When the above work is complete, the Contractor shall arrange for the television inspection.

5. The Contractor will notify the District in writing as to the scheduled date of the television inspection.

6. After conditions as outlined above are met, the entire job shall be initially televised and video recorded. The digital video recordings and reports shall be delivered to the District.

7. Video inspection shall be in digital format that is compatible with WinCan AG, and the audio and video portions shall be free of electrical interference and excessive background noise. All labels shall be typed and shall include the project name, station numbers and manhole numbers.

8. The audio report shall be recorded by the operating technician on the video recordings as they are being produced and shall include the location of the sewer, the names or numbers of the manholes involved, the direction of travel and a description of all lateral locations and conditions in the sewer line as they are encountered and their locations.

9. In addition to the audio report, a written report shall be required listing all the information required in the audio report.

10. The Contractor will be notified in writing of any deficiencies revealed by the television inspection that will require repair. If corrective work is indicated and the Contractor wishes to view video recordings, he shall contact the District to set a time for viewing.

11. Corrective work shall be done.

12. Those portions of the pipeline system that have been corrected must be re-televised and digital video recorded and the files and reports delivered to the District.

13. The procedure outlined above shall be repeated until all deficiencies observed by television inspection have been corrected to the complete satisfaction of the District.

14. All digital video recordings and reports become the property of the District to be used as "As-Builts" for future reference.

15. The District will repeat the TV inspection within the one year warranty period. All defects discovered in this inspection shall be corrected immediately by the Contractor to the satisfaction of the District without cost to the District. If defects are found, the cost of televised inspection and other related testing performed shall be borne by the Contractor.

P. COORDINATION WITH CITY AND COUNTY REQUIREMENTS/ STANDARDS

1. In addition to the design standards outlined herein, the project shall meet the requirements set forth by the City of Fairfield/City of Suisun City/Solano County (as applicable). Standard specifications and details for design shall be obtained from the appropriate agencies.

2. All work shall be submitted to the City of Fairfield/City of Suisun City/ Solano County (as applicable) for review and approval, including any architectural approvals. If the City of Fairfield's/City of Suisun City's/ Solano County's (as applicable) comments conflict with the District's design standards outlined herein, such conflicts shall be discussed and resolved with the District and the City of Fairfield/City of Suisun City/Solano County (as applicable).

3. In general, the following items are not covered within these design standards and shall meet all requirements of the City of Fairfield/City of Suisun City/Solano County (as applicable).

    a) Architectural requirements.

    b) Landscape and irrigation requirements, including planting.

    c) Traffic control, including road closures, detours, flagmen, warning signs, and construction signage.

    d) Street design/replacement, including engineering fabrics, aggregate subbase, aggregate base, asphaltic concrete, signage, stripping and pavement markings, traffic signals, adjustments of manholes, water valves and survey monument boxes, concrete curb, gutter, sidewalk, and driveways.

    e) Street lighting.

    f) Storm drainage.

    g) Sanitary sewers < 12 inches in diameter.

    h) Potable and non-potable water systems.

    i) Testing of materials.

Q. NON-OPEN CUT PIPELINE INSTALLATIONS

1. The design standards outlined within this document are intended for open cut pipeline installations. If non-open cut pipeline installations are proposed or required for installation of the pipeline such as jack and bore, directional drilling, microtunneling, etc., the Design Engineer shall contact the District for specific requirements. In addition, the Geotechnical Report shall address the non-open cut pipeline installation(s) providing recommendations for the materials and installation operation to be used.

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APPENDIX A

DETAILS/ STANDARD DRAWINGS

APPENDIX A
DETAILS

The following details have been provided to supplement the text of this document. The details are not intended for Contractor use during construction, but rather for the Design Engineer. The thought is that such details would be modified for each specific project and then provided in the Project Documents.

For clarity, the District's Design Standards shall not be used as a substitute for the Design Engineer's calculations and design, and shall not be used as a substitute for the Designers' and/ or Developers' Project Documents for construction. These Design Standards spell out the minimum considerations and requirements for all District facilities that the Designer, Contractor, and Developer are responsible for.

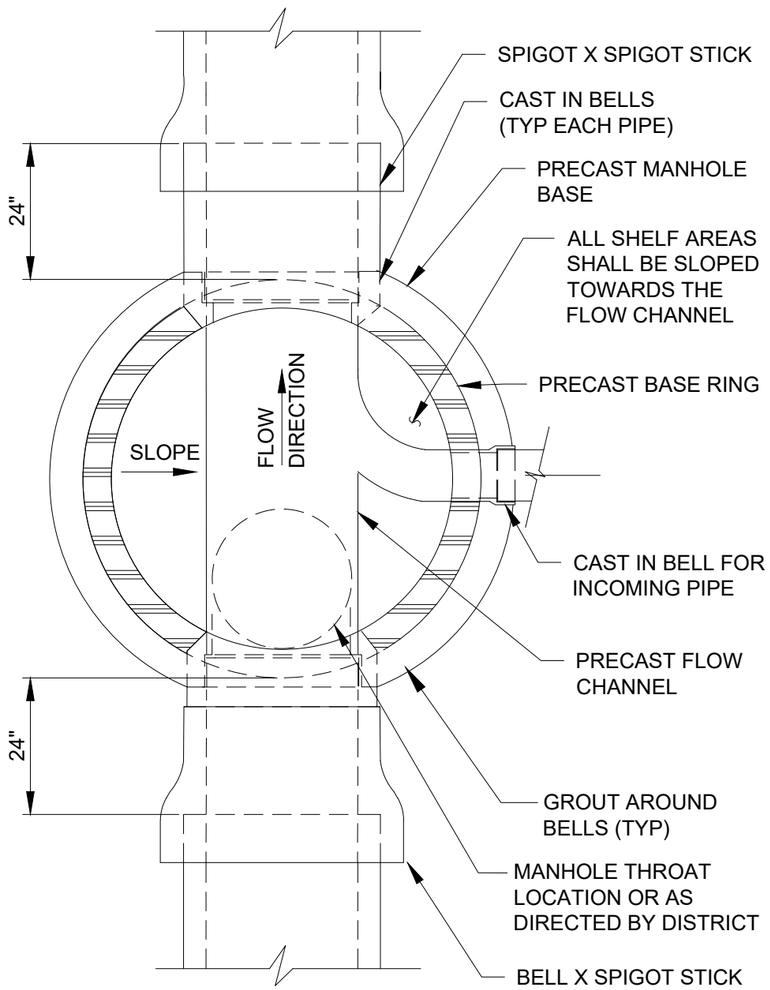
Detail	Description
1.1	Manhole Details Foundation Plan
1.2	Cast-in-Place Manhole Details
2	Thrust Block Detail
3	Trench Detail
4	Wall Penetration Detail
5	VCP Repair Coupling Detail
6	Submersible Pump Station Sewage Schematic
7	False Bottom Detail
8	Approved Manhole Frame and Cover
9	Typical Chain Link Fencing
10	Typical Single Swing Gate

NOTES

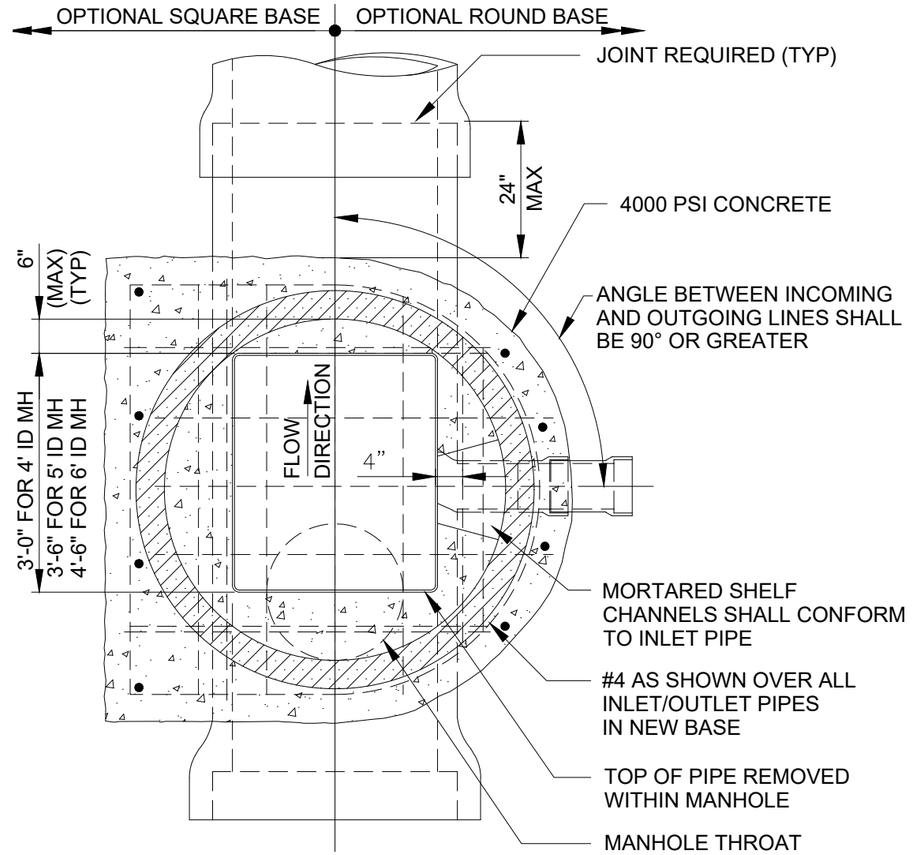
1. LAY PIPE THROUGH MANHOLE WHEN POSSIBLE. OTHERWISE, FORM CHANNEL TO MAINTAIN PIPE SECTION. TRUNK SEWER PIPES ENTERING OR LEAVING THE MANHOLE BASE SHALL HAVE A STANDARD JOINT LOCATED WITHIN 24" OF THE BASE. WHERE PIPES CHANGE DIRECTION WITHIN MANHOLE, FORM CHANNEL WITH DRYPACK GROUT TO FORM SMOOTH TRANSITION WITHIN MANHOLE TO CHANNELIZE FLOW.
2. ALL REINFORCEMENT SHALL BE 3" CLEAR OF CONCRETE FACE.
3. SQUARE BLOCK TO BE USED FOR EASEMENTS.
4. ROUND BLOCK MAY BE USED IN STREETS.
5. NOT USED.
6. MANHOLE SHALL BE TREATED WITH SEWPERCOAT OR APPROVED EQUAL WHEN REQUIRED BY THE DISTRICT. PREPARATION AND APPLICATION SHALL BE PER MANUFACTURER'S DIRECTIONS.
7. MINIMUM MANHOLE INSIDE DIAMETERS SHALL BE AS SHOWN IN TABLE BELOW. LARGER MANHOLES MAY BE REQUIRED DEPENDING ON SIZE AND LOCATION OF SIDE SEWERS.

SEWER DIAMETER	MANHOLE INSIDE DIAMETER (MIN)
< 18"	4'-0"
18" THROUGH 45"	5'-0"
≥ 46"	6'-0"

8. IN UNPAVED AREAS, SET MANHOLE RIM 6-INCHES ABOVE GRADE AND POUR SQUARE CONCRETE COLLAR.
9. ALL MANHOLES AND CASTINGS SHALL BE DESIGNED FOR H-20 LOADING REGARDLESS OF INSTALLATION LOCATION.
10. BACKFILL FOR MANHOLES SHALL BE SPECIFIED BY DESIGN ENGINEER PER THE REQUIREMENTS OF THE GEOTECHNICAL REPORT. BACKFILL SHALL START AT SURFACE UPON WHICH THE MANHOLE BASE RESTS.
11. FOR ALL MANHOLE JOINTS PROVIDE EXTERIOR JOINT WRAP OVER GROUTED JOINTS USING 12" WIDE RUB'R- NEK EXTERNAL CONCRETE JOINT WRAP, OR APPROVED EQUAL.
12. SEE DESIGN STANDARDS FOR ADDITIONAL INFORMATION AT www.FSSD.com/District-Standards/.



FOUNDATION PLAN
PRECAST MANHOLE



FOUNDATION PLAN
CAST-IN-PLACE MANHOLE

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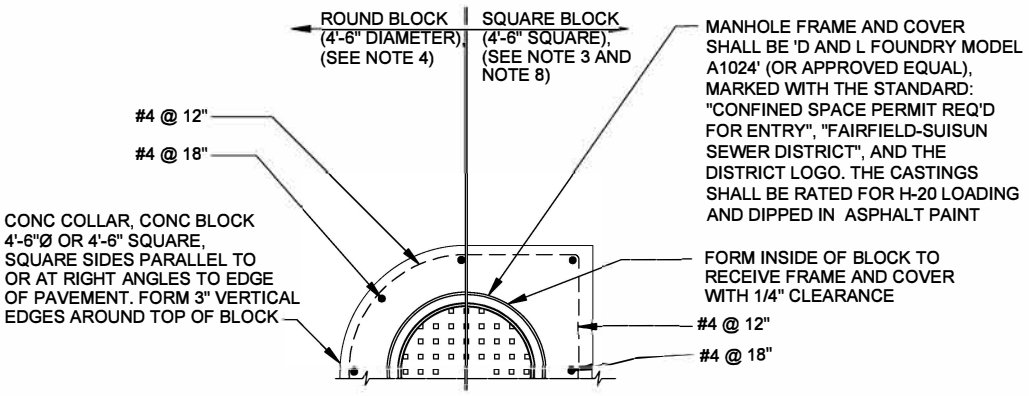
PUMP STATION AND COLLECTION SYSTEM DESIGN STANDARDS

MANHOLE DETAILS FOUNDATION PLAN

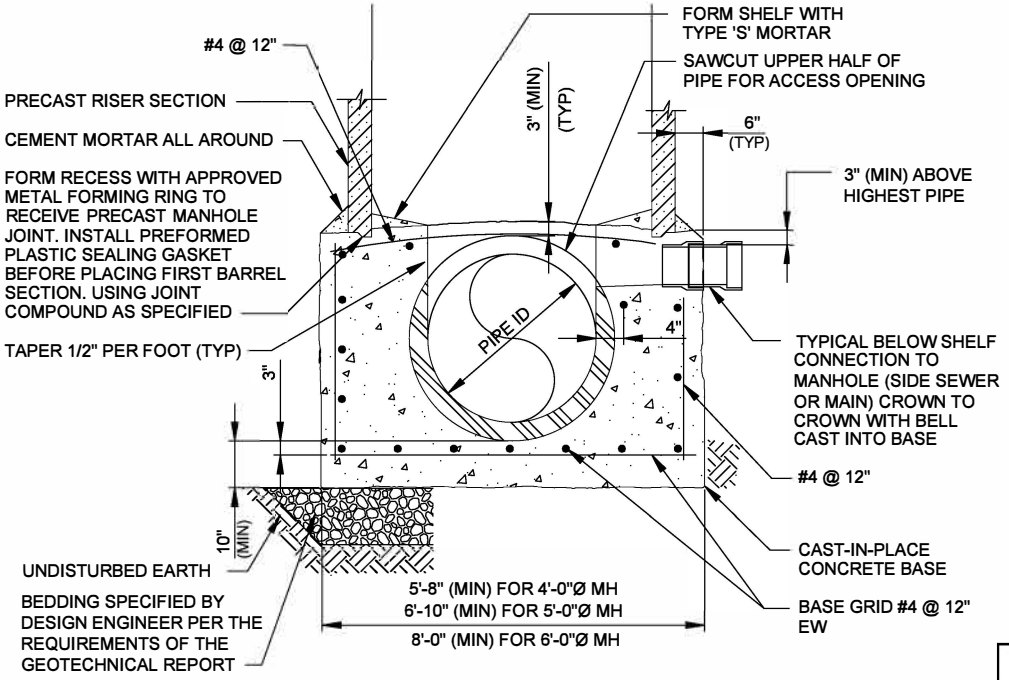
NOT TO SCALE

DETAIL NO. **1.1**

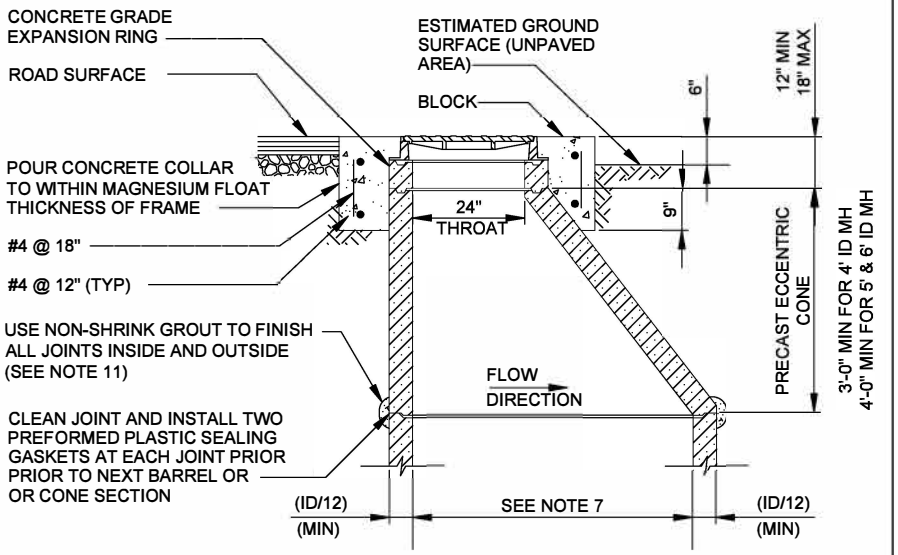
DATE 10/13/2021



PLAN - MANHOLE FRAME



BASE SECTION



UPPER SECTION (ROTATED 90°)

1) A MAXIMUM OF TWO (2) - 6 INCH GRADE RINGS ARE ALLOWED TO RAISE MANHOLE. NO GRADE RINGS SHALL BE LESS THAN 3-INCH IN HEIGHT/ THCIKNESS.

2) THE ECCENTRIC CONE SHALL BE INSTALLED WITH THE SLOPING PORTION OF THE CONE FACING THE DOWNSTREAM PIPING.

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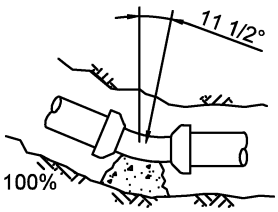
PUMP STATION AND COLLECTION SYSTEM DESIGN STANDARDS

CAST-IN-PLACE MANHOLE DETAILS

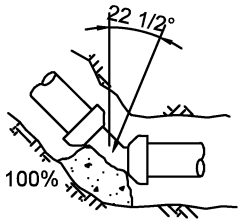
NOT TO SCALE

DETAIL NO. **1.2**

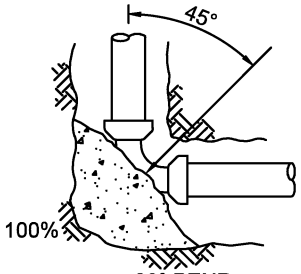
DATE 10/13/2021



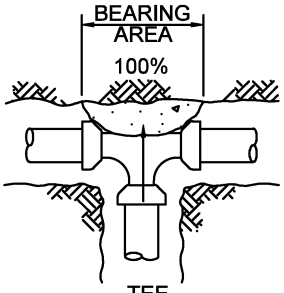
22 1/2° BEND



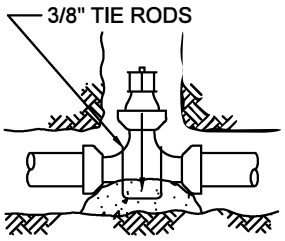
45° BEND



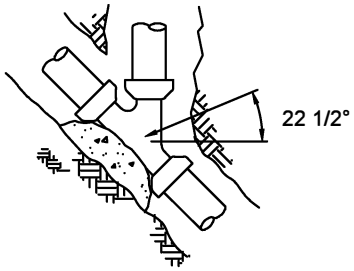
90° BEND



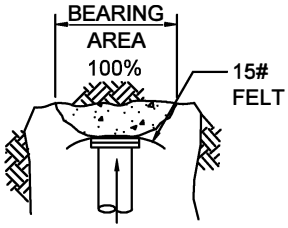
TEE



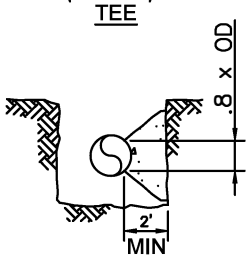
100% OF TEE
VALVE



"Y" BRANCH

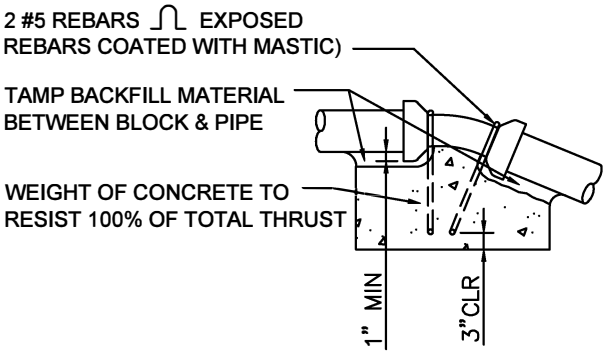


DEAD END



TYPICAL SECTION

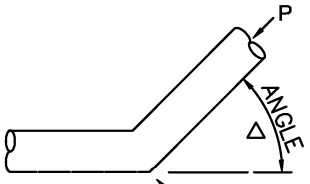
FOR OTHER ANGLES NOT SHOWN, CALCULATE AS REQUIRED.



NOTES:

1. THRUST BLOCK CONC VOLUMES REQUIRED FOR UPWARD THRUST SHALL BE CALCULATED BY DESIGN ENGINEER.

FOR BENDS: $R = 2PA \sin \Delta/2$
FOR TEES AND DEAD ENDS: $R = PA$
WHERE: P = TEST PRESSURE, PSI
A = PIPE AREA, SQ INCHES



USE THE FORMULA BELOW TO CALCULATE BEARING AREA OF THRUST BLOCKS FOR VERTICAL BENDS WITH DOWNWARD THRUST AND HORIZONTAL BENDS.

AREA THRUST BLOCK (SQ FT) = R/SxD

IN WHICH:
R = (FROM FORMULA ABOVE, IN LBS)
S = ALLOWABLE SOIL PASSIVE PRESSURE IN LB/FT^3
D = DISTANCE IN FEET FROM GRADE DOWN TO CENTERLINE OF FITTING FOR HORIZONTAL BENDS; FOR VERTICAL BENDS USE D = 1'-0" FOR CALCULATION REGARDLESS OF DEPTH.

VERTICAL BEND WITH UPWARD THRUST

HORIZONTAL BEND OR VERTICAL BENDS WITH DOWNWARD THRUST

NOTES

1. THESE DETAILS SHALL APPLY TO ALL BURIED PRESSURE PIPING AND IN AREAS OF NON-RESTRAINT WALL PENETRATIONS. WHEN REQUIRED, THRUST BLOCKING SHALL BE PROVIDED AT ALL BENDS, TEES, WYES AND DEAD ENDS AS NECESSARY.
2. ARROWS ( ) INDICATE THRUST DIRECTION.
3. CONCRETE FOR THRUST BLOCKS TO BE 6 SACK, 3/4" AGG MAX 3000 PSI.
4. CAST CONCRETE THRUST BLOCK AGAINST UNDISTURBED EARTH. →
5. FIGURE (100%) AT THRUST BLOCK INDICATES PERCENT OF TOTAL THRUST TO BE APPLIED FOR BEARING AREA.
6. FITTINGS TO RECEIVE POLYETHYLENE WRAPPING SHALL BE WRAPPED PRIOR TO POURING THRUST BLOCK.
7. THRUST BLOCKS FOR VERTICAL BENDS HAVING DOWNWARD RESULTANT THRUSTS SHALL BE THE SAME AS FOR HORIZONTAL BENDS.
8. BEARING AREA OF THRUST BLOCK SHALL NOT BE LESS THAN 1.0 SQ. FT.
9. USE THE MAXIMUM INTERNAL PRESSURE ANTICIPATED (i.e. HYDROSTATIC TEST PRESSURE).
10. ALLOWABLE SOIL PASSIVE PRESSURE (LB/FT) SHALL BE PROVIDED BY GEOTECHNICAL ENGINEER.

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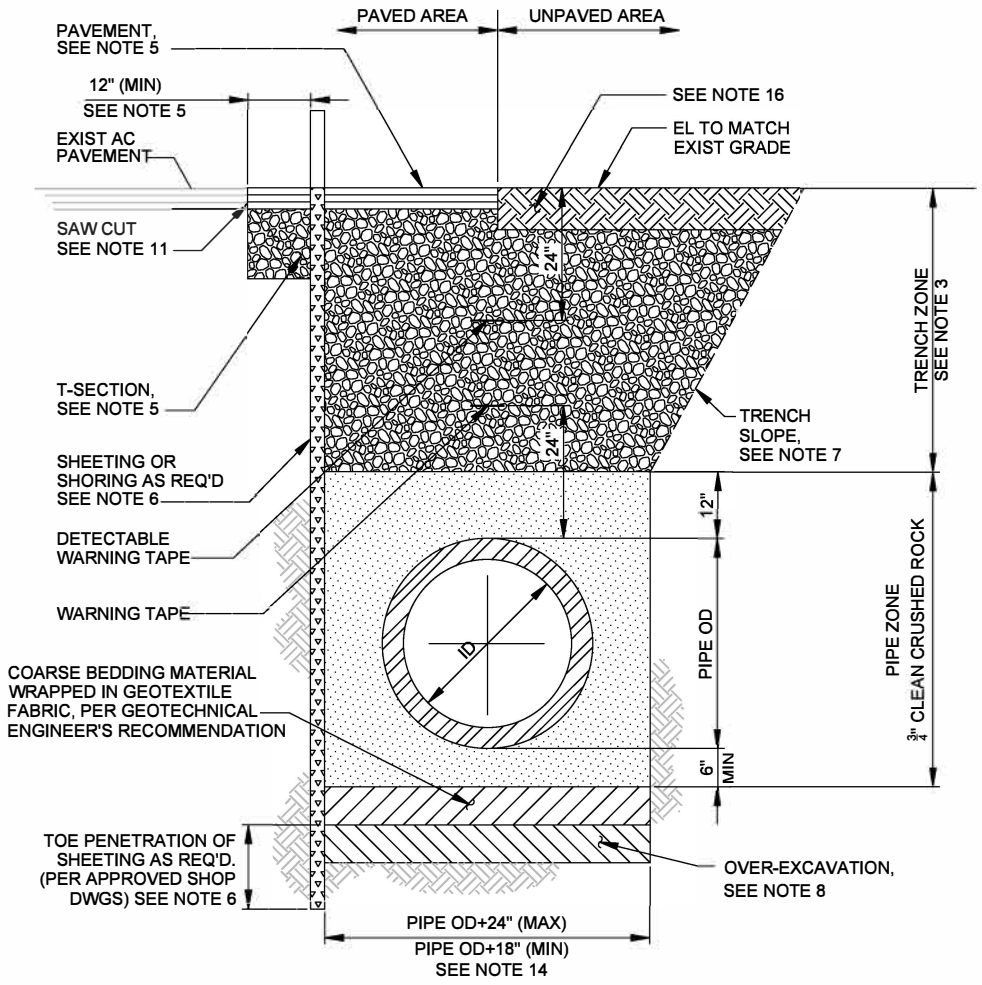
PUMP STATION AND COLLECTION SYSTEM DESIGN STANDARDS

THRUST BLOCK DETAIL

DETAIL NO. **2**

DATE 10/21



NOTES:

1. TRENCH SHALL BE SPECIFICALLY DESIGNED FOR PIPE MATERIAL TO BE USED.
2. ALL TRENCH MATERIALS AND THEIR ASSOCIATED COMPACTION REQUIREMENTS SHALL BE BASED UPON RECOMMENDATION OF THE GEOTECHNICAL REPORT AND PIPE MANUFACTURER.
3. TRENCH ZONE MATERIALS AND COMPACTION SHALL MEET THE REQUIREMENTS OF THE CITY OF FAIRFIELD/CITY OF SUISUN CITY/SOLANO COUNTY, AS APPLICABLE.
4. NO NATIVE MATERIALS SHALL BE USED IN PIPE ZONE OR BELOW UNDER ANY CIRCUMSTANCES. NATIVE MATERIALS MAY NOT BE USED WITHIN THE TRENCH ZONE (ABOVE 12" ABOVE TOP OF PIPE) WITHOUT WRITTEN APPROVAL FROM THE DISTRICT, GEOTECHNICAL ENGINEER, AND CITY OF FAIRFIELD/CITY OF SUISUN CITY/SOLANO COUNTY, AS APPLICABLE.
5. PAVEMENT, PAVEMENT BASE, AND COMPACTION REQUIREMENTS SHALL BE PER REQUIREMENT OF THE CITY OF FAIRFIELD/CITY OF SUISUN CITY/SOLANO COUNTY, AS APPLICABLE.
6. VOID CREATED WHEN SHEETING IS REMOVED SHALL BE BACKFILLED WITH TRENCH MATERIAL AS SHEETING IS REMOVED.
7. IF FULL TRENCH SHEETING IS NOT USED, SLOPE TRENCH IN ACCORDANCE WITH OSHA. SLOPED EXCAVATIONS SHALL NOT BE PERMITTED UNLESS APPROVED BY THE DISTRICT. SLOPED EXCAVATIONS WILL ONLY BE CONSIDERED IN NON-PAVED AREAS.
8. EXCAVATE UNSUITABLE SUBGRADE MATERIAL BELOW EXCAVATION GRADE TO OBTAIN A FIRM AND STABLE BASE. MAINTAIN WATER LEVEL BELOW PIPE LAYING OPERATIONS. THE OVER-EXCAVATED AREA SHALL BE BACKFILLED WITH COARSE BEDDING AND SHALL BE WRAPPED TOGETHER WITH THE TRENCH COARSE BEDDING MATERIAL IN GEOTEXTILE FABRIC, AS NOTED ABOVE. OVER-EXCAVATION SHALL BE AS RECOMMENDED BY THE GEOTECHNICAL ENGINEER.
9. TYPICAL TRENCH DIMENSIONS:
   ID = PIPE INSIDE DIAMETER; I.E., NOMINAL PIPE SIZE, INCHES
   OD = PIPE OUTSIDE DIAMETER, INCHES
10. PROTECT ALL EXISTING PIPES IN VICINITY OF TRENCH.
11. WHERE EDGE OF GUTTER IS WITHIN 3 FEET OF SAW CUT, REMOVE REMAINING EXISTING AC PAVING AND REPLACE WITH NEW AC PAVING.
12. NO JETTING OF TRENCH MATERIALS SHALL BE PERMITTED.
13. PIPE BEDDING OR AGG BASE MATERIAL SHALL NOT BE PLACED IN LIFTS GREATER THAN 8". CONTRACTOR SHALL DEMONSTRATE THAT SPECIFIED COMPACTION CAN BE ACHIEVED WITH 8" LIFTS THROUGH DENSITY TESTS.
14. IF THE MAXIMUM TRENCH WIDTH IS EXCEEDED DURING CONSTRUCTION, CONTACT THE DISTRICT IMMEDIATELY FOR ADDITIONAL REQUIREMENTS TO BE IMPLEMENTED BY THE CONTRACTOR.
15. PROVIDE MECHANICAL COMPACTION TO MEET REQUIREMENTS OF CITY OF FAIRFIELD/CITY OF SUISUN CITY/SOLANO COUNTY.
16. FINAL MATERIAL REQUIREMENTS IN UNPAVED AREAS SHALL BE PER THE RECOMMENDATIONS OF THE CITY OF FAIRFIELD/ CITY OF SUISUN/SOLANO COUNTY, AS APPLICABLE.
17. WHERE ADEQUATE COMPACTION CANNOT BE ACHIEVED ABOVE CROWN OF PIPE DUE TO OBSTRUCTION OR OTHER CONDITIONS. REPLACE PIPE ZONE BACKFILL AND/OR TRENCH ZONE BACKFILL WITH CDF AS DIRECTED BY THE DISTRICT.
18. PRIOR TO TRENCHING, CONTACT USA NORTH BY CALLING 811.
19. BLASTING OF EXCAVATION MATERIALS IS NOT PERMITTED.
20. INSTALL GEOTEXTILE FABRIC BETWEEN BEDDING MATERIAL AND TRENCH BACKFILL.
21. SEE WRITTEN STANDARDS FOR MINIMUM REQUIREMENTS FOR CRUSHED ROCK.
22. FINAL AC PAVING SHALL BE 1" THICKER THAN AND 1/8" ABOVE EXISTING AC PAVING.

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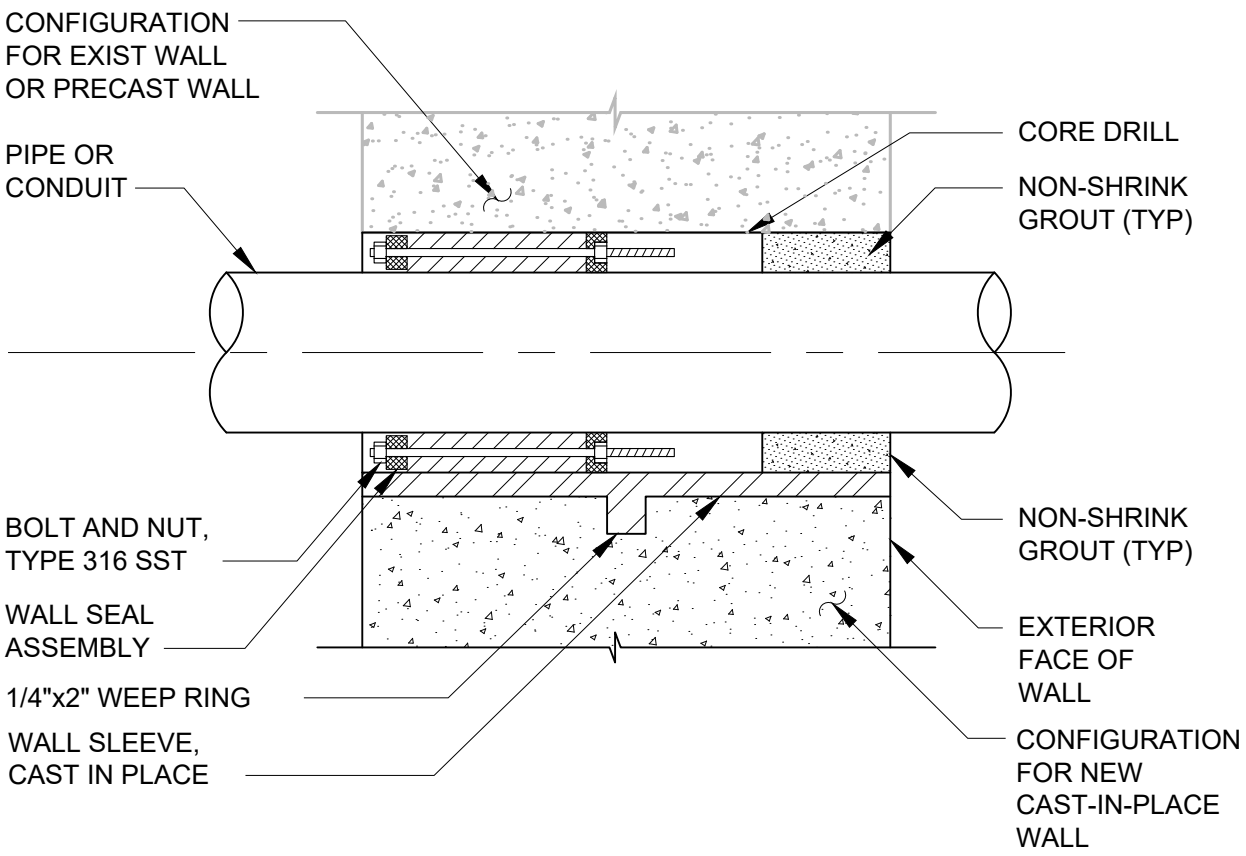
(707) 429-1280 FX

PUMP STATION AND COLLECTION SYSTEM DESIGN STANDARDS

TRENCH DETAIL

DETAIL NO. **3**

DATE 9/23/2021



NOTES:

1. WALL PENETRATION DETAIL SHALL BE USED ON ALL PENETRATIONS BELOW GRADE, UNLESS WALL PIPE IS USED. WALL PIPE SHALL CONSIST OF A 2" MIN INTEGRAL WEEP RING TO THE CARRIER PIPE CAST INTO CONC WALL.

2. INSIDE DIAMETER OF EACH WALL OPENING SHALL BE OF THE SIZE RECOMMENDED BY THE SEAL MANUFACTURER TO FIT THE PIPE OR CONDUIT AND TO ENSURE A WATER-TIGHT JOINT.

3. WALL SEAL ASSEMBLY SHALL BE OF THE MODULAR MECHANICAL TYPE, CONSISTING OF INTERLOCKING SYNTHETIC RUBBER LINKS SHAPED TO FILL THE ANNULAR SPACE BETWEEN THE PIPE AND THE WALL OPENING. A PRESSURE PLATE SHALL BE PROVIDED UNDER EACH BOLT HEAD AND NUT, WITH THE SEAL CONSTRUCTED TO PROVIDE ELECTRICAL INSULATION BETWEEN WALL AND PIPE.

4. WALL SEAL ASSEMBLY SHALL BE LINK SEAL AS MANUFACTURED BY THUNDERLINE CORP, WAYNE, MICHIGAN, CALPICO PIPE LINX, OR EQUAL.

5. PROVIDE ESCUTCHEONS IN FINISHED SPACES.

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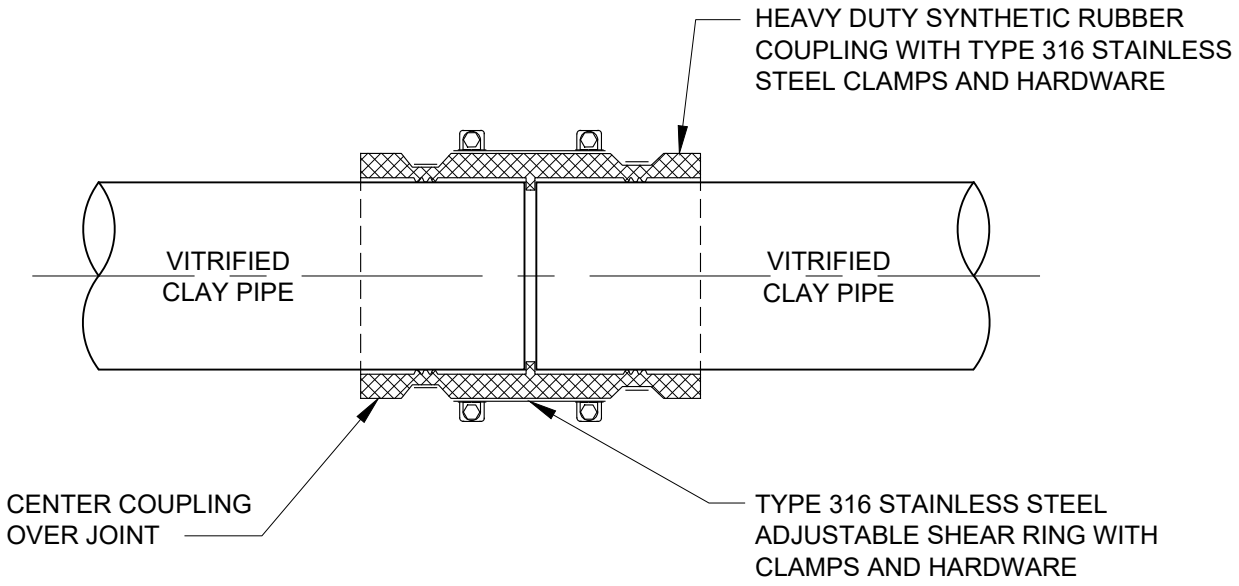
PUMP STATION AND COLLECTION SYSTEM DESIGN STANDARDS

WALL PENETRATION DETAIL

(DETAIL INTENDED FOR USE BY DESIGN ENGINEER, NOT CONTRACTOR)

DETAIL NO. **4**

DATE 9/21



NOTES:

1. COUPLING SHALL BE "BAND-SEAL" ADJUSTABLE COMPRESSION COUPLING FOR SEWER REPAIR OR APPROVED EQUAL.
2. CENTER COUPLING OVER ONE JOINT AT A TIME AND TIGHTEN OUTER BOLTS.
3. AFTER OUTER BOLTS ON BOTH COUPLINGS ARE TIGHTENED, THEN TIGHTEN SHEAR RING.
4. ALL CLAMPS, SHEAR RINGS, AND HARDWARE SHALL BE TYPE 316 STAINLESS STEEL.

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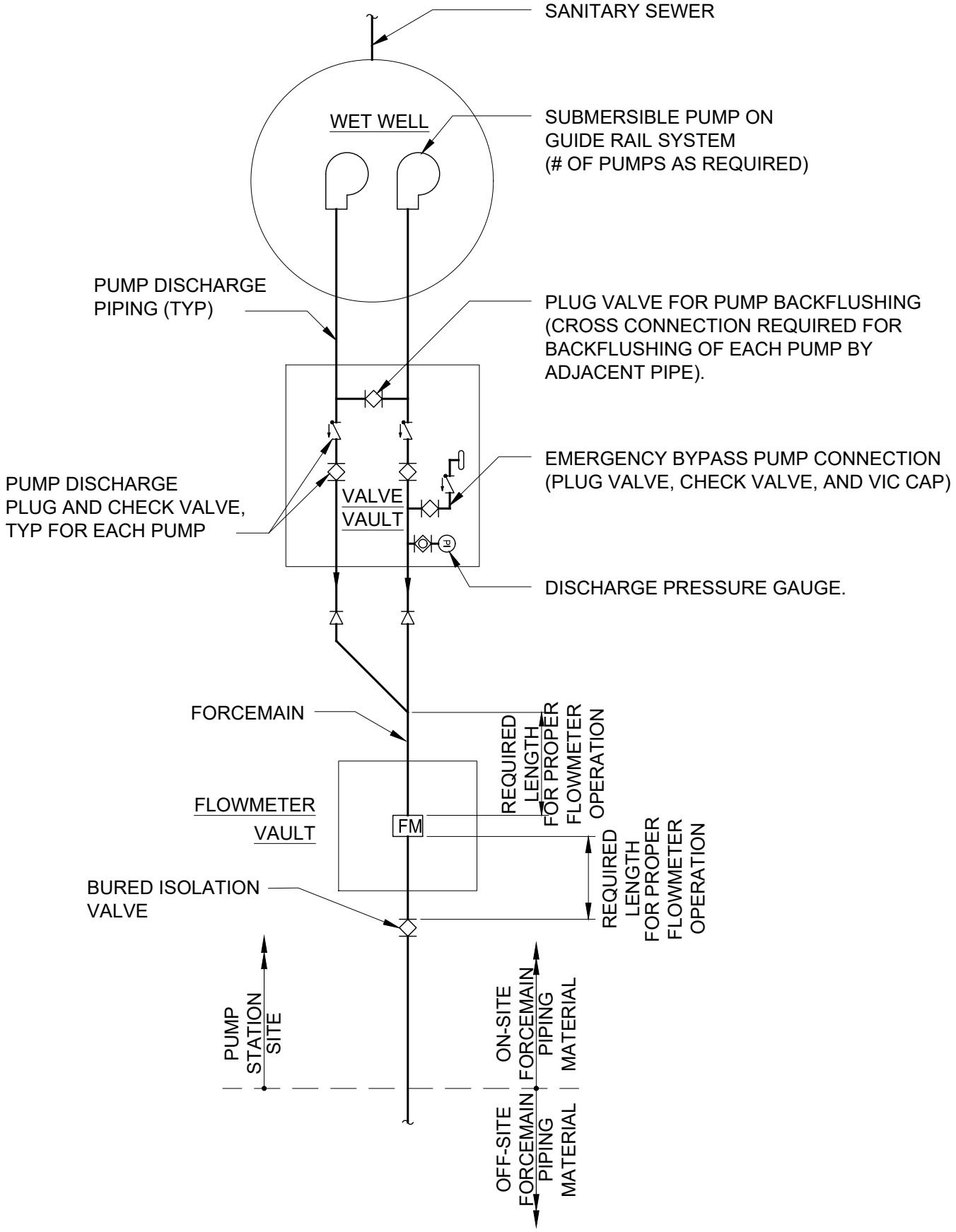
PUMP STATION AND COLLECTION SYSTEM DESIGN STANDARDS

VCP REPAIR COUPLING DETAIL

NOT TO SCALE

DETAIL NO. **5**

DATE 9/21



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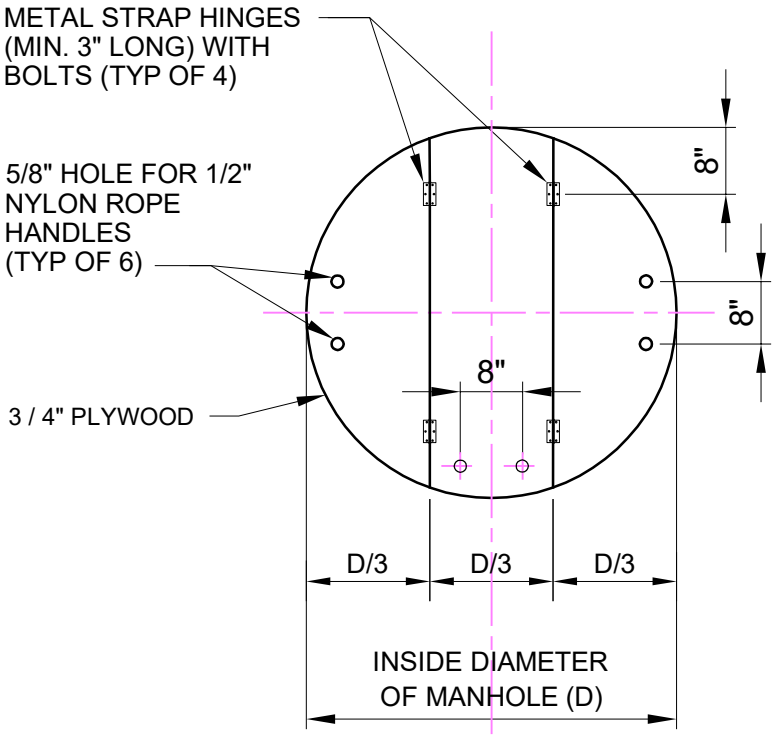
PUMP STATION AND COLLECTION SYSTEM DESIGN STANDARDS

SUBMERSIBLE SEWAGE PUMP STATION SCHEMATIC

(DETAIL INTENDED FOR USE BY DESIGN ENGINEER, NOT CONTRACTOR)

DETAIL NO. **6**

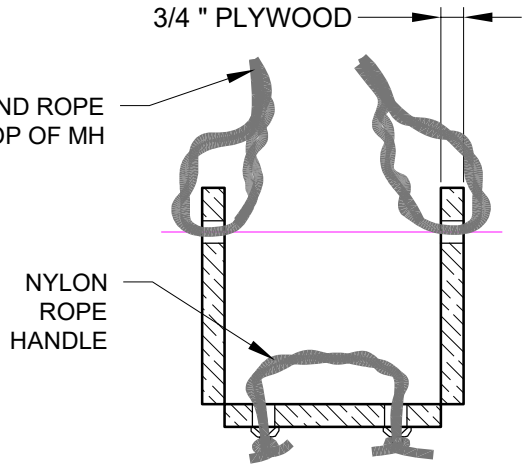
DATE 9/21



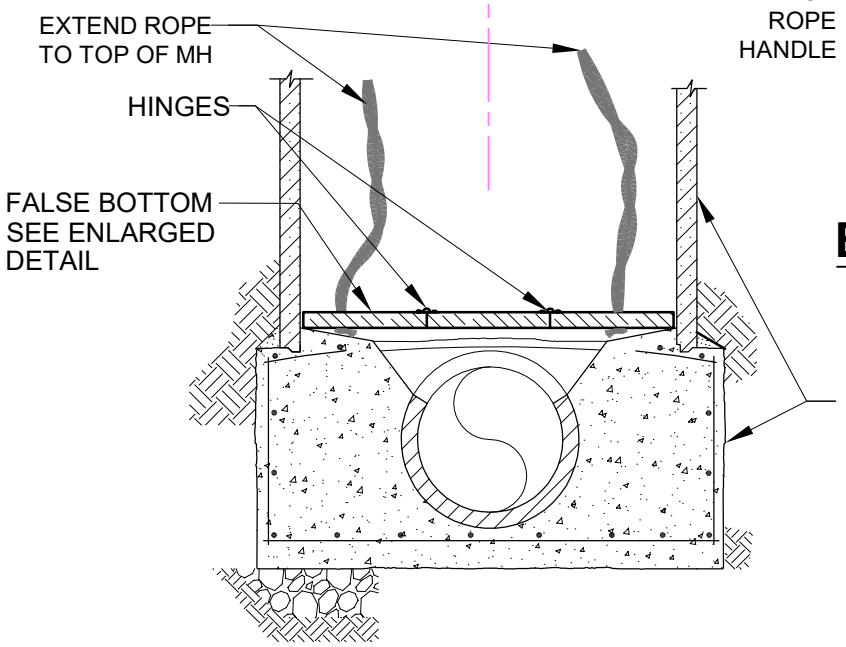
PLAN VIEW

NOTES:

1. FALSE MANHOLE BOTTOM SHALL BE FURNISHED AND INSTALLED IN ALL MANHOLES CONSTRUCTED IN ADVANCE OF PAVING, GRINDING, OR OTHER STREET REHABILITATION WORK. THESE FALSE MANHOLE BOTTOMS WILL BE INSTALLED AT A TIME DIRECTED BY FSSD.
2. FALSE MANHOLE BOTTOM SHALL BE REMOVED AFTER THE FINAL APPURTENANCE ADJUSTMENT INSPECTION. THE PAVING CONTRACTOR AND FSSD WILL COORDINATE THE REMOVAL OF THE FALSE MANHOLE BOTTOMS.



ENLARGED DETAIL



BASE SECTION

FAIRFIELD-SUISUN SEWER DISTRICT
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(707) 429-1280 FX

PUMP STATION AND COLLECTION SYSTEM DESIGN STANDARDS

FALSE BOTTOM DETAIL

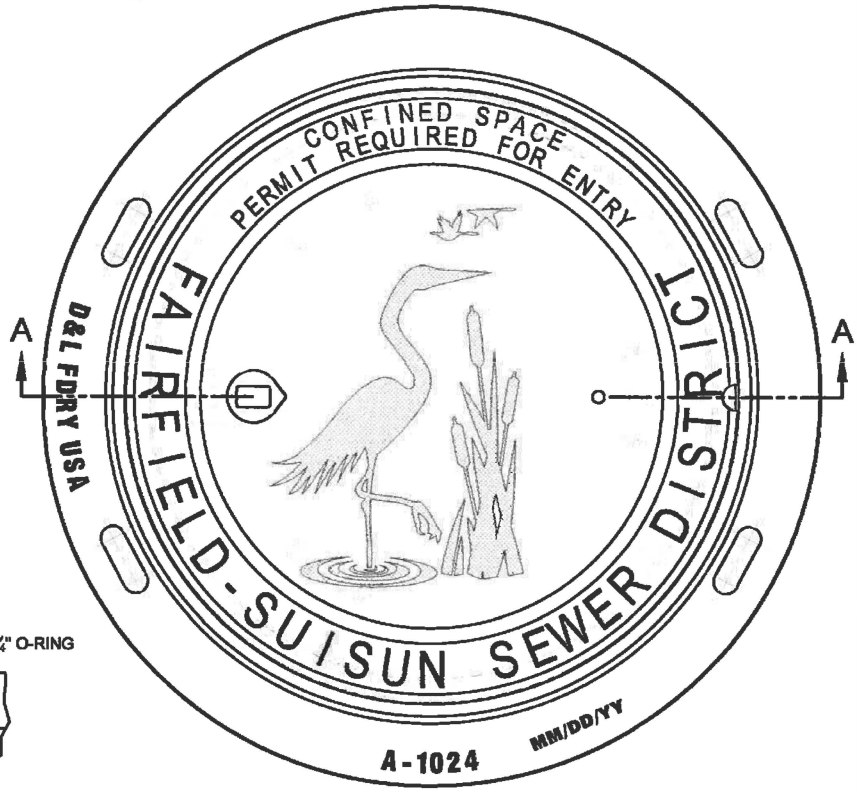
NOT TO SCALE

DETAIL NO. 7

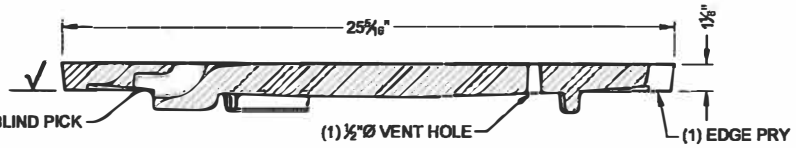
DATE 7/30/2021

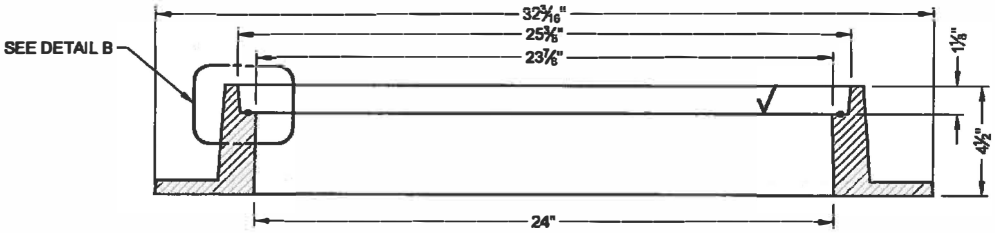
Detail-07_FalseBottom.dwg

A-1024



DETAIL B





SECTION A-A

MADE IN USA

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			PRODUCT NUMBER:	MATERIAL TYPE:
			COVER: A-1024-95	GRAY IRON: ASTM A-48 CL 35B
			RING: A-1024-R4	GRAY IRON: ASTM A-48 CL 35B
			MEETS:	H20 WHEEL LOADING
			G:_DLS DRAWINGS\A\A-1024\A-1024-R4_A-1024-95.DWG	

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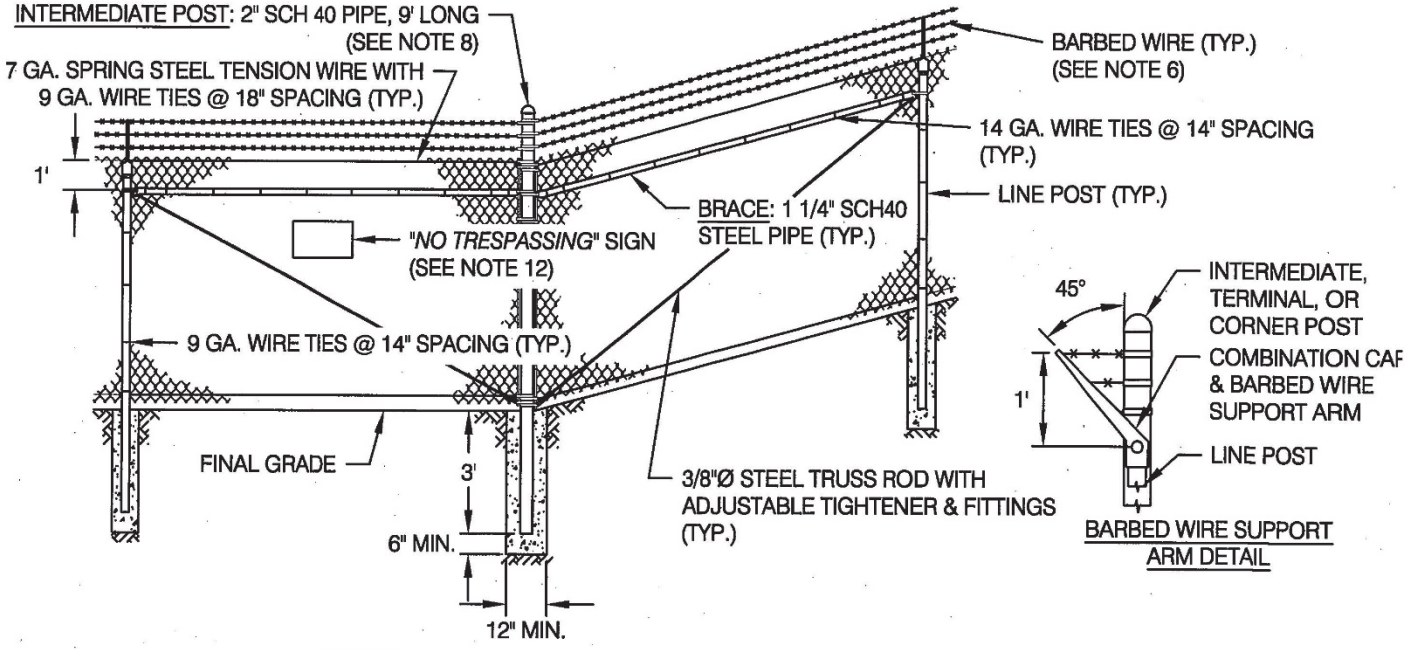
PUMP STATION AND COLLECTION SYSTEM DESIGN STANDARDS

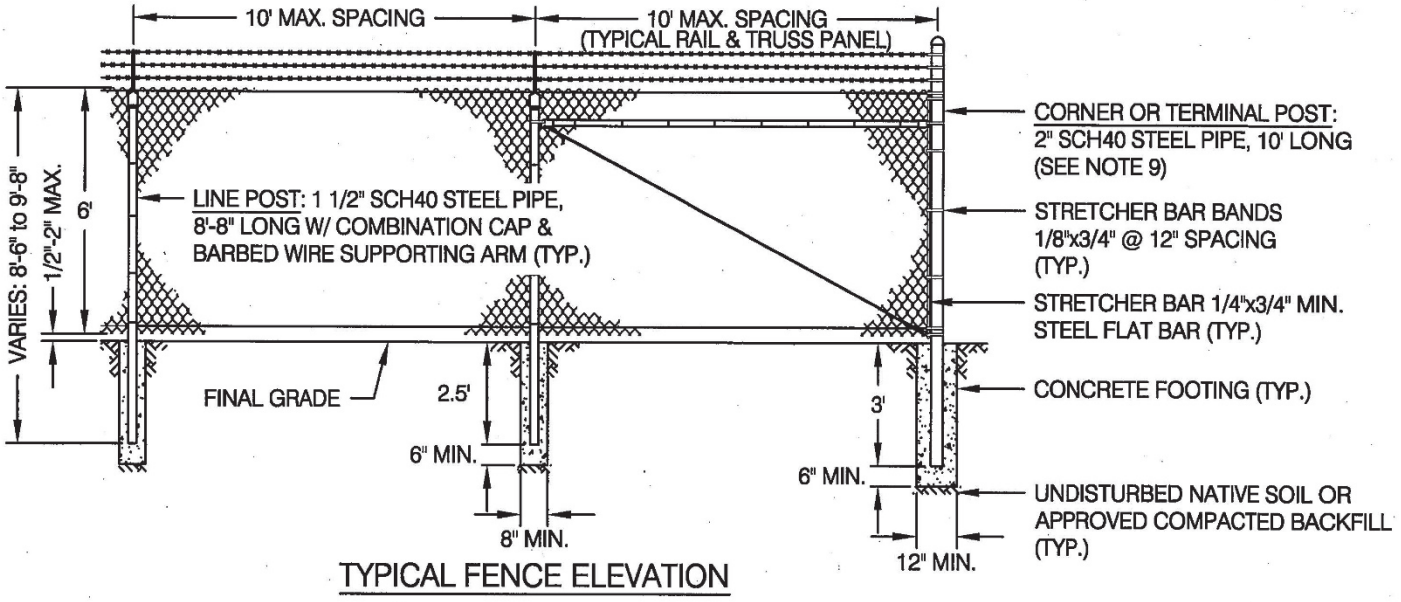
APPROVED_MANHOLE_FRAME_AND_COVER

DETAIL NO. **8**

DATE 9/25



INTERMEDIATE POST DETAIL



TYPICAL FENCE ELEVATION

NOTES:

1. ALTERNATE MANUFACTURING DETAILS NOT COVERED ON THIS DRAWING SHALL BE SUBMITTED BY THE CONTRACTOR FOR APPROVAL BY THE DISTRICT ENGINEER.
2. ADJUSTABLE TIGHTENERS SHALL BE TURNBUCKLE OR EQUIVALENT, HAVING 6" MINIMUM TAKE-UP.
3. SECURE GALVANIZED CAP TO POST WITH 1/4"Ø ROUND HEAD RIVETS.
4. TYPICAL RAIL WIRE PANELS SHALL BE USED AT ALL CORNERS, TERMINAL POSTS, AND ANGLE POINTS.
5. ALL HARDWARE SHALL BE GALVANIZED.
6. BARBED WIRE SHALL BE 2 STRANDS OF GALVANIZED TWISTED 12.5 GA. CARBON STEEL WIRE. BARBS SHALL BE FOUR POINT, 4"± CENTERS.
7. CHAIN LINK FABRIC SHALL BE 72" HIGH OF 9 GA. CARBON STEEL WIRE, WOVEN IN A 2" MESH AND GALVANIZED AFTER WEAVING.
8. INTERMEDIATE POSTS SHALL BE INSTALLED AT NOT MORE THAN 1000' INTERVALS ALONG FENCE LINE AND AT GRADE CHANGES EXCEEDING 5%.
9. CORNER POSTS SHALL HAVE TYPICAL RAIL & TRUSS WIRE PANEL TO JOIN POST IN BOTH DIRECTIONS.
10. THE CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 3000 PSI. ALL CEMENT SHALL BE TYPE II PORTLAND, WITH A MINIMUM OF 5 SACKS OF CEMENT PER CUBIC YARD OF CONCRETE. TOP SURFACES OF ALL CONCRETE FOOTINGS SHALL BE SLOPED TO DRAIN.
11. GRADING PLANS ALONG THE PROPOSED FENCE WILL BE PREPARED BY THE DEVELOPER AND PRESENTED TO THE DISTRICT FOR APPROVAL AS PART OF THE OVERALL SITE DEVELOPMENT PLAN. – NOT USED
12. CONTRACTOR SHALL INSTALL SIGNS AT 150' INTERVALS. PROVIDED BY THE DISTRICT AT THE CONTRACTOR'S EXPENSE.

FAIRFIELD-SUISUN SEWER DISTRICT

NOTE: CALL U.S.A. AT LEAST 48 HOURS PRIOR TO EXCAVATION 1-800-642-2444

REFER TO THE STANDARD SPECIFICATIONS

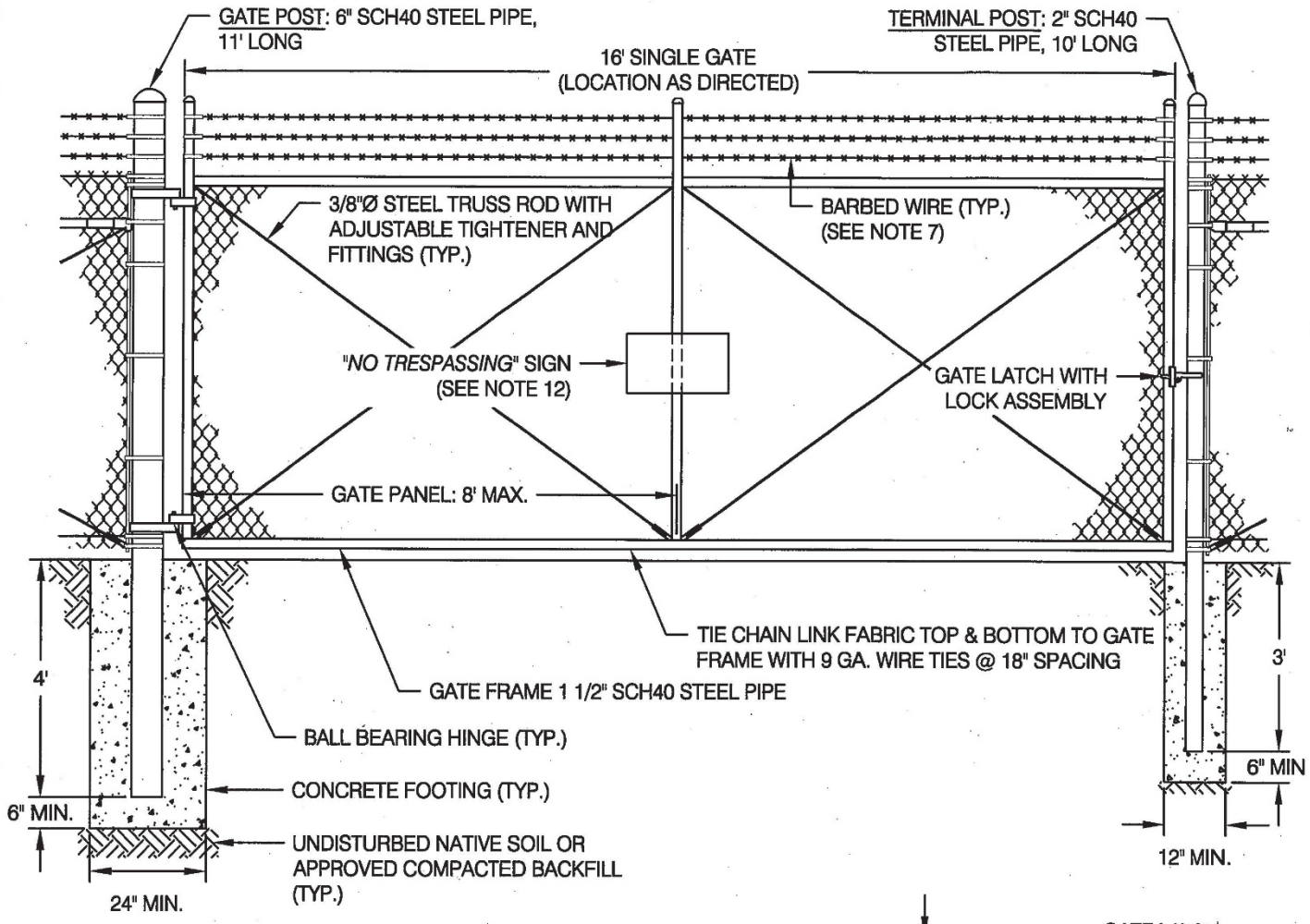
TYPICAL CHAIN LINK FENCING

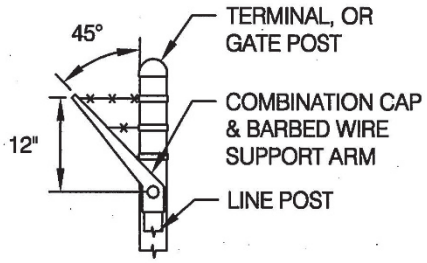
DETAIL 9

APPROVED BY:

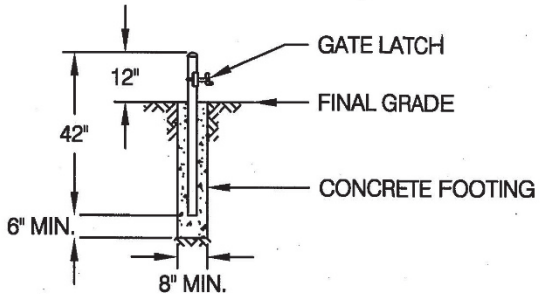
DISTRICT ENGINEER _____ DATE _____

REVISION N.A.





BARBED WIRE SUPPORT ARM DETAIL



GATE STOP POST DETAIL

NOTES:

1. ALTERNATE MANUFACTURING DETAILS NOT COVERED ON THIS DRAWING SHALL BE SUBMITTED BY THE CONTRACTOR FOR APPROVAL BY THE DISTRICT ENGINEER.
2. ADJUSTABLE TIGHTENERS SHALL BE TURNBUCKLE OR EQUIVALENT, HAVING 6" MINIMUM TAKE-UP.
3. SECURE GALVANIZED CAP TO POST WITH 1/4"Ø ROUND HEAD RIVETS.
4. ALL GATE HINGES SHALL BE HEAVY DUTY, MALLEABLE IRON OR STEEL, INDUSTRIAL SERVICE TYPE WITH 180° SWING FROM CLOSED POSITION.
5. TYPICAL RAIL WIRE PANELS SHALL BE USED AT ALL CORNERS, TERMINAL POSTS, AND ANGLE POINTS.
6. ALL HARDWARE SHALL BE GALVANIZED.
7. BARBED WIRE SHALL BE 2 STRANDS OF GALVANIZED TWISTED 12.5 GA. CARBON STEEL WIRE. BARBS SHALL BE FOUR POINT, 4"± CENTERS.
8. CHAIN LINK FABRIC SHALL BE 72" HIGH OF 9 GA. CARBON STEEL WIRE, WOVEN IN A 2" MESH AND GALVANIZED AFTER WEAVING.
9. CORNER POSTS SHALL HAVE TYPICAL RAIL & TRUSS WIRE PANEL TO JOIN POST IN BOTH DIRECTIONS.
10. ALL CONCRETE FOOTINGS SHALL BE TYPE II PORTLAND CEMENT CONCRETE (5 SACK MIX). TOP SURFACES OF ALL CONCRETE FOOTINGS SHALL BE SLOPED TO DRAIN.
11. EACH GATE SHALL BE COMPLETED WITH HINGE AND LOCK ASSEMBLIES INSTALLED, HINGE PLACEMENT FOR GATE SWING SHALL BE DIRECTED BY THE ENGINEER.
12. SIGN SHALL BE PROVIDED BY THE DISTRICT AND INSTALLED BY THE CONTRACTOR AT THE CONTRACTOR'S EXPENSE.

FAIRFIELD-SUISUN SEWER DISTRICT

NOTE: CALL U.S.A. AT LEAST 48 HOURS PRIOR TO EXCAVATION 1-800-642-2444

REFER TO THE STANDARD SPECIFICATIONS

TYPICAL SINGLE SWING GATE

DETAIL 10

APPROVED BY:

DISTRICT ENGINEER _____ DATE _____

REVISION N.A.

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APPENDIX B

GENERAL REQUIREMENTS AND DRAFTING STANDARDS FOR DESIGN AND RECORD DRAWINGS

APPENDIX B

A. GENERAL NOTES

The following General Notes are a listing of general requirements that shall apply to all Project Drawings. The Design Engineer shall incorporate the following requirements into its design and on all Project Plans:

1. At least forty-eight (48) hours before starting any work on or near an existing sewer, notify the Fairfield-Suisun Sewer District (FSSD) at 707-429-8930.
2. Contractor shall comply with the District's insurance and indemnification requirements. Contact the District for insurance and indemnification provisions.
3. All connections to existing sewer pipes shall be made at a new or existing manhole and shall match crown of existing pipe, unless approved otherwise by FSSD.
4. Openings in existing manholes for new pipes shall be core drilled. A Link-Seal, or approved equal, shall be used to make a watertight seal around the pipe.
5. New sewers that enter a new or existing manhole shall match the crown elevation of existing pipes and shall be no more than ninety degrees (90°) from upstream direction. A new channel shall be formed in the existing manhole to provide a smooth flow transition from the new sewer to the existing sewer channel.
6. New manholes shall meet requirements of the District's Manhole Detail; see construction plans. Contact the District for material, construction and testing specifications. Grout shall be placed in all horizontal joints, inside and outside. Grout shall have minimum compression strength of 5000 PSI and shall be equal to Burke Non-Ferrous, Non-Shrink Grout damp pack mix. After assembly and waterproofing, manholes shall be vacuum tested by Contractor and witnessed by FSSD.
7. Sanitary sewers shall have a minimum depth of four feet (4') from top of pipe to finished grade unless otherwise noted by FSSD.
8. Vertical clearance from District sewers shall be a minimum of 12-inches, from outside wall to outside wall, for open cut construction and 24-inches for trenchless installations. Horizontal clearance from District sewers shall be a minimum of 10-feet wall-to-wall. Under special circumstances, horizontal clearance may be reduced at the sole discretion of the District. Any utility crossings of District sewers, or any locations where horizontal clearance cannot be maintained (or where locations are not known) may require potholing and must be witnessed by FSSD. See Note 1.

9. The maximum distance between manholes shall be five hundred feet (500'), unless otherwise noted by FSSD. Curved sanitary sewers are not allowed.

10. Install joints within two feet (2') of each end of concrete caps, concrete encasements, structures, or manholes to maintain pipe flexibility to prevent pipe damage in the event differential settlement occurs.

11. If precast manhole bases are used, a bell end stub must be cast in at both upstream and downstream directions, unless otherwise noted by FSSD.

12. All Contractors working on District facilities shall develop a project specific sewer Overflow Emergency Response plan (OERP). The Contractor's OERP shall be submitted to the District for review and written approval prior to start of any work on District facilities. All of the Contractor's employees shall be trained on the project specific OERP and documentation of the training shall be provided to the District.

13. Flow in existing sewers shall be maintained at all times during construction, unless otherwise approved by FSSD. The Contractor shall use temporary bypass piping, temporary pumping, or other methods as required to maintain existing flow. The Contractor shall submit a proposed plan for maintaining existing flow to the Fairfield-Suisun Sewer District at least two weeks in advance of starting work on an existing sewer.

14. Contractor shall hand dig in vicinity of gas lines.

15. Contractor shall verify, protect, and support all utilities encountered during excavation in a manner acceptable to the utility owner.

16. Contractor shall notify Underground Service Alert USA by calling 811 at least four working days in advance of any planned excavation for this project.

17. All materials, construction methods and testing associated with District facilities shall be in accordance with District Standards. All materials shall be submitted to the District for review and written approval prior to installation. Materials installed without written approval may be rejected. Contact the District for District Standard Specifications and submittal requirements.

18. Contractor shall maintain a set of accurate as-built drawings on-site that are updated weekly at a minimum. Contractor shall turn over completed as-built drawings to the District prior to final inspection or the work will not be accepted.

19. All work on District facilities shall be inspected and accepted in writing by the District. Work on District facilities shall be warranted in writing for one year from final written acceptance.

20. All contractors shall possess up to date Confined Space Certification.

B. GENERAL DRAFTING STANDARDS

These Standards are specified to facilitate the preparation and presentation of data for timely, reliable, and safe infrastructure maintenance and operations.

All pipeline and belowground facilities shall be draw in standard engineering plan and profile format. See sample drawing at the end of this Appendix.

CAD Standards as outlined in this manual are intended to serve as a guideline for producing Construction Drawings and Record "As-Built" Drawings created for FSSD; with the goal of streamlining data transfer from CAD to GIS. CAD standards can be defined as the rules, guidelines, and standard operating procedures used in producing, maintaining, and sharing CAD data/drawings in the electronic environment. GIS is ultimately the data warehouse where many CAD objects are transferred. FSSD stores, maintains, queries, and analyzes all its spatial facilities data in the ESRI enterprise ArcGIS platform spatial database engine (SDE). Data elements in CAD will be uploaded via a "Data loader" in ArcCatalog to the enterprise SDE. For samples of common CAD objects transferred to GIS feature layers, see table in this section.

1. FSSD standard project drawing dimensions are 22"x34" full size. Title blocks and general sheets are available upon request in CAD, see end of this section for samples.

2. Fonts – see drawing std-fonts-linetypes.dwg for FSSD standard fonts and linetypes. Other fonts, such as architectural fonts, must convert to PDF legibly and be approved by FSSD's CAD-GIS Support Person.

3. For specific deliverables such as number of hard copies, electronic copies by submittal, see Chapter III.

4. For additional CAD guidelines see Section E below.

C. SOFTWARE REQUIREMENTS AND FILE REQUIREMENTS

1. CAD Platform: CAD files must be received in the AutoCAD (.dwg) format, version 2020. Contact the District to verify the acceptable version.

2. GIS File GDB: Version 10.7. Contact the District to verify the acceptable version.

3. COORDINATE SYSTEM:

Horizontal Datum: NAD 1983 StatePlane California II FIPS 0402 (US Feet)

NAD_1983_StatePlane_California_II_FIPS_0402_Feet
WKID: 2226 Authority: EPSG

Projection: Lambert_Conformal_Conic
False_Easting: 6561666.666666666
False_Northing: 1640416.666666667
Central_Meridian: -122.0
Standard_Parallel_1: 38.33333333333334
Standard_Parallel_2: 39.83333333333334
Latitude_Of_Origin: 37.66666666666666
Linear Unit: Foot_US (0.3048006096012192)

Geographic Coordinate System: GCS_North_American_1983
Angular Unit: Degree (0.0174532925199433)
Prime Meridian: Greenwich (0.0)
Datum: D_North_American_1983
Spheroid: GRS_1980
Semimajor Axis: 6378137.0
Semiminor Axis: 6356752.314140356
Inverse Flattening: 298.257222101

Vertical Datum: NAVD 1988 (US survey feet)

NAVD_1988_Foot_US
WKID: 105703 Authority: Esri

Linear Units: Foot_US
Direction: positive up
Vertical Shift: 0.0

D. DRAWINGS SET-UP (NOT USED)

E. GRAPHIC GUIDELINES CHECKLIST

1. LINE FEATURES:

- ☐ All line work and objects created using standard AutoCAD "OSNAP" commands ensuring proper joining of the features. Lines constructed without deliberate gaps, slivers, or overruns.
- ☐ Separate line segments shall be used to separate and identify varying pipe diameters and pipe materials, as well as centroid to centroid distance between valves and fittings. If two distinctly different lines are connected, the appropriated point entity that describes the change must be used; i.e. Reducer, Transition Gasket.
- ☐ Intersecting lines within the same layer shall be split.
- ☐ Intersecting lines from unrelated layers shall not be split.
- ☐ Utility lines shall be digitized in the same direction as their physical flow.
- ☐ Utility centerlines shall be digitized as a single-line between structures with no breaks. Lines may be turned OFF (not frozen) but named with "CL" for easy identification; i.e. CIVL_SSWR_CL

a. Sewer Lines:

- ☐ Begin and end lines with a point entity, i.e. manhole, plug, cleanout.
- ☐ Forcemain lines shall be digitized as a continuous polyline between structures/nodes, bends and curves included.
- ☐ Lines drawn from upstream to downstream direction.

b. Storm Drain Lines:

- ☐ Open channels/ditches shall be digitized as a continuous polyline between structures/nodes, bends and curves included.
- ☐ Residential driveway culverts excluded from the storm data. However, culverts crossing under roadways, railroads, commercial drives, or parking areas should be included as storm lines. If driveway culverts and their associated ditches are new, use a single polyline to represent the flowline of the ditch.

c. Water Lines:

- ☐ Begin and end lines with a point entity, i.e. fitting, valve, and hydrant. Extend the line to the centroid of the point entity.
- ☐ Curved lines shall be digitized as a continuous polyline between structures/nodes, with bends and curves included.

2. POINT FEATURES:

- ☐ Utility appurtenances such as valves, meters, hydrants, etc., digitized as:

    - BLOCKS or point features created in Layer 0 and inserted on the appropriate layer
    - Snapped to the centroid insertion point
- ☐ Pumping Stations represented as point features using same layer for sewer structures/nodes. All incoming and outgoing sewer lines must snap to this point, even if it requires adding bends to complete the connection.

3. POLYGON FEATURES:

- ☐ All polygon features such as building footprints, parcels, etc. that are represented with lines, polylines, and arcs, shall be snapped at all endpoints insuring that a closed polygon will be created in GIS.

4. GENERAL CAD GUIDELINES

- ☐ Entity types are individually isolated on separate layers with logically defined names.
- ☐ Blocks or symbols exported legibly to Adobe PDF and/or image platforms.
- ☐ Other entities such as leaders and notes are placed on a non-GIS layer, see US National CAD Standard V6 for guidelines.
- ☐ If existing map data does not agree with features as located by survey, do not edit the existing data. Instead, make a note of the discrepancies on a separate layer. Example: an existing sewer manhole to be used as a connection point may be ten feet from the location identified in the field. Indicate with a note that the connection is to be made at that particular structure – do not move the existing structure and sewer line.
- ☐ If there are features that are specific to the project, but there is no appropriate existing GIS layer to include them on, contact the GIS Support Person for instructions on how to indicate such features.
- ☐ If it is unclear how a line or structure should be drawn please consult with the GIS Support Person for clarification prior to delivering your digital data submittal.
- ☐ Labels or annotation for assets in ANNO or TEXT layer similar to respective features. i.e. SSMH labels C_SSMH_TEXT or C_SSWR_ANNO.
- ☐ Purge ALL objects such as unused layers, linetypes, etc. from all drawings.

CAD drawings electronically submitted to FSSD shall be identical to the submitted hardcopy set.

F. SIGNATURE BLOCK

The District's signature block shall be provide on the title sheet of Drawings containing District facilities. The signature block on the final Plans must be signed and dated by the District's General Manager/ District Engineer, or designee, **a minimum of 14-days prior to commencement of construction of any District facilities**.

FAIRFIELD-SUISUN SEWER DISTRICT

APPROVED FOR CONSTRUCTION.

APPROVED BY: _____ DATE: _____

JORDAN DAMEREL, PE

GENERAL MANAGER/ DISTRICT ENGINEER

APPENDIX C

POLLUTION PREVENTION -

MINIMUM GENERAL FIELD REQUIREMENTS

FAIRFIELD-SUISUN SEWER DISTRICT (FSSD) - FAIRFIELD-SUISUN URBAN RUNOFF MANAGEMENT PROGRAM

POLLUTION PREVENTION - GENERAL FIELD REQUIREMENTS

MAKE SURE YOUR CREWS AND SUBS DO THE JOB RIGHT!

RUNOFF FROM STREETS AND OTHER PAVED AREAS IS A MAJOR SOURCE OF POLLUTION IN LOCAL CREEKS AND SUISUN MARSH. CONSTRUCTION ACTIVITIES CAN DIRECTLY AFFECT THE HEALTH OF THE CREEKS AND THE MARSH UNLESS CONTRACTORS AND CREWS PLAN AHEAD TO KEEP DIRT, DEBRIS, AND OTHER CONSTRUCTION WASTE AWAY FROM STORM DRAINS AND LOCAL CREEKS. FOLLOWING THESE GUIDELINES WILL ENSURE YOUR COMPLIANCE WITH FAIRFIELD-SUISUN URBAN RUNOFF MANAGEMENT PROGRAM REQUIREMENTS.

FAIRFIELD-SUISUN SEWER DISTRICT
(707) 429-8930

MATERIALS STORAGE & SPILL CLEAN-UP

NON-HAZARDOUS MATERIALS

A. SAND, DIRT, AND SIMILAR MATERIALS MUST BE STORED AT LEAST 10 FEET FROM CATCH BASINS AND COVERED WITH TARPS HIGH WINDS, DURING WET WEATHER OR WHEN RAIN IS FORECAST.

B. USE (BUT DO NOT OVERUSE) RECLAIMED WATER FOR DUST CONTROL AS NEEDED.

C. RECYCLE ALL ASPHALT, CONCRETE, AND AGGREGATE BASE MATERIAL FROM DEMOLITION ACTIVITIES.

D. KEEP SITE CLEAN AND LITTER FREE. STORE ALL WASTES IN COVERED DUMPSTERS OR SIMILAR CONTAINMENT DEVICES TO PREVENT CONTACT WITH STORM WATER AND AVOID WINDBLOWN DEBRIS.

E. CHECK DUMPSTERS REGULARLY FOR LEAKS AND TO MAKE SURE THEY DON'T OVERFLOW. REPAIR OR REPLACE LEAKING DUMPSTERS PROMPTLY.

HAZARDOUS MATERIALS

A. LABEL ALL HAZARDOUS MATERIALS AND HAZARDOUS WASTES (SUCH AS PESTICIDES, PAINTS, THINNERS, SOLVENTS FUEL OIL, ANTIFREEZE) IN ACCORDANCE WITH CITY, COUNTY, STATE, AND FEDERAL REQUIREMENTS. CONTACT SOLANO COUNTY DEPARTMENT OF RESOURCE MANAGEMENT AT (707) 784-6765 FOR GREATER DETAIL.

B. STORE HAZARDOUS MATERIALS AND WASTES IN SECONDARY CONTAINMENT AND COVER THEM DURING WET WEATHER.

C. FOLLOW ALL MANUFACTURER'S APPLICATION INSTRUCTIONS FOR HAZARDOUS MATERIALS AND BE CAREFUL NOT TO USE MORE THAN NECESSARY. DO NOT APPLY CHEMICALS OUTDOORS WHEN RAIN IS FORECAST WITHIN 24 HOURS.

D. BE SURE TO ARRANGE FOR APPROPRIATE DISPOSAL OF ALL HAZARDOUS WASTES. CONTACT SOLANO COUNTY DEPARTMENT OF RESOURCE MANAGEMENT AT (707) 784-6765 FOR MORE INFORMATION.

SPILL PREVENTION AND CONTROL

A. KEEP A STOCKPILE OF CLEAN-UP MATERIALS (RAGS, ABSORBENTS, ETC.) AVAILABLE AT THE CONSTRUCTION SITE AT ALL TIMES.

B. WHEN SPILLS OR LEAKS OCCUR, CONTAIN THEM IMMEDIATELY AND BE PARTICULARLY CAREFUL TO PREVENT LEAKS AND SPILLS FROM REACHING THE GUTTER, STREET OR STORM DRAIN. NEVER WASH SPILLED MATERIAL INTO A GUTTER, STREET, STORM DRAIN OR CREEK.

C. REPORT ANY HAZARDOUS MATERIALS SPILLS IMMEDIATELY. CALL 911 AND THE FAIRFIELD-SUISUN SEWER DISTRICT (429-8930).

VEHICLE AND EQUIPMENT MAINTENANCE AND CLEANING

A. INSPECT VEHICLES AND EQUIPMENT FOR LEAKS FREQUENTLY. USE DRIP PANS TO CATCH LEAKS UNTIL REPAIRS ARE MADE; REPAIR LEAKS PROMPTLY.

B. FUEL AND MAINTAIN VEHICLES ON SITE ONLY IN A BERMED AREA OR OVER A DRIP PAN THAT IS BIG ENOUGH TO PREVENT RUNOFF.

C. IF YOU MUST CLEAN VEHICLES OR EQUIPMENT ON SITE, CLEAN WITH WATER ONLY IN A BERMED AREA THAT WILL NOT ALLOW RINSE WATER TO RUN INTO GUTTERS, STREETS, STORM DRAINS, SWALES OR CREEKS.

D. DO NOT CLEAN VEHICLES OR EQUIPMENT ON-SITE USING SOAPS, SOLVENTS, DEGREASERS, STEAM CLEANING EQUIPMENT, ETC.

EROSION AND SEDIMENT CONTROL

A. AN APPROVED EROSION CONTROL PLAN AND STORM WATER POLLUTION PREVENTION PLAN (SWPPP) MUST BE SUBMITTED BEFORE A BUILDING OR GRADING PERMIT WILL BE ISSUED.

B. AVOID SCHEDULING EARTH MOVING ACTIVITIES DURING THE RAINY SEASON (OCTOBER 1 THROUGH APRIL 15). IF GRADING ACTIVITIES ARE ALLOWED DURING THE WET SEASON, IMPLEMENT ALL CONTROL MEASURES NECESSARY TO PREVENT EROSION.

C. MATURE VEGETATION IS BEST FORM OF EROSION CONTROL. MINIMIZE DISTURBANCE TO EXISTING VEGETATION.

D. IF YOU DISTURB A SLOPE DURING CONSTRUCTION, PREVENT EROSION BY SECURING THE SOIL WITH EROSION CONTROL PRODUCTS. ALL DISTURBED AREAS MUST BE COVERED BY OCT. 1ST EACH YEAR TO PREVENT EROSION. AREAS MAY BE COVERED WITH TARPS, PLASTIC, STRAW, SEED, BLANKETS, BFM, ETC.

E. EROSION AND SEDIMENT CONTROL MATERIALS, SUPPLIES, AND DEVICES MUST BE INSTALLED ON ALL DISTURBED AREAS OF THE SITE AT LEAST 24 HOURS BEFORE ANY PREDICTION OF RAIN AND BETWEEN OCTOBER 1 AND APRIL 15. ONCE INSTALLED, THEY MUST BE INSPECTED AND MAINTAINED WEEKLY OR BEFORE, DURING, AND AFTER EACH STORM, WHICHEVER IS MOST FREQUENT. THIS INCLUDES WEEKENDS AND HOLIDAYS.

F. ALL STORM DRAIN INLETS MUST BE PROTECTED FROM SEDIMENT LADEN RUNOFF DURING ALL SEASONS.

STORM DRAIN POLLUTERS MAY BE LIABLE FOR FINES OF UP TO $54,000 PER INCIDENT.

CONTAMINATED SOIL

A. IF YOU SUSPECT CONTAMINATION (FROM SITE HISTORY, DISCOLORATION, ODOR, TEXTURE, ABANDONED PIPES, OR BURIED DEBRIS), CALL SOLANO COUNTY DEPARTMENT OF RESOURCE MANAGEMENT, (707) 784-6765, FOR HELP.

B. MANAGE DISPOSAL OF CONTAMINATED SOIL ACCORDING TO SOLANO COUNTY DEPARTMENT OF RESOURCE MANAGEMENT INSTRUCTIONS.

DEWATERING OPERATIONS

A. REUSE WATER FOR DUST CONTROL, IRRIGATION, OR ANOTHER ON-SITE PURPOSE TO THE GREATEST EXTENT POSSIBLE.

B. BE SURE TO CALL THE FAIRFIELD-SUISUN SEWER DISTRICT (FSSD) INSPECTORS AT (707) 429-8930 BEFORE DISCHARGING WATER TO A STREET, GUTTER, OR STORM DRAIN. FILTRATION OR DIVERSION THROUGH A BASIN, TANK, OR SEDIMENT TRAP IS REQUIRED. WATER DISCHARGED PH MUST BE ABOVE 6 AND BELOW 8. THE MAXIMUM ALLOWABLE TURBIDITY IS 50 NTU.

C. IN AREAS OF KNOWN CONTAMINATION, TESTING IS REQUIRED PRIOR TO REUSE OR DISCHARGE OF GROUNDWATER. CONSULT WITH SOLANO COUNTY DEPARTMENT OR RESOURCE MANAGEMENT, (707) 784-6765, TO DETERMINE WHAT TESTING TO DO. CONTAMINATED GROUNDWATER MUST BE TREATED OR HAULED OFF-SITE FOR PROPER DISPOSAL.

SAW CUTTING

A. ALWAYS COMPLETELY COVER OR BARRICADE STORM DRAIN INLETS WHEN SAW CUTTING WITH SAND BAGS, OR FINE GRAVEL DAMS TO KEEP SLURRY OUT OF THE STORM DRAIN SYSTEM.

B. SHOVEL, ABSORB, OR VACUUM SAW-CUT SLURRY AND PICK UP ALL WASTE AS SOON AS YOU ARE FINISHED IN ONE LOCATION OR AT THE END OF THE DAY (WHICHEVER IS SOONER).

C. IF SAW-CUT SLURRY ENTERS A STORM DRAIN INLET, CLEAN IT UP IMMEDIATELY.

PAVING/ASPHALT WORK

A. DO NOT PAVE DURING WET WEATHER OR WHEN RAIN IS FORECAST.

B. ALWAYS COVER STORM DRAIN INLETS AND MANHOLES WHEN PAVING OR APPLYING SEAL COAT, TACK COAT, SLURRY SEAL, OR FOG SEAL.

C. PLACE DRIP PANS OR ABSORBENT MATERIAL UNDER PAVING EQUIPMENT WHEN NOT IN USE.

D. DO NOT WASH DOWN FRESH ASPHALT OR CONCRETE PAVEMENT.

CONCRETE, GROUT, MORTAR, AND STUCCO STORAGE AND WASTE DISPOSAL

A. STORE CONCRETE, GROUT, MORTAR, AND STUCCO UNDER COVER AND AWAY FROM DRAINAGE AREAS. THESE MATERIALS MUST NEVER ENTER THE STORM DRAIN.

B. WASH OUT CONCRETE AND STUCCO EQUIPMENT/TRUCKS ONLY IN THE DESIGNATED ON-SITE WASHOUT AREA. WASH WATER AND CONCRETE MUST NOT ENTER STORM DRAIN.

C. DIVERT WATER FROM WASHING EXPOSED AGGREGATE CONCRETE SO IT FLOWS TO A DIRT AREA WHERE IT WILL NOT RUN INTO A GUTTER, STREET, OR STORM DRAIN. IF A SUITABLE DIRT AREA IS NOT AVAILABLE, VACUUM UP THE RESIDUAL AND DISCARD ACCORDING TO REGULATIONS.

PAINTING

A. NEVER RINSE PAINT BRUSHES OR MATERIALS IN A GUTTER OR STREET OR OVER A STORM DRAIN.

B. PAINT OUT EXCESS WATER-BASED PAINT BEFORE RINSING BRUSHES, ROLLERS, OR CONTAINERS IN A SINK. IF YOU CAN'T USE A SINK, DIRECT WASH WATER TO A DIRT AREA AND SPADE IT IN.

C. PAINT OUT EXCESS OIL-BASED PAINT BEFORE CLEANING BRUSHES WITH THINNER.

D. FILTER PAINT THINNERS AND SOLVENTS FOR REUSE WHENEVER POSSIBLE. DISPOSE OF OIL-BASED PAINT SLUDGE AND UNUSABLE THINNER AS HAZARDOUS WASTE.

DRYWALL

A. TOOL AND EQUIPMENT CLEANING MUST BE DONE WITHIN A BERMED AREA SO NONE OF THE WASH WATER REACHES THE STREET, GUTTER, STORM DRAIN, OR WATERWAYS.

STREET CLEANING

A. THE STREET, GUTTER, SIDEWALK, AND OTHER PAVED SURFACES SHALL BE CLEANED DAILY OF ANY SOIL OR MATERIALS TRACKED OR DROPPED THERE. FLUSHING OF PAVED SURFACES WITH WATER SHALL NOT BE ALLOWED EXCEPT AFTER THE PAVED SURFACE HAS BEEN SWEPT USING MANUAL OR MECHANICAL BROOMS AND/OR MECHANICAL STREET SWEEPERS AND ALL DEPOSITED MATERIALS THAT CAN BE REMOVED BY REASONABLE MEANS HAVE BEEN REMOVED FROM THE PAVED SURFACE PRIOR TO FLUSHING.

REV	DATE	BY	FSSD PROJ NO	DESCRIPTION
E				
D				
C				
B				
A				

DATE MM/DD/YYYY
DESIGNED BY XX
DRAWN BY XX
CHECKED BY XX
JOB NUMBER XXXX

NOTES: UNLESS OTHERWISE SPECIFIED

WARNING
0 1" IF BAR DOES NOT MEASURE 1 INCH DRAWING IS NOT TO SCALE

FAIRFIELD-SUISUN SEWER DISTRICT
1010 Chadbourne Road
Fairfield, CA 94534-9700
(707) 429-8930 phone
(707) 429-1280 fax

(PROJECT NAME)
(FSSD PROJECT NO)

POLLUTION PREVENTION

SHEET CODE G-2

SHEET 3 OF X SHEETS

H:\CADD STANDARDS\CADD DRAWINGS\STD-POLLUTION PREVENTION R3.DWG

APPENDIX D

SPARE PARTS LIST

(Update in Progress. Required Spare Parts to be identified during plan review based on the type of facilities proposed.)

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APPENDIX E

EQUIPMENT MANUFACTURERS AND MODEL NUMBERS

APPENDIX E
EQUIPMENT MANUFACTURERS AND MODEL NUMBERS

The following is a list of equipment manufacturers and, in particular cases, model numbers for items that shall be provided.

A. SEWAGE PUMPS

1. Pumps:
    a) Flygt.
2. Motor Protection System:
    a) Flygt MiniCAS.
3. Mix Flush Valve:
    a) Flygt.

B. STANDBY ENGINE GENERATOR

1. Generator:
    a) Caterpillar, Cummins, Kohler, or approved equal.
2. Automatic and Non-automatic Transfer Switches:
    a) ASCO Series 7000, Group 5 control panel
3. Load Bank:
    a) Load Technology, Inc., Simplex, Inc., or approved equal.
4. Portable Generator Plug:
    a) Appleton Powerlite Receptacle, Catalog #AJA40044400RS, 4W, 4P, Style 1, reverse service.

C. VALVES

1. Combination Air release and Vacuum Valves:
    a) A.R.I., or approved equal.
2. Plug Valves:
    a) Milliken or DeZurick.

3. Swing Check Valves:

    a) Apco, Golden Anderson Industries, or approved equal.

4. Duckbill Check Valves:

    a) Red Valve Tideflex, or approved equal.

D. PRESSURE GAUGES

1. Ashcroft Duragauge, Model 1279, or approved equal.

E. HATCHES

1. Bilco, or approved equal.

F. FLOWMETER

1. Siemens, SitransFM, or approved equal.

G. pH MONITORING SYSTEM

1. Rosemount, Model #1055 PH.

H. ELECTRICAL, CONTROLS, AND TELEMETRY

1. Motor Control Center:

    a) Eaton Freedom Series

2. PLC:

    a) PLC:

        (1) Allen-Bradley CompactLogix, Model 5320.

    b) Processor:

        (1) Allen-Bradley

    c) Software:

        (1) RS Logix

3. Communications Equipment:

    a) Shall be MDS 9810 spread spectrum radio, MDS diagnostic software, 12 Vdc power supply, Scala Electronic Yagi antenna, Polyphaser IS-B50LN-C2 lightning arrester and Andrews FSJ1-50A 1/4-inch coaxial cable with terminations and waterproofing kits.

4. Level Switches:

a) Anchor Scientific Mini Float SM, or approved equal.

5. Intrinsically Safe Relay:

a) Gem, or approved equal.

6. Level Transmitter:

a) Rosemount, Series 1151.

7. Transmitter Bell:

a) Tesco Model CB612, or approved equal.

8. Solenoid Valves:

(1) Asco, series Red Hat, or approved equal.

9. Bubbler Compressors:

a) ITT, or approved equal.

10. System Integrators:

a) Submit qualifications to District for approval in advance.

11. Operator Interface (IO) Unit:

a) Panelview 1000e, or approved equal.

I. PIPELINE IDENTIFICATION

1. Exposed Piping:

a) W.H. Brady Co., Seton Nameplate Corp., or approved equal.

J. SITE LIGHTING

1. Gardco EH Series, XC Lighting SJ Series, or approved equal.

K. MANHOLES

1. Manholes:

a) Associated Concrete Products, Costa Mesa, CA; Hanson Concrete Products, Milpitas, CA; or approved equal.

2. Castings:

a) Phoenix Iron Works, Model P-1090, or approved equal.

3. Joints:

a) Ram-Nek as manufactured by K.T. Snyder Co.; Quikseal; or approved equal.

4. Waterproofing Material:

   a) Xypex Concentrate, Xypex Chemical Corp.; Tegraproof; Temcrete Systems; or approved equal.

5. Steps:

   a) Lane, or approved equal.

6. Warning Signs:

   a) Accuform Signs, or approved equal.

7. Plastic Lining:

   a) Ameron T-lock, or approved equal.

8. Plastic Lining-Electric Holiday Detector:

   a) Turnhert Rasor, Model AP-W with power pack, or approved equal.

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APPENDIX F

PROTECTIVE COATING SYSTEMS

APPENDIX F
PROTECTIVE COATING SYSTEMS

A. PROTECTIVE COATING SYSTEM SCHEDULE

1. Ferrous Metal-Excluding Galvanized and Stainless Steel (FM).

Item No.	Item	Surface Preparation	System No.
FM-1	All exposed surfaces indoors, outdoors, and within valve and flowmeter vaults, except those included below.	Carbon Steel: SSPC-SP6/NACE No. 3. Cast Iron: NAPF 500-03-04. Surface Profile 1.5 mils minimum	Epoxy/polyurethane (1)
FM-2	Surfaces submerged or intermittently submerged in water, utility water, and/or interior and exterior surfaces of submersible wastewater pumps.	Carbon Steel: SSPC-SP10/NACE No. 2. Cast Iron: NAPF 500-03-04. Surface Profile 1.5 mils minimum	Amine cured epoxy (2)
FM-3	Cast Iron surfaces inside all valves 4-inch in diameter and larger.	NAPF 500-03-04; Surface Profile 1.5 mils minimum	Amine cured epoxy (2)
FM-4	Cast Iron surfaces inside passages of all pumps which have 4-inch discharge diameters or larger.	NAPF 500-03-04; Surface Profile 1.5 mils minimum	Amine cured epoxy (2)
FM-5	Ferrous surfaces of sleeve-type couplings and flanged coupling adapters.	NAPF 500-03-04; Surface Profile 3.0 mils minimum	Fusion bond epoxy (5)
FM-6	Buried Ferrous Metal surfaces not specified elsewhere to be coated.	Carbon Steel: SSPC-SP10/NACE No. 2. Cast Iron: NAPF 500-03-04. Surface Profile 1.5 mils minimum	Amine cured epoxy (2)
FM-7	Exposed surfaces that have been shop coated with fusion bonded epoxy (Does not include surfaces within wetwell).	SSPC-SP7/NACE No. 4	Epoxy/polyurethane (6)
FM-8	Exposed rebar from core drills and demolition.	SSPC-SP15	Amine cured epoxy (2)

2. Non-Ferrous Metal, -Galvanized and Stainless Steel (NFM).

Item No.	Item	Surface Preparation	System No.
NFM-1	All exposed surfaces indoors and outdoors including aluminum sheet metal except as indicated.	SSPC-SP16; Surface Profile 1.5 mils minimum	Epoxy/polyurethane (7)
NFM-2	Buried small galvanized steel pipe and non-ferous metal.	Removal of surface contaminants, dirt, grease, oil	PVC or PE Tape (3)
NFM-3	Surfaces buried.	SSPC-SP16; Surface Profile 1.5 mils minimum	Amine cured epoxy (2)
NFM-4	Aluminum surfaces in contact with concrete, or with any other metal except galvanized ferrous metal.	SSPC-SP1. Uniformly roughen. Surface Profile: 1.0 mil minimum	Aluminum metal isolation (8)

3. Non-Metal, Plastic, Fiberglass (NM).

a) Where isolated non-ferrous parts are associated with equipment or piping, the Contractor shall use the coating system for the adjacent connected surface. Do not coat handrails, gratings, frames or checker plates. Only primers recommended by the coating manufacturer shall be used.

Item No.	Item	Surface Preparation	System No.
NM-1	All exposed non-metal surfaces indoors and outdoors except as indicated.	Solvent clean to remove visible, soluble contaminants. Uniformly roughen. Surface Profile 1.0 mil minimum.	Epoxy/polyurethane (7)
NM-3	PVC pipe, valves and fittings exposed indoors and outdoors (not submerged and/or buried).	Solvent clean to remove visible, soluble contaminants. Uniformly roughen. Surface Profile 1.0	Epoxy/polyurethane (7)

B. PROTECTIVE COATING SYSTEMS

System 1: Epoxy/polyurethane 3-coat system: Rust inhibitive epoxy prime coat, pigmented aliphatic polyurethane intermediate coat, polyurethane finish coat.

Prime Coat (DFT=4-6 mils), Tnemec Series 161HS, Interseal 670HS or equal.

Intermediate coat (DFT=3-5 mils), Tnemec Series 1095, Interthane 990V or equal.

Finish coat (DFT=2-3 mils), Tnemec Series 1095, Interthane 990V or equal.

Minimum System DFT=9.0 mils.

System 2: Amine-Cured Epoxy. High build, amine-cured, straight epoxy resin shall be suitable for long-term immersion service in potable and utility water, and in sewage. Where this system is used for shop-primed equipment, a suitable epoxy primer shall be submitted for review. Where this system is used for indoor electrical, instrumentation, control panels and enclosures, it shall be applied to a DFT of 8 mils.

Prime coat and finish coats (3 or more, DFT = 15.0 to 21.0 mils), Amercoat 385, Tnemec Series V140F, Interseal 670HS or equal.

System 3: PVC or PE Tape. Prior to wrapping the pipe with PVC or PE tape, the pipe and fittings shall be primed using a primer recommended by the PVC or PE tape manufacturer, and in accordance with AWWA C214. After being primed, the pipe shall be wrapped with an adhesive PVC or PE tape system, half-lapped, to a total thickness of 50 mils. The tape system shall be in accordance with AWWA C214. Tape shall extend 6 inches above the finished grade elevation.

System 4: Rich Portland Cement Mortar. Rich portland cement mortar coating shall have a minimum thickness of 1/8-inch, followed by enclosure in an 8-mil thick polyethylene sheet with all joints and edges lapped and sealed with tape.

System 5: Fusion Bonded Epoxy. The coating material shall be a 100 percent powder epoxy applied in accordance with the ANSI/AWWA C213 "AWWA Standard for Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines," except that the surface preparation shall be as specified in the coating system schedule of this Section. The coating shall be applied using the fluidized bed process. Coating shall include ends of pipe unless specified to be field welded.

Liquid Epoxy. For field repairs or where, as confirmed by the Engineer, it would be impossible to use the powder epoxy method without causing damage to the item, the use of a liquid epoxy will be permitted, applied in not less than 3 coats to provide a DFT of 15 mils. The liquid epoxy shall be a 100 percent solids epoxy recommended by the powder epoxy manufacturer.

Coating (DFT = 16 mils minimum): Scotchkote 206N, Miccron 650, Miccron 651, or equal.

System 6: Epoxy/polyurethane. 2-coat system: Two component aliphatic acrylic polyurethane coating material shall provide superior color and gloss, retention, resistance to splash from acid and alkaline chemicals, resistance to chemical fumes and severe weathering and with a minimum solids content of 58 percent by volume. Primer shall be a rust inhibitive two component epoxy coating with a minimum solids content of 75 percent by volume.

Prime coat (DFT = 6-8 mils): Amerlock 400, Carboline 801, Tnemec Series 161HS, Interseal 670HS, or equal.

Finish coat (one or more, DFT = 3-5 mils): Amershield, Carboline 134HS, Tnemec Series 1095, Interthane 990Vor equal.

Note: More than one finish coat shall be applied as necessary to produce a finish with uniform color and texture.

Minimum system DFT = 8 mils.

System 7: Aliphatic Polyurethane finish over a tie coat.

Tie coat (DFT= 3-4 mils), Intergard 251HS, Tnemec Series 135 or equal.

Finish coat (DFT=3-4 mils), Interthane 990V, Tnemec Series 1095 or equal.

Minimum System DFT=6 mils.

System 8: Aluminum Metal Isolation.

Prime coat (DFT = 4-6 mils): Tnemec Series 135, or equal.

Finish coat (one or more, DFT = 8-12 mils): Kop-Coat Bitumastic Super Service Black, Tnemec 46-465, or equal.

Minimum system DFT = 12 mils.

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APPENDIX G

DESIGN STANDARDS FOR WASTEWATER PUMP STATIONS

VII. DESIGN STANDARDS FOR WASTEWATER PUMP STATIONS

Pump stations are not generally acceptable to the District due to reliability, access, and safety issues inherent in such facilities. The District will only allow pump stations in circumstances where a gravity option is not feasible. This section focuses on such requirements.

For clarity, the District's Design Standards shall not be used as a substitute for the Design Engineer's calculations and design, and shall not be used as a substitute for the Designers' and/ or Developers' Project Documents for construction. These Design Standards spell out the minimum considerations and requirements for all District facilities that the Designer, Contractor, and Developer are responsible for.

This portion of the design standards shall be used by a Design Engineer who is preparing Contract Documents for a submersible wastewater pump station to be owned and operated by the District. In general, all wastewater pump stations shall be configured to utilize submersible pumps, unless specifically indicated by the District.

Design standards outlined herein are to be used by the Design Engineer in preparation of Contract Documents, namely specifications and drawings for use by a Contractor. The Contract Documents shall be a stand-alone document and these standards shall not be used by the Contractor to supplement the Contract Documents. All requirements that affect the Contractor shall be incorporated into the Contract Documents by the Design Engineer.

A. PUMP STATION SIZING

Sizing of submersible pump stations for design flows will be based on the more stringent requirements of: 1) the Fairfield-Suisun Sewer District's sizing requirements outlined below and 2) City of Fairfield/City of Suisun City/Solano County (as applicable) sizing requirements. All calculations shall be submitted to both the District and City of Fairfield/City of Suisun City/Solano County (as applicable) for review and comment prior to detailed design.

1. FSSD's Sizing Requirements for Design Flows.

   The sizing of submersible wastewater pump stations for new developments shall be accomplished using the District's Flow Estimating Procedure for New Developments as developed in the latest version of the District's Collection System Master Plan. The Design Engineer shall calculate the estimated flow using the following procedure and submit the calculations to the District prior to any design work for approval of the sizing of the pumping facility. This procedure may be used for developments up to 100 acres. For developments larger than 100 acres, or for facilities that serve existing areas, consult the District to obtain design flows for new facilities.

If flows into the pumping station will vary between startup and when the station's incoming flow reaches its buildout condition, then design flows for the two extreme conditions shall be determined. The District may require maintenance activities (i.e., flushing) to be performed until the facility can operate at its design capacity.

For estimating the design flow rate, the wastewater flow from an area of new development can be divided into three components. Each component is determined individually, and then the design flow is calculated by summing the three components.

Component 1 – Dry Weather Sanitary Flow. This flow component represents sanitary flow generated from residential and/or commercial activity. It can be estimated using the following steps:

a) Determine the gross acres of development and the land use category.

b) Using Table 1, determine the design density of development for that land use category. The density will be in building square feet per acre or dwelling units per acre.

c) Multiply the gross acres by the density to get the building square feet or the number of dwelling units.

d) Using Table 2, determine the unit flow factor for that land use category. The flow factor will be in gallons per day per square foot, or gallons per day per dwelling unit.

e) Multiply the square footage or the number of dwelling units by the appropriate flow factor to determine the daily average sanitary flow in gallons per day and the maximum day sanitary flow in gallons per day.

f) Use a peaking factor to convert from daily average sanitary flow to peak hour sanitary flow. The following peaking factors can be used: 1.8 for residential development and 1.5 for other land use categories.

Component 2 – Groundwater Infiltration. This flow component represents the additional flow that leaks into pipes during the high-groundwater season. It can be estimated by multiplying the gross acres of development by an assumed rate of 100 gallons per day per acre (gpad).

Component 3 – Storm Related Inflow and Infiltration. For new development at less than 100 acres, the inflow and infiltration that leaks into the sewer system can be estimated using the rates shown in Table 3. These rates range from 1,900 gpad to 2,200 gpad for a 20-year storm depending on the location of the development within the service area. This flow component is calculated by multiplying the appropriate rate by the gross acres of development.

The design flow or peak wet weather flow from the development is the sum of the three components listed above, each in gallons per day.

2. Pump Station Capacity.

Once average dry weather flow (ADWF), peak hour sanitary flow, and peak wet weather flow (PWWF) are determined, sizing of pumping facilities may commence. Initial incoming flow conditions, as well as buildout flow conditions, shall be considered when designing facilities.

The following sizing criteria shall be followed when designing submersible wastewater pump stations.

a) Duty pump(s) for the station shall be sized to pump buildout design flow or peak wet weather flows (PWWF). This may be accomplished using one or more duty pumps. When determining the appropriate number of duty pumps and the size of each duty pump, the Design Engineer shall consider minimum flows, average dry weather flows (ADWF), peak dry weather flows (PDWF), and peak wet weather flows (PWWF) anticipated to enter the station at startup through buildout. If initial flows anticipated are considerably different from flows at buildout and the time between startup and buildout is significant, the designer shall consider phasing of equipment. Any phasing of equipment shall be approved in advance by the District, and all facilities shall be sized to accommodate all future equipment.

b) A minimum of one (1) matching standby pump shall be provided, sized such that the firm capacity (flow with the largest pump out of service) meets or exceeds the buildout design flow or PWWF.

c) District requirement is for a single size and make of pump at each facility. If a different pump configuration is required, consult with District for approval.

d) A spare pump impeller shall be provided to the District for each size pump used.

e) Pump discharge piping and sewer forcemains shall be sized to provide for velocities between 3 and 8 feet per second. If variable speed pumping is implemented and the minimum and maximum velocity range outlined above cannot be met under all conditions, the Design Engineer shall contact the District for direction. The sizing of all sewer forcemains shall be designed in unison with its associated pump station.

3. System curves shall be developed for the pump station and forcemain system. System curves, pump curves, and any supporting hydraulic calculations shall be submitted to the District for review along with all calculations with the design submittal. Forcemains shall be sized using a Hazen-Williams C-value of 100, but shall be capable of proper operation at a C-value of 120.

B. PHASING OF FACILITIES

1. All pump station infrastructure shall be designed for conditions at startup through buildout (minimum 40-year facility life cycle). If buildout conditions will not occur for a considerable time period and if deemed appropriate and approved by the District, future equipment may not be required to be installed at startup. Under such conditions, a phasing plan shall be developed and submitted to the District for approval prior to detailed design. However, if phasing of equipment or facilities is approved by the District, all facilities shall be laid out and designed for easy implementation of the equipment in the future.

C. GEOTECHNICAL

1. A Geotechnical Engineering Investigation report shall be prepared by a registered Geotechnical Engineer in the State of California for the pump station site. Refer to Section II - Non-Technical Requirements, for geotechnical requirements.

D. SURVEY WORK

1. Survey work shall be performed during the design phase for the project. See Survey Requirements outlined in Section II - Non-Technical Requirements.

E. UTILITY COORDINATION

1. Design Engineer shall contact all utilities within the project vicinity to coordinate with existing utilities that need to be avoided, relocated, and/or required for service at the new facilities. This work shall include, but not be limited to, obtaining drawings of existing utilities for location, size and coordination for electrical service or other services required for the new facilities, preparation and submittal of applications with payment of fees, and conformance to all permit requirements.

2. PG&E Service: required voltage is 480 volt, 3 phase, 4 wire.

3. The preferred method of service is underground.

4. The switchboard and motor control center shall be rated for the fault current available at the meter plus a 50 percent safety factor.

5. Provide reduced voltage solid state starters when required by PG&E.

6. Water service to site. The size (firm capacity) of the pump station and any chemical storage onsite will dictate the water use requirements (i.e. emergency showers). At a minimum, all sites shall include 1-inch service for a hose bib.

F. UTILITY LOCATING

1. Locating existing utilities in the vicinity of the new work shall include potholing of all existing utilities to determine their exact location during the design phase. Potholing is not required for utilities where both end points have been surveyed, such as gravity sewers or storm drains. Potholing shall be the responsibility of the Design Engineer in addition to obtaining utility maps from agencies. The utility maps and surface features, such as valve boxes, etc. shall be used as guides to determine where to pothole. Copies of all potholing information, maps, and related records shall be provided to the District.

G. SEISMIC DESIGN REQUIREMENTS

1. All facilities, including structures, shall be designed to meet Seismic Zone 4 requirements for essential facilities conforming to the latest codes. All structural work shall be signed and stamped by a Structural Engineer licensed in the State of California.

2. All pieces of electrical, mechanical, and instrumentation equipment and appurtenant facilities that are separately mounted or anchored shall be installed so as to be in conformance with all requirements of the Uniform Building Code, latest edition, both for vertical and seismic loading. This requirement applies, but is not limited to, such items as electrical and instrumentation panels, tanks, pumps, piping, pipe supports and hangers, generators, motors, fans, ventilating ducts and equipment, and other similar equipment or facilities in excess of 400 pounds.

3. All components of this facility shall be considered essential for the purpose of determining seismic force values. The seismic zone shall be considered Zone 4 for this project.

4. Not all anchorage is required to be designed by the Design Engineer. In cases of equipment anchorage, the Design Engineer may include such requirements within the Contract Documents that the manufacturer or Contractor submit anchorage calculations for equipment. All calculations shall be included with equipment submittals and shall be signed and stamped by a Structural Engineer licensed in the State of California.

H. SITE REQUIREMENTS

The pump station site shall provide the following features at a minimum, and shall be approved by both the City of Fairfield/City of Suisun City/Solano County (as applicable) and the District:

1. The site shall be completely fenced and a secure environment shall be provided for all equipment and facilities. All items included at the pump station, including vaults and all buried valves, shall be located within the fenced site.

2. The site shall be provided with a 16' wide (minimum) gate for vehicular access.

3. Gate shall be positioned to open so it will not interfere with District vehicle access within the site for operation and maintenance activities.

4. Site to be fenced with wrought-iron security fencing, unless otherwise required by City of Fairfield/City of Suisun City/Solano County as part of development conditions, or otherwise required by District.

5. Space shall be provided prior to gate in order to park vehicle out of traffic way to unlock and open gate.

6. A minimum of two parking spaces shall be provided within the fenced site. One space shall be sized to accommodate a boom truck. Boom truck parking space size shall be 15 feet wide (minimum) and 30 feet long (minimum) with outriggers extended. Parking space shall be adjacent to wetwell to minimize boom extension. Site shall be laid out to ensure pump removal with District's boom truck.

7. Site shall include adequate access for equipment removal and maintenance, including boom truck operation for pump removal.

8. Site shall be provided with concrete pavement, unless specifically indicated otherwise by District, City of Fairfield/City of Suisun City/Solano County (as applicable). Site requirements, in addition to pavement, may include such items as landscaping. Pavement shall be designed by the Design Engineer and shall meet requirements of City of Fairfield/City of Suisun City/Solano County (as applicable). Design Engineer shall obtain loading requirements from District for boom truck outriggers and anticipated vehicular traffic. If landscaping is provided, an automatic irrigation system shall be provided.

9. Site gates and all equipment, electrical panels, generator enclosure and hatches shall be lockable by means of a padlock. All padlocks shall be `master keyed to District requirements.

10. Site shall be provided with 1 inch diameter potable water hose bibbs on site for washdown. Provide backflow preventor, meter, and any other requirements as dictated by City of Fairfield/City of Suisun City/Solano County (as applicable). Provide adequate hose length or multiple hose bibbs with hose as required for washdown of entire site. Provide hose racks with reel.

11. Provide 4-inch curb around site at fencing to prevent runoff from exiting the site. Slope site to catch basin(s) within the site. Catch basin(s) shall be connected to wetwell and a duck-billed check valve shall be provided within wetwell to prevent flow or odors from exiting the wetwell. The line between the catch basin and wetwell shall contain a buried eccentric plug valve.

12. Site shall contain removable bollards located as required to protect above grade facilities from vehicles.

13. All hatches, vaults, valve box, electrical pull boxes, etc. shall be located within the fenced site and shall be rated for H20 loading. Hatches to access points shall be furnished with integral hinged fall protection grating.

14. Site shall be configured to provide access for a portable pump to be used at the pump station, with provisions for pump discharge to be connected to each pump station forcemain.

15. Site shall be configured to facilitate use of portable generator with automatic transfer switch. Ensure easy access to generator plug.

16. Lighting.

    a) Site shall be provided with adequate lighting for operation and maintenance of all facilities. Lighting shall be low voltage and controlled by a local switch inside gate with selectable photoelectric cell bypass operation. Lighting shall be LED. Lighting shall be pole mounted on 15-foot pole with shoebox fixture to direct light downward for containment on site. Provide vandal proof lenses.

    b) Fixtures shall be dark bronze finish, mounted on 15-foot powder coated steel pole with mounting bracket. Poles and bases shall be rated for 110 mph wind loads. Each pole shall include receptacle and enable light switch. All pole mounted lights shall be controlled by photoelectric cell.

    c) Amount of outdoor lighting shall be as required to provide adequate lighting on site for operations and maintenance activities at night, including illumination into wetwell and valve and flowmeter vaults.

    d) Switchboard/Motor Control Center/Control Panel/Cabinet lighting shall be LED type, operated by door switches.

    e) Provide additional receptacles on site for portable supplemental lighting.

17. Elevation of pump station facility and access shall be greater than the published FEMA 100-year flood elevation at the time of construction.

I. PUMPING EQUIPMENT

Pumping equipment for submersible wastewater pump stations shall meet the sizing requirements previously outlined, as well as the following criteria:

1. General.

    a) Pumps shall be heavy duty, submersible, centrifugal non-clog type specifically designed for pumping raw wastewater. Pumps shall be complete with electric motor and discharge elbow. Pump and motor shall be a single unit with a common shaft fabricated by a single manufacturer, and shall be suitable for continuous operation under

submerged, partially submerged, or dry conditions. Without derating the motor, the pump shall be able to pump continuously with the motor exposed and the water level at the top of the volute under full load without an external cooling system.

b) The pumps shall be capable of operating continuously at the specified operating conditions without cavitation or damaging vibration, as tested in accordance with the American Hydraulic Institute standards for testing.

c) All points along the pump curve where the pump is expected to operate shall be within the recommended operating range per the pump manufacturer. All design points shall be indicated with the specifications along with their associated minimum efficiency. At a minimum, the following design criteria shall be provided within the specification, including design point(s), minimum shutoff head, maximum runout head, minimum pump efficiency at design point(s), maximum pump speed, minimum motor horsepower, minimum motor efficiency, and net positive suction head available (NPSHA) at design point(s). If variable speed drives are provided, design points at reduced speed shall also be specified.

d) Pumps shall be provided with discharge elbows for semi-permanent installation in the wetwell. The pumps shall be automatically connected to the discharge connection elbow when lowered into place. Pumps shall be easily removable for inspection or service, requiring no bolts, nuts, or other fastenings to be removed for the purpose and no need for personnel to enter the wetwell. Sealing of the pumping unit to the discharge elbow shall be accomplished by a simple linear downward motion of the pumps with the entire weight of the pumping units guided to and pressed tightly against the discharge elbow with a metal-to-metal watertight contact. Sealing of the discharge interface by means of a diaphragm, O-ring, or other device will not be acceptable. No portion of the pump shall bear directly on the floor of the sump. Guide bars, which shall steer the pump into proper contact with the discharge elbow, shall be non-adjustable, and shall not bear the weight of the pump.

2. Pump Construction.

a) Major pump components shall be of gray cast-iron, ASTM A48 Class 30 or Class 35B, with smooth surfaces void of blow holes and other irregularities. Where watertight sealing is required, O-rings made of nitrile rubber shall be used. All exposed nuts and bolts shall be made of Type 316 stainless steel.

3. Pump Speed. Pump speed shall be minimized, but in no case greater than 1,800 rpm.

4. Pump Efficiency. Pump efficiency shall be maximized. Constant speed pumps shall be selected if possible, so that the duty point is near the

pump's best efficiency point. Minimum efficiency at the design point shall be 65 percent. Pump selection shall be coordinated with the District, as required in "Pump Station Sizing" section above.

5. Voltage/Cycle/Phase. All pumps shall be designed for 480 volt, 60 cycle, 3 phase, 3 wire.

6. Solid Size. Pump shall pass 3-inch solid size (minimum). Solid size shall be maximized.

7. Nuts and Bolts. All nuts and bolts exposed to wastewater shall be constructed of Type 316 stainless steel.

8. Motor Protection. Thermal sensors shall be specified to monitor the motor stator temperatures. These shall be used in conjunction with external motor protection and wired to the control panel. Thermal sensors shall be normally closed contacts that open on high temperature, set per the manufacturer's recommendation, and rated for pilot duty. Each pump shall be provided with a moisture detection system. Specialty relays, required for moisture sensors, shall be provided by the pump vendor and installed in the starter enclosure. Manufacturer's standard motor protection system, such as Flygt MiniCAS, shall be provided for installation in motor starter cubicle in field. Conductors within the power cable shall be utilized for protective sensors so that only one cable to the pump is required.

9. Mechanical Seal. Each pump shall be provided with a tandem, dual-directional, mechanical rotating shaft seal system. Seals shall run in an oil reservoir. The lower seal unit, between the pump and oil chamber, shall contain one stationary and one positively driven rotating tungsten-carbide ring. The upper seal unit, between the oil sump and motor housing, shall contain one stationary tungsten-carbide ring and one positively driven rotating tungsten carbide ring. Each interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment, but shall be easily inspected and replaceable.

    a) Moisture sensing probe(s) shall be provided in the upper siding chamber to detect the ingress of conductive liquid past the outer seal.

    b) Each pump shall be provided with an oil chamber for the shaft sealing system. The oil chamber shall be designed to prevent overfilling and to provide oil expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without seal damage while pumping under load.

    c) Oil shall be FDA approved. Oil shall be of a paraffin type that is colorless, odorless, and non-poisonous.

10. Impeller. Impellers shall be gray cast-iron ASTM A48, Class 30 or Class 35B, dynamically and statically balanced. The impeller shall be locked to

the impeller shaft and shall isolate the shaft from the pumped fluid. The impeller shall be capable of handling solids, fibrous material, heavy sludge, and other matter found in wastewater. Provide replaceable wear rings.

11. Bearings. Bearings shall be permanently lubricated. The pump shaft shall rotate on two permanently lubricated bearings. The upper bearing shall be a single row deep groove ball bearing and the lower bearing a two row angular contact ball bearing. Minimum B10 bearing life shall be specified as 100,000 hours.

12. Motor.

    a) The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistance Class H insulation rated for 180 degrees C (356 degrees F).

    b) The motor shall be specifically designed for submersible pump usage and designed for continuous duty pumping media of up to 40 degrees C (104 degrees F) with an 80 degrees C temperature rise and capable of at least 15 evenly spaced starts per hour. Motors shall not require wastewater for cooling and shall be rated for running in a dry wetwell with no submergence.

    c) The motor shall be NEMA MG-1 rated for inverter duty. The same manufacturer shall produce the motor and the pump.

    d) The combined service factor (combined effect of voltage, amperage, frequency, load, and specific gravity) shall be a minimum of 1.15.

    e) The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet (minimum). Pumps with protective sensors shall utilize conductors in the power cable so only one cable to the pump is required.

    f) The motor horsepower shall not be less than the maximum pump horsepower specified for each pump and the actual horsepower shall be adequate through the entire range of the published curve without overloading.

    g) Motor RPM shall be less than 1800.

13. Explosion-Proof Service. Explosion Proof Service. The pump system and appurtenances, including the pump, motor, and wiring, shall be approved by a nationally approved testing agency for installation in the State of California for explosion proof service. The system shall be rated for Class 1, Division 1, Group C and D service as determined by the NEC and

approved by a nationally recognized testing agency (UL or FM) at the time of installation.

14. Cable Seal. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall isolate the motor interior from foreign material gaining access through the pump top. The cable entry seal mechanism shall consist of a single elastomeric grommet flanked on both sides by washers and compressed by the junction chamber body. Provide strain relief and preclude specific torque requirements to insure a watertight and submersible seal. Epoxies, silicones, or other secondary sealing systems will not be considered acceptable.

15. Guide Bars and Brackets.

    a) Two guide bars shall be provided for each pump raising and lowering the pumping units. The guide bars shall not support any portion of the weight of the pump. Guide bars shall be of the diameter and length recommended by the pump manufacturer for proper installation. Guide bars and all associated hardware shall be Type 316 stainless steel, and shall be suitable for guiding pumps. Single guide bars or guide rope is not acceptable. The lower guide bar holders shall be integral with the discharge elbow. The upper guide bracket shall be furnished to support and align the rails at the top of the wetwell. Intermediate support brackets shall be provided as required by the pump manufacturer to eliminate deflection of the guide bars.

    b) The pump unit shall be guided on the bars by a guide bracket that shall be an integral part of the pump. Upper guide bar brackets, safety hooks, and cable holder shall be provided and shall be fabricated from Type 316 stainless steel. Chain holder shall be attached near top of the wetwell for access.

16. Lifting Chain. Each pump shall be fitted with load-rated Type 316 stainless steel lifting chain capable of lifting the pump and motor including a minimum factor of safety of 2. The necessary fittings shall be Type 316 stainless steel. Cable is not an acceptable substitute. Provide two Type 316 stainless steel shackles per pump.

17. Mix Flush Valve.

    a) A mix flush valve shall be mounted directly to one pump volute to direct part of the pumped discharge to flush solids into suspension at the start of each pumping cycle. The pump and valve shall be designed for such use.

    b) The valve shall be open at the beginning of each pumping cycle and closed under full pump discharge pressure after a pre-selected time. The valve shall be operated by the liquid being pumped through a self-contained hydraulic system. No external power source should be required to operate the valve. The valve shall be controlled by

hydraulic pressure from the pump. External electrical, hydraulic or pneumatic lines shall not be allowed. A means of adjustment should be provided to achieve a 30 second flushing period for different head and flow conditions.

c) The mix flush valve shall be manufactured by Flygt and shall be designed for use with the pump provided.

18. Spare Parts.

a) Spare parts shall be provided as outlined in Appendix D, Spare Parts List.

19. Nameplates. Equipment nameplates shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. All materials shall be Type 316 stainless steel. Nameplates shall indicate clearly the following information:

a) Manufacturer

b) Date of manufacture

c) Model and size

d) Serial number

e) Rating in capacity

f) Feet of head at capacity

g) Speed at rated capacity

h) Impeller diameter

20. Factory Testing.

a) Contract Documents shall call for all pumps and motors to be factory tested. All test results shall be approved by the District prior to shipment of equipment. Such approval, however, shall not be considered as final acceptance, which will only be made on the basis of the results of field tests of the equipment after it is installed.

b) At a minimum the procedures specified for factory testing shall be included within the Contract Documents and shall include the following:

(1) Factory test shall be performed in accordance with the test code of the Hydraulic Institute. All pumps shall be tested fully assembled. Hydrostatic testing of the casing shall be at a minimum of 125 percent of the shut-off head or 150 percent of the design head, whichever is greater, for 20 minutes.

(2) The pumps shall be tested to verify that performance requirements are met. Tests shall be made to permit plotting head-capacity, brake horsepower, and efficiency curves from minimum head to shut-off head. All curves shall be plotted against flow on the abscissa (horizontal axis).

(3) Tests shall be performed between no less than three-quarter full speed and no more than 120 percent full speed for the specified motor speed. If the tests are performed at less or greater than either speed, the laws for hydraulic similarity shall be used to establish curves for the design speed and 75 percent of the design speed. If variable speed drives are to be provided, testing of pumps at minimum specified speed shall also be performed.

(4) Motors shall have tests performed at the factory, including no-load current and speed, winding resistance, locked rotor current, and high potential tests, in accordance with NEMA MG-1, and IEEE 112.

(5) Prior to submergence, each pump shall be run dry to establish correct rotation.

(6) Motor and cable insulation shall be tested and results recorded for moisture content for insulation defects.

(7) All factory test curves shall be submitted to District for review and approval in a formal Contractor's submittal prior to shipment. This data shall also be included within the O&M manual.

21. Painting/Protective Coatings. Protective coatings for pumps and motors shall include all exposed services as well as internal passages inside pumps. Protective coatings shall be factory applied and shall be as indicated herein and in accordance with the manufacturer's recommendation for immersion in raw wastewater.

22. Manufacturer.

    a) Pumps and motors shall be manufactured by Flygt. No equal will be accepted.

23. Installation. Contract Documents shall specify that pumps be installed in accordance with the manufacturer's recommendations. Pump shall be installed with proper clearance between the bottom of the pump and the floor, per manufacturer's recommendations. Factory trained personnel shall inspect the installation and provide start-up services. The manufacturer shall state in writing that the installation is in accordance with the manufacturer's recommendation.

24. Field Testing.

a) Contract Documents shall call for field testing. Field testing shall consist of the following, as a minimum:

(1) Verify performance of each pump and motor. Provide all personnel, water, oil, grease, gauges, meters, test piping, calibration equipment and other test equipment necessary to substantiate that the equipment conforms to the Contract Documents. The District shall be present during all field testing.

(2) The final adjustments and inspections shall be made by factory-trained and authorized service personnel other than sales representatives, who also shall inspect the installation and test operation.

(3) The tests shall demonstrate that the equipment has been properly installed, aligned and connected, is free of mechanical defects, electrical defects, excessive vibration, overheating or overloading, and that the control system performs as specified and meets all operating criteria. All parts shall operate satisfactorily in all respects and in accordance with the specified requirements for the full duration of the test period. If any part of a unit shows evidence of unsatisfactory or improper operation during the test period, correction or repairs shall be made and the full operational test shall be redone for that unit after all parts operate satisfactorily.

(4) A field functional acceptance test shall be made of the entire pumping system, including instruments, controls, alarms, control strategy, motors, new pumps, and valves, to ensure compliance with the Contract Documents.

(5) The pumping station shall operate as described under the control strategy outlined in the Contract Documents.

25. Manufacturer Services. In addition to any other requirements outlined within these design standards, the following shall be specified within the Contract Documents:

a) The pump/motor manufacturer shall train District personnel at a factory owned facility on the proper maintenance and operation of the product. The District shall be certified to work on the product (pump and motor) being supplied by the manufacturer by a nationally recognized testing organization (UL or Factory Mutual) and by the manufacturer after successfully completing the two-day course. The training school at the factory shall consist of 16 hours. The manufacturer shall be responsible for all transportation, food and lodging expense associated with this training for up to four people. This training is in addition to the field training provided.

26. Manufacturer's Certificate. The Contract Documents shall call for a manufacturer's certificate of satisfactory installation to be provided to the District at project completion.

27. Warranty. The pump and motor manufacturer shall warranty the units against defects in the workmanship and material for a period of five years, or 10,000 hours, for both parts and labor at a prorated basis.

J. WETWELL SIZING AND CONSTANT SPEED vs. VARIABLE SPEED OPERATION

1. Submersible wastewater pump stations shall be constant speed unless directed otherwise by the District.

    a) Wetwells shall be sized for a maximum of 6 starts per hour regardless of whether or not the pump manufacturer states that additional starts per hour are acceptable.

    b) Pump shall operate on level. Pump control shall be accomplished through use of an ultrasonic level sensor. Floats shall be provided for emergency backup control, and shall include low level pump cutoff, high level and high-high level alarms.

    c) Under no circumstance shall the normal operating levels exceed the invert elevation of the lowest sewer entering the wetwell.

    d) The low water level for operation shall not be below the low water level recommended by the pump manufacturer for normal operation.

    e) If more than one duty pump is provided at the station, additional pumps shall be called to operate or turn off based on wetwell level.

    f) Constant speed pumps shall be selected to allow for operation near the pump’s best efficiency point.

2. If variable speed operation is required by the District, the Design Engineer shall obtain requirements for variable speed drives from the District. If variable speed drives are provided, each pump shall have its own independent variable speed drive, including the standby pump.

K. STANDBY POWER AND FUEL STORAGE

1. General.

    a) Standby power shall be required for all electric loads at the pump station upon an electric utility power outage to pump PWWF at buildout. Standby power shall be provided by an on-site diesel engine generator with automatic transfer switch capable of running all electrical equipment minus standby unit to pump PWWFs plus all miscellaneous station loads at buildout.

b) The generator size shall be determined using the specified manufacturer's sizing software. Sequencing of the loads shall be assumed and not all loads shall be allowed to start at once. The maximum voltage dip shall be 15 percent when using across the line or reduced voltage starters (reduced voltage starters shall be provided when required by PG&E), and 10 percent when using VFDs for motor controllers.

c) The engine shall be a CARB-EPA compliant diesel, four-cycle, fuel injection, compression ignition, liquid cooled with an integrally mounted radiator and fan, and shall operate satisfactorily on a commercial grade of No. 2 diesel. (It shall not require a premium fuel.)

d) The generator shall be heavy-duty industrial type, revolving field, single-bearing synchronous type with brushless exciter, and shall be suitable for standby duty under the conditions specified.

e) The standby generator shall include the following items:

(1) Engine cooling system. The engine shall be cooled by means of an engine-mounted radiator with pusher-type fan and shall be sized to maintain safe operation with incoming cooling air at 40-degree C maximum ambient temperature, with the engine at full load.

(a) Top access shall be provided for coolant filling/testing.

(b) Provide coolant recovery tank inside enclosure.

(c) Oil and coolant drain pipes shall extend outside of enclosure.

(2) Engine exhaust system.

(a) Silencer shall be rated as supercritical or better, if required to meet maximum sound levels. All noise requirements specified herein shall be met.

(b) Exhaust shall be provided with rain cap.

(3) Battery system including charger. The combined battery voltage shall be minimum 12 volts (nominal), unless otherwise approved by the District.

(4) Panel meter cluster consisting of ammeter, voltmeter, frequency meter, temperature gauge, oil pressure gauges, and fuel level gauge.

(5) Vibration isolators.

(6) Block heater with isolation valves. Provide silicon heater hoses from block heater to engine block.

(7) Weather enclosure if located outdoors. The District does not require the generator to be housed within a building, but such requirements may be imposed by the City of Fairfield/City of Suisun City/Solano County (as applicable). If the generator is housed within a building, the building shall be provided with suction and discharge louvers for adequate air supply, as well as all acoustical appurtenances to meet the noise requirements outlined herein. The building shall have a means for removal of the generator, as well as access for District operations and maintenance activities. The building shall be designed to meet all requirements of the City of Fairfield/City of Suisun City/Solano County Building Department and Fire Marshall as applicable.

(8) Acoustical requirements. Sound attenuation of the standby generator will be as required to meet the requirements of 70 dba (maximum) at 23 feet or at the property line, whichever is more stringent. If more stringent noise requirements are dictated by the City of Fairfield/City of Suisun City/Solano County for (as applicable), then such requirements shall be met. Consult City of Fairfield/City of Suisun City/Solano County (as applicable) for noise ordinance and requirements. Acoustical requirements shall be accomplished by providing an acoustical enclosure and appropriate exhaust silencer (supercritical or better) for the generator or providing acoustical specialties as required if the generator is located within a building.

(9) Fuel System.

(a) The standby generator shall be provided with fuel storage capacity for 72-hour (min) operation under full load. Fuel storage shall be accomplished by a double-contained, subbase type fuel tank located above grade below the generator unit. The subbase type unit shall be designed integral with the generator upon a single skid.

(b) The fuel tank shall be provided with leak detection and double-containment

(c) The fill location shall be provided with overfill protection and shall be located to facilitate deliveries of fuel. Fuel cap shall be lockable.

(d) Fuel system shall meet all requirements of the Fire Marshal and Solano County, including labeling.

(e) Any external fuel piping shall be black steel Schedule 40 (min), socket welded, and any buried fuel piping shall be provided with a double-containment system.

(f) The tank shall be delivered to the District full of fuel.

(10) Circuit Breaker.

(11) External Water Jacket Heater.

(12) Paint. The engine generator and/or enclosure shall receive a prime coat and two coats of industrial paint, per manufacturer's requirements, suitable for the intended use. Color of finish coat shall be selected by the District.

(13) Load Bank.

(a) Any generator 100 Kw or greater shall be provided with a resistive type load bank system, radiator-duct mounted or pad mounted, outdoor weather proof, complete with all power and pilot controls necessary to test and exercise the standby generator. The load bank shall be rated for 50 percent (minimum) of the size (Kw) of the standby generator. The power contactors shall be integral to the load bank and the pilot controls shall be provided in a separate enclosure. A load bank circuit breaker shall be mounted on the generator.

(b) The control panel shall control the load bank and shall include the following:

(1) AUTO-OFF-MANUAL control switch. In the AUTO position, the system shall be manually operated with automatic disconnect on loss of utility power. In the OFF position, the system shall be completely locked out or shut down. In the MANUAL position, the system shall be manually operated without regard for the utility power condition.

(2) Individual load step switches. The load bank systems shall allow application of load resistance in steps of 25 Kw.

(3) Master load switch. The master load switch shall be capable of simultaneous control of pre-selected load steps.

(4) Circuitry shall be included for accepting a dry contact closure signal from the generator control panel for disconnecting the load bank in the event of utility power failure.

(5) Provide red indicating lights to indicate each load step that is energized.

(c) The load bank shall be as manufactured by, or approved equal:

(1) Load Technology, Inc.

(2) Simplex, Inc.

(14) All items within the generator enclosure shall be located to allow access for operations and maintenance. Enclosure doors and removable panels shall be provided as applicable. All doors and panels shall be lockable.

(15) Transfer switches shall be as outlined under "Electrical, Controls, and Telemetry" within this Section of the design standards.

(16) Standby engine generator shall be manufactured by, or approved equal:

(a) Caterpillar.

(b) Cummins??.

(c) Kohler.

2. The Contract Documents shall include the following:

a) Service Requirements. The supplier of the generator set and the manufacturers of the component parts shall have representatives located within 100 miles of the installation that can provide regular service, inspection, spare parts, and emergency service.

b) Warranty.

(1) The work and equipment shall be guaranteed against defective materials, design, and workmanship.

(2) The manufacturer's authorized dealer shall be capable of administering the manufacturer's warranty for all components supplied.

(3) The manufacturer's and dealer's extended warranty shall be for a period of five years from date of acceptance of the system and shall include repair parts, labor, reasonable travel expense necessary for repairs at the jobsite, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Running hours shall not be a limiting factor for the system warranty by either the manufacturer or servicing dealer.

Submittals received without written warranties as specified will be rejected in their entirety.

(4) The generator set supplier shall have factory trained service representatives and tooling necessary to install, test, maintain, and repair all provided equipment.

c) Manufacturer's Services. A manufacturer's representative shall be present at the jobsite for assistance during construction, equipment startup, and testing.

d) Air Quality Requirements. The standby generator shall meet all of Bay Area Air Quality Management District's (BAAQMD) rules and regulations and a permit shall be obtained for the unit from the BAAQMD. If required, an emissions test shall be performed by BAAQMD at the Contractor's expense.

e) Spare Parts. Spare parts shall be provided as outlined in Appendix D, Spare Parts List.

f) Factory Test.

(1) The generator set, together with all controls and safety devices, shall be tested at the manufacturer's plant to determine conformance with the Contract Documents, including motor starting requirements.

(2) The factory test shall be performed on the standby generator with sound enclosure (if applicable) and automatic transfer switch together with all controls, contactors, and safety devices. The automatic transfer switch may be simulated by external contact closures.

(3) All factory test results shall be submitted to the District for review prior to shipment of the equipment.

g) Operational Readiness Test.

(1) Prior to startup, all equipment and systems specified under this Section shall be inspected and tested to show that they are ready for operation. The Operational Readiness Test shall include testing of the standby generator, automatic transfer switch, fuel system, and other equipment and subsystems.

h) Field Test.

(1) Once the facility has been started up and is operating, and after written confirmation by the Contractor that the Operational Readiness Test has been completed, a witnessed field test shall be performed on the equipment and systems specified to

demonstrate that they are operating as specified and meet the requirements of the specifications.

(2) The field test shall operate all equipment and systems over the full operating range, shall demonstrate proper operation of alarms and indicators, and, in general, shall demonstrate that the equipment and systems meet the requirements of the Contract Documents.

(3) The field test shall demonstrate under actual operating conditions, that operation is satisfactory without overheating of any part and that the equipment is free from excessive vibration throughout the entire range of speed and load.

(4) The generator set shall be operated at rated standby service load for a period of not less than 2 hours, and all necessary adjustments shall be made by the generator-set supplier. This test shall demonstrate the ability of the set to satisfactorily carry its rated load and to meet requirements for motor starting. If provided, the load bank shall be used during testing.

(5) If any equipment or system fails the field test, the Contractor shall correct the problem and shall repeat the test until it is successful.

(6) The field test shall be performed in the presence of the District. Schedule the test date with District staff a minimum of 10 working days in advance.

(7) After completion of the field test, the Contractor shall prepare a test report and shall submit it for review. The system will not be accepted before the field test is successfully completed and the test report submitted and reviewed by the District.

i) Manufacturer's Certificate. A manufacturer's certificate of satisfactory installation shall be provided to the District.

3. Portable Generator Receptacle.

a) In addition to a permanent standby generator, a manual transfer switch (MTS) with receptacle for a portable generator shall also be provided.

b) The plug shall be Appleton Powertite Receptacle (for model number, refer to Appendix E).

c) Design Engineer shall coordinate with District for standard wiring configuration for portable generator connection.

d) In addition, provide 220V, 1Ø plug for block heater and battery charger.

L. PIPING, VALVES, AND APPURTENANCES

1. Piping.

   a) General. All piping on the pump station site shall be suitable for its intended purpose and pressure. All hardware used on piping shall be Type 316 stainless steel.

   b) Fuel Piping. All diesel fuel piping shall meet the requirements outlined under Section entitled "Standby Power and Fuel Storage", included herein.

   c) Gravity Sewers. All gravity sewer piping 12 inches in diameter and larger shall meet the requirements specified within Section VIII of this document, unless specifically stated otherwise within this Section. All gravity sewers less than 12 inches in diameter shall meet the requirements of the City of Fairfield/City of Suisun City/Solano County (as applicable).

   d) Sewer Forcemains. All sewer forcemains on the pump station site shall meet the requirements specified below, unless specifically stated otherwise within this Section.

   e) Pump Discharge Piping and Sewer Forcemain Piping on Site.

      (1) All pump discharge and forcemain piping and fittings on site shall be ductile iron and shall be provided with flanged or rigid grooved end (victaulic) joints at exposed locations and flanged joints at buried locations, unless otherwise indicated herein. Grooved end couplings shall be provided within vaults at strategic locations to facilitate removal of flowmeter and valves.

      (2) Ductile iron pipe and fittings shall be Class 53 (minimum) conforming to the requirements of AWWA C150 and AWWA C151 for pipe, and AWWA C110 for fittings. Flanged ductile iron pipe and fittings shall conform to the requirements of AWWA C115.

      (3) Prior to exiting the pump station site, the pipe material shall transition to the material, and meet requirements, outlined within Section IX of these design standards.

      (4) All ductile iron piping located within the wetwell, buried or exposed, shall be lined and coated with factory applied fusion bond epoxy (16 mils minimum).

      (5) For exposed piping, including piping located within valve and flowmeter vaults, additional coating shall be applied over fusion bond epoxy for color and UV protection.

      (6) For buried ductile iron piping, polyethylene film conforming to AWWA C105, Type 1, Class C (black), Grade E1, 8 mils

(minimum) shall be provided on fusion bond epoxy coated ductile iron pipe.

(7) For all buried piping and fittings, wrap with a self-adhesive corrosion tape wrap, minimum 10 mils thick.

(8) All hardware shall be Type 316 stainless steel.

f) Generator Exhaust Piping. Generator exhaust piping shall be Type 316L stainless steel, schedule 10.

g) Potable Water Piping. Buried potable water piping and fittings shall be schedule 80 PVC with solvent weld joints. Exposed potable water piping and fittings shall be painted, galvanized steel, with threaded joints.

h) Wetwell Vent Piping. Wetwell shall be provided with vent pipe. Vent pipe shall run underground to fenceline prior to extending above grade. Provide U-Vent above grade with bird screen. Vent shall be ductile iron.

(1) Ductile iron pipe and fittings shall be Class 53 (minimum) conforming to the requirements of AWWA C150 and AWWA C151 for pipe, and AWWA C110 for fittings. Flanged ductile iron pipe and fittings shall conform to the requirements of AWWA C115.

(2) All ductile iron piping shall be lined and coated with factory applied fusion bond epoxy (16 mils minimum).

(3) For exposed piping, additional coating shall be applied over fusion bond epoxy for color and UV protection.

(4) For buried ductile iron piping, polyethylene film conforming to AWWA C105, Type 1, Class C (black), Grade E1, 8 mils (minimum) shall be provided on fusion bond epoxy coated ductile iron pipe.

(5) All hardware shall be Type 316 stainless steel.

2. Valves.

a) General. All valves on pump station site shall be suitable for intended service and pressure.

b) Pump Discharge Valves. Each pump shall be provided with a discharge swing check (external lever and weight type) valve and isolation eccentric plug valve. Such valves shall be exposed and located within a lockable, hatched H20 rated valve vault on the pump station site. See typical submersible pump station sewage schematic in Appendix A.

c) Emergency Bypass Valves. An emergency bypass connection to the forcemain piping on site as specified within this document shall be provided with a swing check (external lever and weight type) valve and an eccentric plug valve. Such valves shall be located within valve vault. See typical submersible pump station sewage schematic in Appendix A.

d) Pump Backflush Valve. Eccentric plug valves shall be provided between adjacent pump discharge pipes upstream of their associated discharge check valves to allow a pump to backflush the adjacent pump. Such valves shall be located within the valve vault. See typical submersible pump station sewage schematic in Appendix A.

e) Fuel Valves. Valves within fuel piping shall be metal seated globe valves.

f) Miscellaneous Small Valves. Miscellaneous small valves shall be globe valves or gate valves, as applicable.

g) Wastewater Valves. All isolation valves to be used within the forcemain or on wastewater piping shall be eccentric plug valves.

h) Eccentric Plug Valves.

(1) Plug valves shall be of the non-lubricated eccentric type with cast iron bodies, conforming to ASTM A126, Class B. Plugs shall be resilient faced (Buna-N) and suitable for their intended service. Valves shall be furnished with welded overlay seats of not less than 90 percent nickel in accordance with AWWA C507. Sprayed, plated, or screwed seats are not acceptable. Valves shall be furnished with sleeve type bearings. Bearings shall be constructed of Type 316 stainless steel, conforming to ASTM A743, Grade CF-8M, furnished with permanently-lubricated bearing surfaces. All valves for sizes 4 inches and larger shall have worm gear operators and flanged ends, in accordance with ANSI B16.1. All valves 3-inch and smaller shall have operating levers and screwed or flanged ends. All buried valves and valves in the valve box shall be equipped with worm gear operators, lubricated and sealed to prevent entry of dirt or water into the operator and shall be provided with 2-inch operating nuts. All exposed valves not located within valve box shall be provided with levers or handwheels. All valves less than 24 inches in diameter shall have an unobstructed port area of not less than 80 percent of full pipe area. All eccentric plug valves 12 inches and smaller shall have a pressure rating of not less than 175 psi WOG, for bubble-tight shut-off. Each valve shall be given a hydrostatic and seat test. All operators shall indicate valve position. All valves with 2-inch operating nuts shall be provided with position indicator at 2-inch nut.

(2) Plug valves shall be manufactured by Milliken or DeZurick.

i) Swing Check Valves.

(1) All check valves 2 inches and larger shall be swing check valves and shall be of the external lever and weight type, designed for a water-working pressure of 150 psi (minimum) and shall have a flanged cover piece to provide access to the disc. All ferrous surfaces of valves shall be factory fusion bonded epoxy lined and coated in conformance with AWWA C550 and C213.

(2) All check valves shall be designed for operation in either horizontal or vertical flow up position.

(3) The valve body and cover shall be ASTM A126, Class B, cast-iron, flanged end. The valve seat shall be stainless steel (ASTM A276) and locked in place with stainless steel screws and be field replaceable without the use of special tools. The disc and seats shall be field replaceable without disconnecting either inlet or outlet flanges.

(4) The valve disc shall be ductile iron, ASTM A536 or cast-iron, ASTM A126, Class B utilizing a double clevis and connected to a ductile iron disc arm. Disc arm shall be ductile iron, ASTM A536. The disc seat shall be resilient Buna-N and shall be easily replaceable in the field without the use of special tools. Disc seat shall provide for watertight shut-off. Hinge pins shall be stainless steel. The lever and weight shall be so constructed and so positioned that it can operate without interference by any piping, supports, or equipment.

(5) The pivot shaft shall be continuous stainless steel, and fully extended from the body. Four mounting holes shall be provided on the side of the valve body for future provisions of air or oil cushion cylinder. The shaft supplied shall be sized to accommodate forces generated by the dampening unit (oil or air) that will create the largest forces.

(6) Check valves shall be suitable for intended use.

(7) Swing check valves shall be as manufactured by, or approved equal:

(a) Apco Valve.

(b) Golden Anderson Industries.

(c) Milliken CCNE

j) "Duckbill" Check Valves. Duckbill type check valves shall be used on all lines discharging into the wetwell, except sanitary sewer lines. The duckbill check valves shall be used to prevent wastewater or fumes within the wetwell from exiting into other structures, catch basins,

etc. Duckbill check valves shall be manufactured by Red Valve Tideflex, or approved equal.

k) Hose Bibbs. Hose bibbs, hose racks, and hoses shall be provided for washdown with potable water. Backflow preventors, water meters, etc., as required by City of Fairfield/City of Suisun City/Solano County (as applicable) for potable water service, shall meet the requirements of the applicable water utility.

l) Combination Air Release and Vacuum Valves.

(1) Combination air release and vacuum valves shall be provided at all high points within pump discharge piping and sewer forcemain piping. Combination air release and vacuum valves shall be sized and specified for their exact application, minimum size shall be 4-inches. All valves shall be specifically designed and recommended for use on raw wastewater.

(2) High points within pipelines shall be minimized.

(3) Installation for combination air release and vacuum valves shall include isolation plug valve.

(4) Combination air release and vacuum valves may be either installed above grade inside a lockable ARV enclosure shall as fabricated by Placer Waterworks, Inc. (where not in conflict with existing facilities and as allowed by the District); or inside accessible Maintenance Holes. (Refer to Maintenance Holes design and construction sections for requirements.)

(5) If high water table is below bottom of valve (per geotechnical report), then valve may be placed within below-grade precast box (with adequate space within box for maintenance and removal). Box shall be located out of main traffic ways, but shall be rated for H20 loading. If high groundwater precludes the installation of the valve below grade, then valve shall be located above grade within padlockable enclosure suitable for outdoor exposure. Adequate space within enclosure shall be provided for maintenance and removal.

(6) All piping between sewer forcemain piping and combination air release and vacuum valves shall be Type 316 stainless steel piping and fittings rated for the sewer forcemain test pressure.

(7) Combination air release and vacuum valves shall be manufactured by A.R.I.

m) Buried Valves. All buried valves shall be provided with valve pot, extension stem, 2-inch AWWA nut, and position indicator and shall be designed for buried service.

n) Exposed Valves. All exposed valves in valve boxes or above grade shall be provided with lever or handwheel. Any valve located within below grade valve box shall be suitable for submerged service. All exposed valves shall have position indicator for visual verification of valve position.

o) Actuators. All valves shall be manual unless specified otherwise by the District. Any valve installed with the valve operator center line more than 5-foot 0-inches above the operating floor shall be provided with a chain wheel operator. Manual valve operators shall be designed for not less than 125 percent of the operating torque required for the service. Handwheels shall be sized to require an operating force of not more than 40 pounds, and shall have arrows cast thereon to indicate the direction of rotation for opening the valve.

p) Spare Parts. Spare parts shall be provided as outlined in Appendix D, Spare Parts List.

3. Pipe and Valve Linings and Coatings.

a) Design Engineer shall follow lining and coating requirements for gravity sewers and sewer forcemains as indicated within this document. In addition, lining and coating requirements for other piping as indicated above, shall follow the requirements set forth within this document. If a piping system is used for which no requirements are given, contact the District for the coating and lining system to be used.

b) The Design Engineer shall develop lining and coating specifications for all piping and valves to be installed. Such specifications shall specify appropriate linings for the service provided and coating specifications shall specify appropriate coatings for the environment, including but not limited to exposed, buried, or wetwell location.

c) Refer to requirements outlined under Protective Coatings for additional standards.

4. Pressure Gauges.

a) A discharge pressure gauge shall be provided within the valve vault downstream of all pump check valves. See typical submersible pump station sewage schematic in Appendix A.

b) Gauges shall be suitable for wastewater service. Gauges shall be provided with 1/2 inch bottom connections. Gauges shall be minimum of 4-1/2 inches in diameter. Pressure gauges shall be liquid filled and provided with iso-ring seal and accurate to 1/2 percent full scale. All wetted parts shall be Type 316 stainless steel.

c) Gauges shall be provided with suitable range in psi.

d) Gauges shall be provided with phenolic case. All gauges shall be provided with quarter turn Type 316 stainless steel isolation ball valve. Gauges shall be manufactured by, or approved equal:

(1) Ashcroft Duragauge (for model number, refer to Appendix E).

5. Geotextile Filter Fabric

a) The contractor shall install nonwoven geotextile filter fabric between the Bedding and Backfill material in such a manner to prevent migration of the backfill material into the bedding whenever Crushed Rock is used as bedding.

b) Filter fabric shall meet or exceed the following specifications:

TRENCH FILTER FABRIC			
Property	**ASTM Test Method**	**Nonwoven Minimum Average Roll Value (English)**	**Nonwoven Minimum Average Roll Value (Metric)**
Grab Tensile Strength	D4632	112 lbs	500 newtons
Trapezoidal Tear Strength	D4533	40 lbs	180 newtons
Puncture Strength	D4833	40 lbs	180 newtons
Permittivity	D4491	1.5 sec^{-1}	1.5 sec^{-1}
Apparent Opening Size (AOS)	D4751	Maximum #70 sieve	Maximum 0.212 minimum
UV After 500 Hours	D4355	70%	70%
[1] All values in this table are the minimum values allowed in each direction except as noted, and are based on Minimum Average Roll Value (MARV).			

c) Filter fabric installation requirements:
(1) Trench filter fabric shall be installed in such a manner to prevent migration of fines.
(2) Adjacent rolls shall be overlapped a minimum of 24” in the longitudinal and transverse directions.

d) Crushed Rock gradation requirements:
(1) 90% of the aggregate shall have at least one fractured face.
(2) 75% of the aggregate shall have at least two fractured faces.
(3) 50% of the aggregate shall have at least three fractured faces.

CRUSHED ROCK GRADATION REQUIREMENTS	
Sieve Size	**Percent Passing**
1 inch	100
¾ inch	90-100
½ inch	20-50
No. 4	0-5

M. STRUCTURES

1. At a minimum, the pump station site shall contain the following structures:

    a) Wetwell.

    b) Discharge valve vault (also includes emergency bypass pump connection and associated valves). See submersible sewage pump station schematic in Appendix A.

    c) Flowmeter vault.

2. Other structures such as buildings for generator and electrical equipment may be required by the City of Fairfield/City of Suisun City/Solano County (as applicable). Consult City of Fairfield/City of Suisun City/Solano County (as applicable) for structural and aesthetic requirements for thesubmersible wastewater pump station prior to starting design.

3. All structures shall be designed meeting all applicable codes and regulations and requirements of the City of Fairfield/City of Suisun City/Solano County (as applicable). All structures shall be designed, stamped, and signed by a Structural Engineer licensed in the State of California. All structures shall be designed for seismic Zone 4.

4. Concrete for structures, slabs, etc., shall be reinforced concrete made with Type II or Type V Portland cement with a minimum compressive strength of 4000 psi. Structures may be cast-in-place or precast.

5. All below grade penetrations into structures shall be provided with watertight penetrations such as link seals or wall pipes with weep rings. Pipe penetrations into wetwell shall not be within one foot of any structural joint.

6. All hydraulic structures shall be tested as outlined within this document for manholes.

7. Bedding and backfill requirements for structures shall be specified by the Design Engineer in accordance with the recommendations of the geotechnical report. The Design Engineer shall include requirements within the Contract Documents for compaction testing of materials during construction. Compaction testing shall be provided by an independent firm and compaction test reports shall show conformance with the requirements of the Contract Documents and shall be submitted to the District.

8. Wetwell.

    a) The wetwell shall be below grade and shall be constructed of precast manhole sections, precast concrete, or a cast-in-place concrete structure. The structure shall be rated for H20 loading. If manhole sections are used, wetwell shall meet the requirements outlined for manholes within Design Standards for Gravity Sewers, as applicable.

b) The wetwell shall be accessible for removal of pumping equipment. Type 316 stainless steel H20 rated hatch(es) shall be provided over pumping units for access.

c) All interior wetwell surfaces except bottom slab shall be PVC T-lock lined for corrosion protection. PVC T-lock shall meet the requirements for Plastic Lining for Manholes and Structures under Manholes within Design Standards for Gravity Sewers.

d) The wetwell shall be constructed with painted level calibration lines to be used during start-up for the calibration of level sensing instruments.

9. Vaults.

a) Vaults shall be located below grade for discharge valves, emergency bypass pump connection and valves, and flowmeter. Vaults shall be designed for H20 loading and provided with H20 rated aluminum hatches to provide access for maintenance and operation and equipment removal. Vaults shall be provided with ladders.

b) Vaults shall be provided with means for drainage. Drainage shall be routed to the wetwell by either permanent sump pump on level control or gravity drain with duckbill check valve. If sump pump is provided, it shall be controlled by intrinsically safe float switches for start, stop, and high water alarm. Bottom slabs shall slope to drain or to sump.

10. Other Structures.

a) Design of other on-site structures as dictated by City of Fairfield/City of Suisun City/Solano County (as applicable) shall be designed meeting all requirements outlined above. Such structures shall be designed to facilitate access for District operations and maintenance and removal of equipment.

b) All above-grade equipment, including electrical panels, shall be installed on concrete equipment pads. MCC and PLC shall be installed beneath canopies and overhangs for sun and rain protection.

c) All exposed concrete slabs and walk surfaces shall be provided with broom finish.

11. Hatches.

a) Hatches shall be gutter type. The design live load shall be rated for AASHTO H2O wheel loading for all hatches. Maximum deflection shall be $1/150^{th}$ of the span, unless noted otherwise.

b) Hatch opening sizes, number and direction of swing of door leaves, and locations, shall be shown on the Contract Documents. Clear

openings shall be provided for removal of equipment below when lifting straight up. Openings larger than 42 inches in either direction shall have double-leaf doors. Hinges shall be located to allow access for removal of equipment and to allow site lighting to illuminate vault.

c) Door leaves shall be diamond pattern plate. Channel frames shall be provided with an anchor flange around the perimeter. Hatches shall be provided with an automatic hold-open arm with release handle. Double leaf hatches shall be provided with safety bars to go across the open sides of the hatch and fall protection safety gratings including hardware to lock gratings in the open position when required. When in the open position, brackets shall be provided on the underside of the hatches to hold the safety bars when not in use. Doors shall be equipped with heavy forged brass hinges having stainless steel pins and pivot so that the cover does not protrude into the channel frame.

d) Hatches shall be designed for each opening by one person from both inside and outside and shall be balanced to require no more than 30 pounds of opening force. Compression spring operators enclosed in telescopic tubes shall be provided for smooth, easy, and controlled door operation throughout the entire arc of opening and closing. Hatches shall be provided with a recessed padlock compartment.

e) Hatches shall be designed for flush mounting.

f) Hatches shall be designed to be water-tight and shall be equipped with a joint gutter and a moat-type edge drain. A 1-1/2 inch diameter (minimum) drain connection shall be provided. Hatches shall be gasketed. Gasket material shall be suitable for use outdoors.

g) Hatches shall be of material stated above. All hardware shall be Type 316 stainless steel. Hatches shall be manufactured by Bilco or approved equal.

12. Dewatering for all structures shall be as described in Section II, S. DEWATERING.

N. ODOR CONTROL

1. Odor control for the wetwell may be required. Odor control may be required due to initial low flows into the station, long detention times, proximity to current or future residence, etc. Design Engineer shall contact the District prior to any design work to determine the requirements for the odor control system. Acceptable odor control systems may include packaged biofilters, odor control soil bed, etc. Due to the visual impact of the odor control system, the City of Fairfield/City of Suisun City/Solano County (as applicable) planning department should also be consulted prior to design.

2. All items of an odor control system should be designed for constituents normally found in raw wastewater. All materials used on the system shall

be designed for the corrosive environment. Acceptable materials of construction may include PVC, fiberglass, and Type 316 stainless steel.

3. The odor control unit/system shall be designed to prevent odors from exiting the pump station site.

O. NOISE

1. All equipment, including the standby generator, shall be designed for 70 dba (minimum) at 23 feet. Any additional enclosures or acoustical specialties, etc. needed to meet these requirements shall be provided. If more stringent noise requirements are dictated by City of Fairfield/City of Suisun City/Solano County (as applicable), then such requirements shall be met. Consult City of Fairfield/City of Suisun City/Solano County (as applicable) for noise ordinance or specific requirements for the project. Design Engineer shall implement designs that satisfy both the functional requirements of the District and meet the noise requirements. Equipment that may affect sound levels at the pump station includes, but is not limited to, standby generator, odor control equipment, and surge control equipment. Sound attenuation enclosures shall be designed to facilitate operation and maintenance of equipment.

P. FLOW MEASUREMENT

1. Flow measurement shall be provided at all submersible wastewater pump stations. Flow measurement shall include:

    a) Provide magnetic flowmeter. The magnetic flowmeter shall consist of a flow element, transmitter, and interconnecting cable. The flow element shall be suitable for use with raw wastewater and shall be of the electromagnetic type, utilizing the pulsed dc-type coil excitation principle with high pre-amp input impedance. The flow measuring system, which consists of flow element, transmitter, and appurtenances, shall cover the expected range from minimum flows at startup to peak wet weather flows at buildout and shall have an overall accuracy of plus or minus 0.5 percent of rate of all flows resulting from pipe velocities in the range of 1.5 to 30 feet per second and plus or minus 1 percent or better for flows resulting from fluid velocities in the range of 1 to 1.5 feet per second.

    b) The system shall be calibrated such that transmitter output of 4 to 20 milliamps corresponds to a flow range of zero to the specified flow range noted.

    c) The flowmeter shall operate on 120 volts, 60 Hz, plus or minus 10%. The same power source shall supply both the flow element and the transmitter, with the power source connected at the transmitter.

    d) The unit shall incorporate an empty pipe detection feature and shall have output damping to provide a means to reduce the frequency response of the transmitter.

e) The flow element shall be of watertight construction and shall operate and meet the requirements of the Specifications during and after continuous submergence in 5 feet of water.

f) The flow element shall consist of a meter tube, 150-pound ANSI carbon steel raised-face flanges, polyurethane or neoprene liner, and Type 316 stainless steel electrodes. Suitable covers shall be provided for flow element ends to protect the tube liner during shipment. Each unit shall be furnished with a grounding ring on the inlet side of the flowmeter to protect the leading edge of the flowmeter's liner from erosion due to scouring action of the raw wastewater.

g) The transmitter shall be microprocessor-based and shall indicate, totalize, and transmit flow. The transmitter output shall be a 4 to 20 mA dc signal in linear proportion to flow. It shall drive loads with impedances in the range of 0 to 800 ohms without adjustments. Readout shall be a liquid crystal display. The transmitter shall be remote from the flow element and shall be suitable for backpan or wall mounting.

h) Sufficient special cable(s) shall be provided for interconnection between the flow element and the transmitter. Cable(s) shall facilitate both signal and power for the flow element.

i) The flowmeter shall be Siemens SitransFM, or approved equal.

j) Remote flow measurement reading shall be transmitted through SCADA.

k) Flowmeter shall be same diameter as the forcemain, unless granted otherwise by the District.

l) No flow recorder shall be required.

2. Flowmeter element shall be located within the sewer forcemain piping on site and all flow shall pass through the meter. The appropriate length of upstream and downstream straight piping run shall be provided to ensure accurate readings.

3. Flowmeter shall be located within below grade concrete vault with H20 rated aluminum hatch. Vault shall be padlockable and located within the fenced site. Vault shall be sized to accommodate maintenance and meter removal.

4. The flowmeter shall be removable from the vault, either through the use of a restrained sleeve type coupling, restrained flange coupling adapter, or rigid grooved end (vic) coupling.

5. An eccentric plug isolation valve shall be provided downstream of the flowmeter vault within the fenced site.

6. A sewer forcemain pipe spool of appropriate diameter, length, and joint type shall be provided to District for use when flowmeter is removed from pipeline for service.

Q. pH MONITORING

1. pH monitoring may be required at all pumping stations that serve any non-residential facilities. The pH monitoring system shall be Rosemount (for model number, refer to Appendix E) and design of system shall be as approved by the District. pH readings shall be tied into SCADA.

R. SAMPLING

1. Provisions for the addition of future sampling of the wetwell shall be incorporated into the pump station design. At a minimum, the following shall be provided.

    a) Space for future portable sampler.

    b) Electrical outlet/ receptacle for future sampler.

    c) A two-inch PVC conduit embedded through top of wetwell. Conduit shall be flush with top of wetwell and shall extend into the wetwell a minimum of two feet. The conduit shall be plugged with an electrical cap flush with the wetwell surface.

S. EMERGENCY BYPASS PUMP CONNECTION

1. An emergency bypass pump connection shall be provided at the pump station to allow a District owned portable pump to pump into the forcemain upon a catastrophic failure at the pump station.

2. The connection shall be located downstream of all pump check and isolation valves. The connection shall be located inside the pump discharge valve vault. The connection point shall be accessible by the District for connection to a portable pump.

3. Connection shall consist of a tee off of the forcemain or one of the pump discharge pipes after all pump valves. The tee shall be provided with a lever and weight swing check valve and an eccentric plug valve. After the plug valve, a short pipe spool shall be provided with grooved end (vic) cap.

4. All piping and valves shall be same size as forcemain or discharge piping to which it connects, unless indicated otherwise by the District.

5. Refer to submersible pump station sewage schematic in Appendix A.

T. SURGE PROTECTION

1. A surge analysis of the pump station and associated forcemain system shall be performed for the pump station prior to detailed design. The surge

analysis will determine if potentially damaging surge conditions may occur. Such conditions often occur from a power failure or a fast closing valve. If a potentially damaging surge condition could be encountered, surge protection shall be designed for the station. Surge protection may consist of a surge tank(s) or other method of protection acceptable to the District.

2. Prior to or at the 50 percent design submittal the surge analysis data, results, and recommendations shall be submitted to the District for review.

U. CATHODIC PROTECTION

1. Based on the design standards outlined, cathodic protection is not envisioned for the facilities at the pump station site. If specific site conditions are present (e.g. existing C.P. systems in the area, corrosion soils or overhead high voltage lines), a cathodic protection specialist shall be utilized to analyze the site conditions and design a cathodic protection system if warranted.

V. MATERIALS OF CONSTRUCTION

1. General. Materials of construction shall be specified for their intended use and installation location. Where indicated otherwise within these standards, such materials of construction shall be used.

2. Miscellaneous metalwork and hardware:

   a) All hardware including bolts, nuts, washers, etc. used in buried applications, within the wetwell, or on forcemain piping regardless of location, shall be entirely constructed of Type 316 stainless steel.

   b) Exposed hardware including bolts, nuts and hardware not conforming to conditions stated above, may be galvanized steel.

   c) All miscellaneous metalwork including pipe supports, etc. located within the wetwell or buried shall be fabricated entirely from Type 316 stainless steel.

   d) Exposed miscellaneous metalwork not located within the wetwell or buried may be constructed/fabricated from steel and then hot-dipped galvanized and painted.

3. All equipment to be installed in the wetwell shall be suitable for the atmosphere and its intended use and shall meet the classification requirements of the wetwell.

W. PROTECTIVE COATINGS

1. Contract Documents shall be prepared that include protective coatings of all surfaces, including all surface preparation, pretreatment, coating application, touch-up of factory-coated surfaces, protection of surfaces not to be coated, cleanup, and appurtenant work.

2. The following surfaces shall not require protective coating:

    (1) Concrete, unless otherwise specified

    (2) Stainless steel

    (3) Machined surfaces and bearings

    (4) Grease fittings

    (5) Glass

    (6) Equipment nameplates and tags

    (7) Traffic boxes

    (8) Gratings and frames, checker plates, hatches, stair treads, door thresholds, and other walk surfaces

    (9) Aluminum handrails

    (10) Rubber hoses and rubber assemblies

    (11) Fiberglass, unless otherwise specified

    (12) Wiring

    (13) Existing surfaces, unless specifically identified to be recoated or if existing coatings are damaged due to the work of this contract.

    (14) All other surfaces shall be protective coated.

3. Coatings and linings used in conjunction with potable water (1W) supply system shall have Environmental Protection Agency (EPA) approval for use with potable water and shall not impact a taste or odor of the water.

4. Specifications shall state that the protective coatings applicator shall possess a valid state license as required for performance of the painting and coating work and shall provide 5 references which show successful experience with the specified or comparable coating systems. Include the name, address, contact name, and telephone number for the Owner of each installation for which the protective coating was provided. Outside independent inspection services for all coatings to be submerged or to be used in a corrosive environment shall be provided by the Contractor at his expense.

5. Inspection Devices. Specifications shall state that the Contractor shall furnish, until final acceptance of coatings, inspection devices in good working condition for the measurement of dry-film thicknesses and holiday inspection of protective coatings. Dry-film thickness gauges shall be made available for the District's use at all times while coating is being done, until final acceptance of such coatings.

6. Specifications shall state that a warranty be provided that there shall be no evidence of blistering, running, peeling, scaling, chalking, streaking, stains or evidence of other coating related defects at the end of one year warranty period.

7. In any coating system, only compatible materials from a single manufacturer shall be used in the work. Particular attention shall be directed to compatibility of primers and finish coats.

8. Protective Coating Materials. Products shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Where requested, the Contractor shall provide the District with the names of not less than 10 successful applications of the proposed manufacturer's products demonstrating compliance with this specification requirement.

9. The protective coating systems to be used are included in Appendix F, including product to be used, surface preparation requirements, and minimum dry film thickness (DFT). All colors shall be approved by FSSD/City of Fairfield/City of Suisun City/Solano County (as applicable). If a specified coating system does not meet the current local, state, and federal air pollution rules and regulations at the time of design, the Design Engineer shall submit a substitute coating system for review by the District. In addition, additional coating systems shall be added as appropriate for the items on the given project.

10. Contract Documents for protective coatings shall include requirements for:
    (1) Surface preparation for:
    (2) Metal surface preparation (ungalvanized).
    (3) Galvanized ferrous metal.
    (4) Ferrous surfaces with existing coatings.
    (5) Plastic, fiberglass, and nonferrous metals.
    (6) Shop coating requirements.
    (7) Application of coatings.

    b) Curing of coatings.

X. ELECTRICAL, CONTROLS, AND TELEMETRY

1. The design and installation shall be based upon the latest version of the National Electric Code. The Design Engineer shall include the following information in the Contract Documents:

    a) Technical specifications for all equipment required on the project, standards for installation, and programming narratives.

    b) Site plans, single line diagrams, panel schedules, equipment elevations, wiring diagrams, and installation details.

    c) Conduit and wire routing schedule.

d) Hazardous area (and boundaries) shall be shown on the drawings on the electrical site plan.

e) Locations for seal fittings shall be shown on the drawings on the site plan.

f) Load calculations shall be shown on the drawings.

g) Utility contacts shall be shown on the drawings.

h) Symbols and abbreviations.

i) Sample interconnection wiring diagram.

2. Descriptive nameplates shall be provided for all equipment, disconnects, operators including all internal components housed in control panels, motor control centers, and other panels. Nameplates shall be plastic, multilayer with engraved lettering. Nameplates shall be attached with stainless steel screws.

3. The service ground shall be an electrode type (Ufer) install under the motor control center or pedestal pad. Antenna masts, metal fences and gate shall be connected to the service ground by a #2/0 or larger bare copper conductor. All panels, pedestals and motor control center Sections shall include a ground bus. All conduits shall include a ground wire.

4. Conduits. Exposed conduit shall be rigid steel type. Risers and elbows shall be rigid steel. Conduits under building footings shall be rigid steel. Conduits buried and encased in concrete but not associated with the wetwell or the seal-off fittings shall be PVC type. Conduits between wetwell and seal off shall be PVC coated rigid conduits. All below grade conduits shall be provided with plastic spacers and be encased in red reinforced concrete ductbanks. Spare conduits shall be provided for any "future" equipment shown on the plans. In addition, a minimum of one spare conduit from the MCC to the wetwell for controls and pump feed shall be provided as well as one spare conduit from the MCC to the generator. Stub-outs shall be provided for each freestanding outdoor motor control center and location markers shall be provided. The Contract Documents shall include that the Contractor shall mandrel all conduits prior to installation of conductors. Provide warning tapes in all trenches above conduits and duct banks. Conduit and conductor schedules shall be shown on the drawings. Conduit installation details and conduit routing shall be shown on the drawings. Equipment designations shall be consistent between the conduit schedule, the various sheets in the drawing set and the specifications.

   a) The method of installation of pump cables, seal-off fittings, junction boxes and cord compression fittings shall not require the pump cable to be cut or damage in order to remove the pump from the wetwell for service off site. The pump cables shall not be installed in seal-off fittings. Pump cables shall be reachable from outside wetwell access hatch(es) and wetwell entry shall not be required.

b) Junction boxes shall be installed above the wetwell. Boxes that might be exposed to gases from the wetwell shall be rated NEMA 7. Other boxes, mounting brackets and hardware shall be constructed of Type 316 stainless steel. All conduit installed between the seal-off fittings and the wetwell shall be PVC coated rigid steel type. Conduit attached to the seal-off fitting shall be PVC coated rigid steel type.

5. All power and control cable shall be stranded copper with THWN/THHN insulation rated for 600 V. Signal cables shall be twisted shielded pairs, #16 awg with 600 V insulation. All wire shall be labeled and color coded.
   (1) All feeders shall be installed without the use of splices.
   (2) All wire in control panels, other panels, MCCs, switchboards, boxes and instrument enclosures shall be labeled. Label designations shall be consistent with approved shop writing diagrams.

b) All wire exiting control panels, MCCs, switchboards, boxes and instrument enclosures shall be labeled. Label designations shall be consistent with approved interconnection wiring diagrams with matching labels at each end of the wire.

c) Labeling method shall be machine imprinted heat shrink tubing. Contractor shall label all wire per wiring diagrams and interconnection wiring diagrams. The Contract Documents shall include requirements that the Contractor shall submit labeling method to the District for review and approval. Both ends of each wire shall be labeled with identical labels.

d) The color code of all wire shall conform to the following table:

WIRE COLOR CODE TABLE

DESCRIPTION	PHASE/CODE LETTER	FIELD WIRE /WIRE OR TAPE COLOR	NON-FIELD WIRE COLOR
480 V, 3 Phase	A	Brown	Brown
	B	Orange	Orange
	C	Yellow	Yellow
240 V or 208 V, 3 Phase	A	Black	Black
	B	Red (Orange if high leg)	Red (Orange if high leg)
	C	Blue	Blue
12 V Positive	12P	Dark Blue	Dark Blue
12 V Negative	12N	Black/Red Stripe	Black/Red Stripe
24 V Positive	24P	Blue	Blue
24 V Negative	24N	Brown	Brown
240 / 120 V, 1 Phase	L1	Black	Black
	L2	Red	
AC Control	CNTL	Violet	Red (Yellow for foreign circuits)
DC Control		Blue	Blue
Neutral	N	White	White

Ground	G	Green	Green
Shielded Pair	+	Black	Black
	-	White	White

Note: 1. High leg of open delta shall be colored orange per NEC 215-8.

6. The electrical equipment line up shall include a switchboard, motor control center and control panel. The equipment enclosures shall be rated NEMA 12 where mounted indoors and NEMA 3R where mounted outdoors.

   a) The switchboard shall consist of the pull section, meter section, and transfer switches. Automatic and non-automatic transfer switches shall be manufactured by Asco (for model number, see Appendix E).

   b) The motor control center and all components shall be manufactured by Cutler-Hammer. The MCC shall be UL labeled. Starters shall be across the line type except when PG&E requires reduced voltage starting. All starter circuits shall be powered by control power transformers. Specialty relays (moisture sensors) required with mechanical equipment shall be integrated into the controls. Provide power/phase failure protection and time delay on start to sequence pumps on restart when power returns. Provide "RUN" pilot lights, "H-O-A" selector switches, Elapsed Time Meters, fuses and terminal blocks. In the "AUTO" mode the pumps shall normally be called by the level controller, but the level switches and PLC (remotely) can also call the pumps. Provide a control power transformer for each starter.

   c) The control panel shall include a UL 508 label. The PLC, communication equipment, UPS, level controller shall be housed in the control panel.

   d) Pedestal type electrical enclosures shall not be allowed unless specifically approved by the District.

   e) All electrical panels and MCC shall be provided with NEMA 3 weatherproof wraps.

   f) Control panel.
      (1) All components on the backpan shall be labeled using nameplates. The designations shall match approved shop wiring diagrams and elevation drawings.
      (2) Terminal blocks shall be full sized and not stacked. Provide 10 percent (minimum) spare terminal blocks.
      (3) MCC shall be labeled "MCC" followed by the initials of the project location. (The District may request to modify the initials if there is a duplication in their system.)

7. The PLC shall monitor the pump station and act as a remote telemetry unit and pump controller. The PLC shall be Allen-Bradley CompactLogix, Model 5320. The processor shall be Allen-Bradley. The PLC shall be programmed

by the Integrator based upon the written specifications and approved narrative in the equipment submittal.

a) Programming shall be developed utilizing RSLogix software. The Contractor and Integrator shall contact the District prior to submitting programming information to obtain an example of a standard program for a similar installation. All programming shall include imbedded comments.
   (1) All PLCs shall be capable of Allen-Bradley DF1 series communications and Ethernet (Allen-Bradley TCP/IP) communications through radio telemetry back to the WWTP.
   (2) I/O modules shall be compatible with AB CompactLogix.
   (3) Ethernet cards shall be compatible with CompactLogix.
   (4) Provide an operator interface (OI) unit. The unit shall monitor and indicate all status and alarms of all equipment as well as allow for changing setpoints (requiring a password). The OI unit shall be colored and allow for animated graphics and alphanumeric readouts. Provide multiple screens: overview, setpoints, and alarm history, as a minimum.
   (5) Communications with the WWTP shall be by Ethernet running over standard radios.

8. The communication equipment at each site shall include a MDS 9810 spread spectrum radio, MDS diagnostic software, 12 Vdc power supply, Scala Electronic Yagi antenna, Polyphaser IS-B50LN-C2 lightning arrester and Andrews FSJ1-50A 1/4 inch coaxial cable with terminations and waterproofing kits.

   a) Where antennas are mounted on separate masts not attached to the control panels the Design Engineer shall calculate the required coaxial cable size and submit the calculations with the 50 percent design submittal.

   b) A topology radio path signal study shall be performed during design and submitted to the District prior to or with the 50 percent submittal. Based upon findings of topology radio path signal study, the District may require that field signal strength testing of actual sites, be performed.

9. Control and communication equipment shall be provided with a UPS. Provide a UPS. Size UPS to supply power to PLC and radio telemetry in power station for one-hour minimum (500 VA minimum rating with batteries to meet minimum time requirement).

10. Provide high and low level float switches in wetwell. Level switches shall be Anchor Scientific Mini Float SM or approved equal. The level switches shall initiate alarms and act as back-up controls to the level controller to call the pumps in the auto mode. Each level switch requires an intrinsically safe relay (ISR). ISRs shall be Gem or approved equal. The floats shall be hung from a 316 stainless steel mounting bracket mounted with Type 316 stainless steel hardware.

11. Level sensing shall be accomplished by an ultrasonic level sensor.

    a) The level transmitter will supply a 4-20 mA signal to the PLC. The level transmitter shall be calibrated for the depth of the wet well. The level transmitter shall be manufactured by Siemens, HydroRanger model. Exact model shall be coordinated with the District to meet project specific requirements.

    b) The wetwell shall be constructed with painted level calibration lines to be used during start-up.

    c)

12. Provide PLC I/O, PLC programming and SCADA system modifications to control, monitor, indicate status, alarm, and acknowledge alarms based upon the lists provided herein. Alarms shall automatically reset when the alarm condition clears.

    a) Analog signals shall include low alarms, high alarms and high-high alarms and associated setpoints.

    b) Integrator shall modify the existing SCADA software to integrate the new facility into the system. Integration shall include necessary programming at pump station and WWTP PLC to read required I/O data from the pump station to the WWTP PLC. All communications shall be read/written from the PLC at the plant (no remote station communication initiations).

    c) SCADA programming. Integrator shall use the same version of development software that the District is using to make modifications or schedule programming time on the WWTP site using the District development node. Modifications made off site shall be pre-approved before appending the new work to the existing system. Appending new screens to existing system, the Integrator shall import screens to existing District application and update database by performing a database dump, modification, and load.

    d) All alarm, status, registers, timers, set points, etc. shall be grouped for polling request from the WWTP through the radio link. All work at the WWTP shall be by Contractor, including:
    (1) PLC I/O and Wonderware SCADA modifications:

        (a) Screen development for pump station showing:
    (2) Pump Status (on, off/manual, auto).
    (3) Generator Status.
    (4) Wetwell Level.
    (5) Power Status.
    (6) Flow Rate.
    (7) Flow Total, MG.
    (8) Pump Lead/Lag Status.

(9) pH Monitoring (as required).
(10) Alarms (with SCADA acknowledge):

(1) Pump Failure.

(2) Generator Failure (oil pressure, temperature, high/low voltage, high/low frequency, over current). For SCADA, generator failure shall be indicated for all listed conditions. At pump station, generator shall indicate specific failure cause.

(3) High/Low Wetwell Level.

(4) Power Fail.

(5) Intrusion.

(6) High Cabinet Temperature.

(7) Communications Failure Alarm.

(8) High Sump Level (if sump pumps are provided).

(b) Controls:

(1) Pump Control

(2) Remote Pump Stop and Start/Manual Control (Manual through SCADA).

(3) Reset Controls.

(4) Change Lead/Lag Position.

(5) Local Control at Pump Station.

(c) Status:

(1) Pump Runtime.

(2) Generator Runtime.

(d) Trending:

(1) Wetwell Level.

(2) Runtime.

(3) Flow Rate.

(4) pH Monitoring (as required).

(e) Reporting:

(1) Runtime.

(2) Flow, MGD.

(f) SCADA Analog:

(1) Wetwell Level (Scaled Value).

(2) Flowmeter (Scaled Value).

(3) pH (Scaled Value).

(4) ORP (Scaled Value).

(5) Pump Start/Stop Setpoints (operator settable through SCADA).

(6) Wetwell Alarm Setpoints (operator settable through SCADA).

(7) Pump Station Power Usage – Low Power Monitor.

(8) Pump Speed (if VFDs are implemented).

(g) Operator Interface (OI) Unit: Monitor and indicate all functions incorporated in the PLC. Operator interface shall be Panelview 1000e, or approved equal.

(h) Pump Control: Control pumps based on level (pump down) with manual or automatic alternation (based on pump starts). Provide lead and lag start and stop setpoints. Provide a check to make sure the setpoints are logical (start above stop and lead before lag). Upon failure of the lead pump move the lag pump to the lead position.

13. A System Integrator shall provide all controls, PLCs, communication equipment, and instruments as a complete package. The Contractor and the Integrator shall be required to complete start-up services. Start-up services shall include inspections, terminations, testing, calibrating, and training. Testing services shall include factory testing, field testing and witnessed start-up. Forms shall be submitted documenting testing and calibration. Approved documentation shall be included in the O&M manual. Acceptable Integrators are DST, Meyer Control Corporation, TESCO, and CMC (the Design Engineer shall obtain the latest list of approved Integrators from the District prior to finalizing the Contract Documents).

14. The System Integrator’s project manager shall meet with the District for a preliminary design review meeting, prior to generating the submittal, to insure the Integrator has all the latest standards and a complete

understanding of the scope of work. Integrator shall contact District to obtain an example program to be used as a basis for the programming.

a) Specifications shall require the Integrator to include the programming of the PLC and SCADA computer in his scope of work.

b) The Design Engineer shall include a description (narrative) of the PLC program and the programming modifications to the SCADA system in the technical specifications.

15. The Design Engineer shall include within the Contract Documents requirements for the Contractor to perform tests as required to demonstrate that the equipment and systems provided operate correctly and safely. The Contractor shall provide all labor, instruments, and other material to complete the tests.

a) The Contractor shall coordinate the testing activities of the Integrator with the District.

b) All testing activities shall be documented and results submitted for District review. Examples of test forms are available from the District.

c) Factory Test.
   (1) The Integrator shall test the control panel, PLC, and program, prior to shipment to the job site, at the factory. The District shall be notified 14 days prior to factory testing and shall have the option to witness the testing.
   (2) Operational Readiness Test. The ORT shall show that the electrical, controls and instrumentation systems are ready for operational testing. The following tests shall be performed during the ORT.
   (3) Insulation Test. Perform a 1000-volt megger test on all 600 Volt class control and power wiring.
   (4) Motor Test. Submit test data showing (for every new motor) a winding resistance check of each phase, amperes in each phase with motor loaded, motor nameplate amperes, thermal overload element rating, and catalog number. At time of test, record voltage at switchboard for all three phases. Check for correct rotation of mechanical equipment.
   (5) Controls Testing. Test hardwired controls (non-PLC controls) and operate equipment.
   (6) Instrumentation Testing. Calibrate and test all instruments and pump controllers.
   (7) Communication Test. Test the radio communication system.
   (8) SCADA Test. Test the SCADA system and workstations.
   (9) Software and Program Test. Test the PLC program.
   (10) Transfer switch and generator tests.
   (11) A point-by-point test shall be performed.
   (12) Infrared scan all connections and MCC.
   (13) Final Field Test.

(14) The Contractor shall perform the final field test after he has delivered written notice to the District that the operational readiness test has been completed.
(15) The Contractor shall inform the District at least 14 days prior to the final field test so that the District may witness the test.
(16) The FAT shall operate all equipment and systems over the full operating range, shall demonstrate proper operation of alarms and indicators, and, in general, shall demonstrate that the equipment and systems meet the requirements of the Contract Documents.
(17) If any equipment or system fails the final field test, the Contractor shall correct the problem and shall repeat the test until it is successful.
(18) Test plans and test reports shall be treated as a formal submittal. Tests and test plans shall be in the cause and effect format. The person conducting the test shall initiate an action (cause) and, upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied.

16. The documentation submitted shall include single line diagrams, elementary diagrams, elevations and layouts, PLC program, interconnection diagrams and test reports. All submitted drawings shall be generated using AutoCAD software. Hard copies shall be submitted in 11" x 17" form. A copy of all the as-built drawing files shall be submitted via DropBox, Microsoft OneDrive, or Microsoft SharePoint with the O&M manual at the end of the project. Similarly, the as-built PLC program files shall be submitted on CD.

17. Spare Parts. Spare parts shall be provided as outline in Appendix D, Spare Parts List.

Y. PIPELINE INSTALLATION

1. Pipeline installation shall meet the following design standards.

   a) Shoring, sheeting, bracing, or sloping of trenches shall meet the requirements outlined in Section IV of this report. Shoring, sheeting, bracing, or sloping of trenches shall be addressed in the Geotechnical Report.

   b) Dewatering shall meet the requirements as outlined within "Geotechnical" in this Section. Dewatering shall be addressed in the Geotechnical Report. Dewatering for all structures shall be as described in Section II, S. DEWATERING.

   c) Trench. Trench detail(s) shall be developed specifically for pipelines on the project. The trench detail shall include trench dimensions and trench materials and shall conform to the basic requirements indicated within the trench detail included in Appendix A. Specifications shall include information on trench materials and

compaction requirements. Trench design shall be addressed in the Geotechnical Report as outlined within "Geotechnical" in this Section.

d) All pipelines and appurtenances shall have direct burial wire laid above the top of pipe before backfilling The wire shall be installed and spliced in accordance with the manufacturer's written instructions and the Standard Drawings to form a set of continuous electrical conductors throughout the pipe system. Wire shall be #10 AWG single strand wire with insulation.

2. Pipeline Flexibility.

a) Pipeline flexibility shall be provided where pipelines exit or enter structures, including, but not limited to, the wetwell, valve vault(s), flowmeter vault, and manholes. Flexibility may be provided through use of flexible joints, sleeve type couplings, or flange coupling adaptors. The amount of flexibility required is dependent upon the amount of expected differential settlement between pipelines and structures. Expected settlement shall be obtained from the Geotechnical Report.

b) All sleeve type couplings and flange coupling adapters shall be fusion bond epoxy lined and coated or Type 316 stainless steel. All hardware shall be Type 316 stainless steel.

3. Pipeline Penetrations.

a) Pipeline penetrations into below grade structures shall be water tight. Such penetrations shall be either by wall pipes (weep ring integral to pipe and cast into structure wall) or by means of link seal. Link seals shall be modular mechanical type, consisting of interlocking rubber links shaped to continuously fill the annular space between the pipe and wall sleeve. Links shall be loosely assembled with bolts to form a continuous rubber joint around the pipe. Bolts and nuts shall be stainless steel. Tightening the bolts shall cause the rubber sealing elements to expand and provide a watertight seal. The seal shall be constructed to provide electrical insulation. For link seal installation, see Detail in Appendix A.

4. Pipeline Cover.

a) All buried pipelines shall be designed with a minimum cover of 4 feet over the pipeline crown, unless more stringent requirements are specified by the City of Fairfield/City of Suisun City/Solano County (as applicable). Pipelines shall be designed for live and dead loads.

b) Minimum pipe cover and clearance shall be maintained in the design. If certain conditions exist which make it impractical to meet the minimum cover and clearance requirements, the conditions and locations shall be specifically noted above the profile on the drawings. Each location not meeting the minimum cover and clearance requirements will require special approval. Any planned condition being specially approved with less than minimum cover will require

special pipe, bedding, and/or backfill as directed by the District and City of Fairfield/City of Suisun/Solano County (as applicable).

5. Pipeline Identification.

   a) All piping shall be provided with identification.

   b) Exposed Piping.
      (1) Each pipe shall contain a printed label identifying the name of the pipe contents, a flow arrow to indicate direction of flow in the pipe, and color-coded bands painted directly onto the pipe. All labels shall be preprinted on pressure-sensitive adhesive-backed vinyl cloth or plastic tape. Arrows shall be die-cut of the same type of material as the labels.
      (2) Letter sizes and colors for lettering, arrows, and a background shall conform to ANSI A13.1
      (3) Preprinted identification devices shall be as manufactured by W. H. Brady Co., Seton Nameplate Corp., or approved equal.
      (4) Each pipe shall be identified at intervals of 20 feet, and at least one time in each location. Pipe identification shall consist of 3 elements, i.e., painted color coding, a lettered label, and a directional label.

   c) Buried Piping. Warning tape shall be provided on all buried piping. Warning tape shall indicate type of pipeline and shall be specifically designed for this use. Warning tape for all buried pipelines shall be detectable, where indicated. Warning tape shall be 6 inches wide by 5 mils thick, with aluminum foil center. Wording shall be printed on both sides of tape every 16 to 36 inches along the tape. Warning tape shall read "CAUTION - BURIED PIPELINE". Refer to Trench Detail in Appendix A for location and type of warning tape to be provided.

6. Pipe Supports.

   a) All exposed piping, including piping within valve and flowmeter vaults and wetwell shall be supported and braced for Seismic Zone 4.

   b) Pipe supports and hardware within the wetwell shall be fabricated entirely from Type 316 stainless steel. Pipe supports for above grade piping and piping within valve vault and flowmeter vault shall be fabricated from steel and hot-dip galvanized.

   c) General.
      (1) Piping shall be supported to accommodate loading, expansion, and contraction.
      (2) Where piping connects to equipment, it shall be supported by a pipe support and not by the equipment.
      (3) Pipe support system components shall withstand the dead loads imposed by the weight of the pipes filled with water, plus any insulation, and shall have a minimum safety factor of 5. At each support, every pipe shall be provided with a pipe clamp or guide.

(4) No punched strap, wire, or other makeshift devices will be accepted.
(5) Where exposed pipes change from horizontal to vertical, the pipes shall be supported on the horizontal runs within 2 feet of the change in direction.
(6) For vertical runs exceeding 10 feet, pipes shall be supported by a base elbow.
(7) All vertical pipes shall be supported at intervals of no more than 8 feet, on wall rests, and at all points necessary to ensure rigid construction.

7. Pipeline Restraint.

a) Pipelines shall be restrained for internal pressure. Restraint systems shall be designed for minimum of 1.5 times the maximum operating pressure, the test pressure, or anticipated maximum surge pressure.
(1) Restraint system for exposed piping shall be by means of pipe supports/kickers, restrained joints, or tie rods.
(2) Restraint system for buried piping shall be by means of restrained joints, tie rods, or thrust blocks.
(3) All buried hardware, including tie rods, shall be Type 316 stainless steel.

8. Compaction Testing.

a) The Design Engineer shall include requirements within the Contract Documents for compaction testing of trench materials during construction. Compaction testing shall be provided by an independent firm and compaction test reports shall show conformance with the requirements of the Contract Documents and shall be submitted to the District.

Z. SPARE PARTS

1. Spare parts shall be provided as indicated in Appendix D, Spare Parts List.

2. A list of recommended parts shall be provided to the District for all equipment at the pump station. In addition, any special tools required for maintenance of equipment shall be provided. The list shall be approved by the District and all spare parts shall be provided to the District at project completion.

3. Each part shall be fully identified as to the manufacturer, part number, purpose, and associated item of equipment.

AA. TESTING OF FACILITIES

1. Prior to acceptance of any submersible wastewater pump station by the District, all facilities shall undergo a 7-day test. Prior to commencement of this test, all equipment shall undergo and pass all specified factory and field testing. The 7-day test shall test the operation of all items at the pump station, including pumps, standby generator, odor control system, surge

control system, instruments, controls, alarms, etc., to ensure that all facilities are complete and ready for acceptance. The District will provide portable generator for testing of portable generator plug.

2. The test shall demonstrate that the equipment has been properly installed, aligned, and connected, is free of mechanical defects, electrical defects, excessive vibration, overheating, or overloading, and that the control system performs as specified and meets all operating criteria. Proper operation of control devices, limit switches, level switches, and alarm devices shall be demonstrated. If process conditions cannot be manipulated to demonstrate operation of alarm or control switches, then they shall be actuated artificially to effect the required demonstration. Demonstration shall include verification that all indicators and read-outs are functioning as required. All parts shall operate satisfactorily in all respects and in accordance with the specified requirements for the full duration of the test period.

3. If any part of the system shows evidence of unsatisfactory or improper operation during the test period, correction or repairs shall be made and the full test duration shall be re-started until all components operate satisfactorily.

4. Contractor shall prepare and submit a 7-day test plan and schedule to the District for review. In the course of testing, the Contractor shall expand the conditions and transitions tested as additional causes and circumstances arise during the test. Any failure of the 7-day test shall result in the 7-day test being restarted.

5. The testing shall be witnessed by the District. Upon successful completion of the testing, the District shall sign off on the testing. Such approval is required prior to acceptance of the facilities by the District.

6. The Design Engineer shall include these requirements in the Contract Documents.

BB. COORDINATION WITH CITY AND COUNTY REQUIREMENTS/ STANDARDS

1. In addition to the design standards outlined herein, the project shall meet the requirements set forth by the City of Fairfield/City of Suisun City/Solano County (as applicable). Standard specifications and details for design shall be obtained from the appropriate agencies.

2. All work shall be submitted to the City of Fairfield/City of Suisun City/ Solano County (as applicable) for review and approval, including all architectural approvals. If the City of Fairfield's/City of Suisun City's/ Solano County's (as applicable) comments conflict with the District's design standards outlined herein, such conflicts shall be discussed and resolved with the District and the City of Fairfield/City of Suisun City/Solano County (as applicable).

3. In general, the following items are not covered within these design standards and shall meet all requirements of the City of Fairfield/City of Suisun City/Solano County (as applicable).

(1) Architectural requirements.

b) Landscape and irrigation requirements, including planting.

c) Traffic control, including road closures, detours, flagmen, warning signs, and construction signage.

d) Street design/replacement, including engineering fabrics, aggregate subbase, aggregate base, asphaltic concrete, signage, stripping and pavement markings, traffic signals, adjustments of manholes, water valves and survey monument boxes, concrete curb, gutter, sidewalk, and driveways.

e) Street lighting.

f) Storm drainage.

g) Sanitary sewers < 12 inches in diameter.

h) Potable and non-potable water systems.

i) Testing of materials.

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APPENDIX H

DESIGN STANDARDS FOR SEWER FORCEMAINS

VIII. DESIGN STANDARDS FOR SEWER FORCEMAINS

This portion of the design standards shall be used by a Design Engineer who is preparing Contract Documents for sewer forcemains to be owned and operated by the District.

For clarity, the District's Design Standards shall not be used as a substitute for the Design Engineer's calculations and design, and shall not be used as a substitute for the Designers' and/ or Developers' Project Documents for construction. These Design Standards spell out the minimum considerations and requirements for all District facilities that the Designer, Contractor, and Developer are responsible for.

Design standards outlined herein are to be used by the Design Engineer in preparation of Contract Documents, namely specification and drawings for use by a Contractor. All requirements that affect the Contractor shall be incorporated into the Contract Documents by the Design Engineer.

A. SEWER FORCEMAIN SIZING

Sizing of sewer forcemains for design flows will be based on the more stringent requirements of the 1) Fairfield-Suisun Sewer District's sizing requirements outlined below and 2) City of Fairfield/City of Suisun City/Solano County (as applicable) sizing requirements. All calculations shall be submitted to both the District and the City of Fairfield/City of Suisun City/Solano County (as applicable) for review and comment prior to detailed design.

1. FSSD's Sizing Requirements for Design Flows.

   The sizing of sewer forcemains for new developments shall be accomplished using the District's Flow Estimating Procedure for New Developments as developed in the District's Collection System Master Plan. The Design Engineer shall calculate the estimated flow using the following procedure and submit the calculations to the District prior to any design work for approval of the sizing of the sewer forcemain facilities. This procedure may be used for developments up to 100 acres. For developments larger than 100 acres, or for facilities that serve existing areas, consult the District to obtain design flows for new facilities.

   If flows through the sewer forcemain(s) will vary between start up and when the forcemain(s) flow reaches buildout condition, then design flows for the two extreme conditions shall be determined.

   For estimating the design flow rate, the wastewater flow from an area of new development can be divided into three components (dry weather sanitary flow, groundwater infiltration, and storm related inflow and infiltration). Each component is determined individually, and then the

design flow is calculated by summing the three components. Follow the same procedures outlined in "Gravity Sewer Sizing" in Section VIII – Design Standards for Gravity Sewers (≥12" Diameter).

2. Sewer Forcemain Sizing.

   Once dry weather sanitary flow (average dry weather flow [ADWF]), peak hour sanitary flow, and design flow (peak wet weather flow [PWWF]) are determined, sizing of sewer forcemains may commence. Initial flow conditions, as well as buildout flow conditions, shall be considered when designing facilities.

   Sewer forcemains shall be sized to provide for velocities between 3 and 8 feet per second. If variable speed pumping is implemented and the minimum and maximum velocity range outlined above cannot be met under all conditions, the designer shall contact the District for direction. The sizing of all sewer forcemains shall be designed in unison with its associated pump station, whether new or existing.

   System curves shall be developed for the pump station and forcemain system. System curves and pump curves shall be plotted and submitted to District for review, along with all calculations, with the 50 percent submittal. Sewer forcemains shall be sized using a Hazen-Williams C-value of 100, but shall also be capable of proper operation at a C-value of 120.

B. GEOTECHNICAL

1. A Geotechnical Engineering Investigation Report shall be prepared by a registered Geotechnical Engineer in the State of California for the sewer forcemain facilities. Refer to Section II - General Requirements, for geotechnical requirements.

C. SURVEY WORK

1. Survey work shall be performed during the design phase for the project. See Survey Requirements outlined in Section II - General Requirements.

D. UTILITY COORDINATION

1. Design Engineer shall contact all utilities within the project vicinity to coordinate with existing utilities that need to be avoided, relocated, and/or required for service at the new facilities. This work shall include, but not be limited to, obtaining drawings of existing utilities for location and size.

E. UTILITY LOCATING

1. Locating existing utilities in the vicinity of the new work shall include potholing of all existing utilities to determine their exact location during

the design phase. Potholing is not required for utilities where both end points have been surveyed, such as gravity sewers or storm drains. Potholing shall be performed in addition to obtaining utility maps from agencies. The utility maps and surface features, such as valve boxes, etc. shall be used as guides to determine where to pothole.

F. SEPARATION OF WATER AND WASTEWATER PIPES

1. Design shall comply with all California Code of Regulations requirements and any other local requirements at the time of design regarding separation of gravity sewer pipelines from potable water pipelines. All requirements shall be complied with including, but not limited to, pipeline separation, pipeline location, pipeline materials, casing pipes, and joint location. If requirements conflict with the design standards outline within this document, consult the District.

G. CONTRACT DOCUMENTS FOR SEWER FORCEMAINS

1. Contract Documents for the construction of sewer forcemains shall be prepared, including specifications and drawings.

2. Drawings shall include plan and profile drawings for all pipelines. The drawings shall include the plan view across the top of the drawing and its associated profile across the bottom of the drawing. Plan and profile drawings shall include the following elements at a minimum.

    a) Plan view shall include:

        1) Topography survey of background as outlined under Survey Work, including contours, surface features, etc.

        2) All existing utilities as obtained from Utility Coordination and Utility Locating, outlined herein.

        3) Plan locations of new facilities, including pipeline and bends.

        4) Stationing of new pipeline.

        5) Coordinates, stationing, and angle of each horizontal bend.

        6) Geotechnical soil boring locations per the Geotechnical Report.

    b) Profile shall include:

        1) Grid with stationing and elevations.

        2) New pipeline and bends.

        3) All existing utilities crossing the new pipeline alignment as obtained from Utility Coordination and Utility Locating, outlined

herein. Show vertical and horizontal location, size, and type of utility.

4) Existing grade and proposed grade.

5) Pipeline inverts, stationing, and angle of each vertical bend.

6) Type and stationing of all appurtenances (air relief valves, blowoffs, isolation valves, etc.).

7) New pipeline size, slope and material.

3. Provide all required details, including but not limited to:

a) Trench detail.

b) Pavement detail.

c) Thrust block detail.

d) Tie-in connection detail(s).

e) Buried valve detail, if applicable.

H. PIPELINE MATERIALS

1. Sewer forcemains shall be polyvinyl chloride (PVC) pipe with PVC fittings. Design Engineer should consult the District if pipeline is to serve any non-residential customers to determine if PVC is acceptable. If another material is required by the District, the Design Engineer shall contact the District for pipe requirements.

2. Sewer forcemains 4 inches in diameter through 12 inches in diameter shall conform to AWWA C900 meeting DR-18 (150 psi) minimum with cast iron outside diameters. Pipeline calculations for wall thickness and pressure rating shall be submitted to the District for review with the 50 percent submittal. Such calculations shall account for maximum internal pressure of the pipeline, including test pressure and expected surge pressure as well as dead and live loads subject to the pipeline. Trench width and trench materials to be used should be considered in the calculations. If calculations indicate that DR-18 is insufficient, DR-14 shall be used, if sufficient.

3. For sewer forcemains 14 inches in diameter and greater, Design Engineer shall contact District for pipeline material and associated requirements.

4. Pipe shall be made of compounds conforming to ASTM D1784 with cell classification of 12454.

5. All piping shall be continuously marked in conformance with the appropriate ASTM.

6. Joining of PVC pipe shall be with elastomeric gasket bell ends or couplings. The bell ends shall be integral thickened bell end or an integral sleeve-reinforced bell end. The bell end joints shall have a minimum wall thickness of the bell or sleeve-reinforced bell equal, at all points, to the DR (dimension ratio) requirements for the pipe. The minimum wall thickness in the ring groove and bell-entry sections shall equal or exceed the minimum wall thickness of the pipe barrel. Conform to ASTM D3139.

7. One PVC coupling, manufactured of the same material and by the same manufacturer as the pipe, shall be furnished with each length of pipe together with two (2) rubber rings. The couplings shall be designed so as to ensure a watertight joint with the pipe. The couplings body and sockets shall have a wall thickness equal to the pipe barrel thickness with which the coupling is to be used.

8. All rubber rings shall be furnished by the pipe manufacturer. These rubber rings (elastomeric gaskets) shall be manufactured to conform with the requirements of ASTM F477.

9. Cleanouts may be required in sewer forcemains less than 12 inches in diameter, at 500 feet minimum, and at each change in direction. Cleanouts shall provide for bi-directional flushing.. No cleanout piping or appurtenances shall be PVC.

    a) Ductile iron pipe and fittings shall be Class 53 (minimum) conforming to the requirements of AWWA C150 and AWWA C151 for pipe, and AWWA C110 for fittings. Flanged ductile iron pipe and fittings shall conform to the requirements of AWWA C115.

    b) All ductile iron items shall be lined and coated with factory applied fusion bond epoxy (16 mils minimum).

    c) For exposed items, including cleanouts located within valve boxes, additional coating shall be applied over fusion bond epoxy for color and UV protection. See Appendix F for information on coating materials.

    d) For buried ductile iron items, polyethylene film conforming to AWWA C105, Type 1, Class C (black), Grade E1, 8 mils (minimum) shall be provided on fusion bond epoxy coated ductile iron pipe and fittings.

    e) All hardware shall be Type 316 stainless steel.

10. Deflections at joints shall not exceed 50 percent of maximum deflection recommended by the manufacturer when installed by the Contractor. No joint deflection shall be allowed for joints that are over-belled or not belled to the stop mark. No joint deflection shall be designed and substituting joint deflection for special fittings is not permitted.

11. Bending of pipe shall not exceed recommendations of AWWA or manufacturer's printed recommendations.

12. Forcemain fittings shall be PVC as specified below:

    a) PVC. PVC pressure fittings shall be manufactured in accordance with AWWA C900 and shall be same DR as pipe with CI pipe outside diameters. Elbows 45 degrees and less and all tees and crosses shall be cast or formed as a single piece or from pieces, formed from single pipe pieces and solvent welded to form durable, stable pressure rated fittings. All fittings shall be manufactured with integral bell and spigot joints and shall comply with ASTM D3139. Fittings shall be provided with elastomeric gaskets complying with ASTM F477. Fittings shall be PVC pressure fittings as manufactured by Nyloplast, or approved equal. Where non-standard angle PVC pressure fittings are required, custom-made fittings to the required angulation shall be made.

13. Forcemain piping on pump station site.

    a) Forcemain piping on pump station site shall be as specified in Section VII of these design standards.

I. PIPELINE DESIGN AND INSTALLATION

1. Design Considerations.

    a) No deflection at joints shall be allowed in the design. Special PVC fittings to the required angulation shall be provided for all vertical and horizontal deflection.

    b) Restraint system shall consist of thrust blocks. Restraint shall be provided at all buried elbows, tees, valves, dead ends, etc. See thrust block detail in Appendix A. Mechanical restraint systems shall not be utilized. Restraint shall be sized to accommodate highest allowable pressure anticipated.

    c) Any bypass pumping of raw wastewater required to construct the facilities shall be specified by the Design Engineer for implementation by the Contractor.

    d) All miscellaneous metallic items, including all hardware used on the project that are installed below grade or within a wastewater structure, shall be Type 316 stainless steel.

    e) All PVC pipe shall be suitable for use with raw wastewater.

    f) Minimum depth of cover over any forcemain is 4 feet, or the requirements of the City of Fairfield/City of Suisun City/Solano County (as applicable), whichever is more stringent. Minimum pipe cover and clearance shall be maintained in the design. If certain conditions exist

which make it impractical to meet the minimum cover and clearance requirements, the conditions and locations shall be specifically noted above the profile on the drawings. Each location not meeting the minimum cover and clearance requirements will require special approval. Any planned condition being specially approved with less than minimum cover will require special pipe, bedding, and/or backfill as directed by the District and/or City of Fairfield/City of Suisun/Solano County (as applicable).

g) Combination air release and vacuum valves shall be provided at all high points.

h) High points within the sewer forcemain shall be minimized during design.

i) Pipelines shall be designed for 1.5 times the maximum expected internal pressure (minimum) and in excess of the test pressure given in this section under "Testing of Facilities."

j) Sleeve type coupling may be used within sewer forcemains for flexibility or constructibility. All sleeve type couplings shall be fusion bond epoxy lined and coated or Type 316 stainless steel. All hardware shall be Type 316 stainless steel.

2. Pipeline Installation.

a) Pipeline installation shall be specified in the Contract Documents to meet the following design standards:

1) Shoring, sheeting, bracing, or sloping of trenches shall meet the requirements outlined in "Geotechnical" in this section. Shoring, sheeting, bracing, or sloping of trenches shall be addressed in the Geotechnical Report.

2) Dewatering shall meet the requirements outlined in "Geotechnical" in this section. Dewatering shall be addressed in the Geotechnical Report and shall meet the requirements in "Dewatering" in Section II – General Requirements.

3) Trench. Trench detail(s) shall be developed specifically for pipelines on the project. The trench detail shall include trench dimensions and trench materials and shall conform to the basic requirements indicated within the trench detail included in Appendix A. Specifications shall include information on trench materials and compaction requirements. Trench design shall be addressed in the Geotechnical Report as outlined within "Geotechnical" in this section. Trench design for PVC pipes shall be in accordance with Geotechnical Report requirements and pipe manufacturer's recommendations.

b) All pipelines and appurtenances shall have direct burial wire laid above the top of pipe before backfilling The wire shall be installed and spliced in accordance with the manufacturer's written instructions and the Standard Drawings to form a set of continuous electrical conductors throughout the pipe system. Wire shall be #10 AWG single strand wire with insulation.

c) Warning tape shall be provided on all buried piping. Warning tape shall indicate type of pipeline and shall be specifically designed for this use. Warning tape for all buried pipelines shall be detectable where indicated. Warning tape shall be 6 inches wide by 5 mils thick, with aluminum foil center. Wording shall be printed on both sides of tape every 16 to 36 inches along the tape. Warning tape shall read "CAUTION – BURIED SEWER". Refer to trench detail in Appendix A for location of warning tape.

1) Geotextile Filter Fabric

(a) The contractor shall install nonwoven geotextile filter fabric between the Bedding and Backfill material in such a manner to prevent migration of the backfill material into the bedding.

(b) Filter fabric shall meet or exceed the following specifications:

TRENCH FILTER FABRIC			
Property	**ASTM Test Method**	**Nonwoven Minimum Average Roll Value (English)**	**Nonwoven Minimum Average Roll Value (Metric)**
Grab Tensile Strength	D4632	112 lbs	500 newtons
Trapezoidal Tear Strength	D4533	40 lbs	180 newtons
Puncture Strength	D4833	40 lbs	180 newtons
Permittivity	D4491	1.5 sec^{-1}	1.5 sec^{-1}
Apparent Opening Size (AOS)	D4751	Maximum #70 sieve	Maximum 0.212 minimum
UV After 500 Hours	D4355	70%	70%
[1] All values in this table are the minimum values allowed in each direction except as noted, and are based on Minimum Average Roll Value (MARV).			

(c) Filter fabric installation requirements:

(1) Trench filter fabric shall be installed in such a manner to prevent migration of fines.

(2) Adjacent rolls shall be overlapped a minimum of 24” in the longitudinal and transverse directions.

d) The following shall be included within the Contract Documents. If sewer forcemain other than PVC pipe is required for use by the District, the Design Engineer shall consult the District for installation standards.

1) The installation of plastic pipe and fittings shall be in strict accordance with the manufacturer's technical data and printed instructions.

2) All laying, jointing, testing for defects and for leakage shall be performed in the presence of the District and shall be subject to District approval before acceptance. All material found during the process to have defects will be rejected and the Contractor shall promptly remove such defective materials from the site of the work.

3) Particular care should be taken to avoid overstressing or breaking of the pipe at the sleeves.

4) Pipe shall be handled, stored, laid, and installed per the manufacturer's instructions and AWWA C605. Wherever the provisions of this section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

5) Bell and spigot pipe shall be laid with the bell end pointing in the direction of laying. Pipe shall be set to grade in straight lines, taking care to avoid the formation of any dips or low points. Pipe shall not be laid when the conditions of trench or weather are unsuitable, as determined by the District. At the end of each day's work, open ends of pipe shall be closed temporarily with water-tight, expandable type plugs.

6) Pipelines laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement.

7) Pipe shall be supported at its proper elevation and grade, care being taken to secure firm and uniform support. Wood support blocking will not be permitted. The full length of each section of pipe and fittings shall rest solidly on the pipe bed, with recessed excavation to accommodate bells and joints.

8) Joints shall be installed according to the manufacturer's recommendations. Trenches shall be kept free of water until joints have been properly made.

9) Pipe shall be cut by means of saws, power driven abrasive wheels, or pipe cutters that will produce a square cut. No wedge-type roller cutters will be permitted. After cutting, the end of the

pipe shall be beveled using a beveling tool, portable type sander, or abrasive disk.

10) All necessary precautions shall be taken to prevent uplift or floating of the pipe prior to the completion of the backfilling operation. The Contractor shall assume full responsibility for any damage due to this cause and shall restore and replace the pipe to its specified condition and grade if it is displaced due to floating.

11) Each pipe elastomeric gasket joint shall be installed in conformance with the manufacturer's printed recommendations.

12) Pipe, fittings, and accessories shall not be stored in direct sunlight. Pipe shall be stored in such a manner so as to prevent sagging or bending. Pipe supports shall be properly and adequately supported and anchored so as to maintain the supported loads in proper position under all operating conditions without unnecessary movement or strain on any piece of equipment. Thrust blocks shall be provided where necessary to resist system pressure on fittings.

13) Any section of pipe that has been dented, damaged, or in any other way found to be defective, either before or after placing, shall be replaced with sound pipe.

14) All plastic pipe to valves and metal pipe connections shall be made using flanged connections.

15) Trenches shall be excavated to a width shown on the Contract Drawings. Trench walls shall not be undercut.

16) The measured width at the top of the pipe shall not exceed maximum design trench width as shown on the Contract Drawings.

17) Uniform support shall be provided along the length of the barrel. Bell or coupling holes shall be excavated to prevent point loading of the bells or couplings.

18) Where sheeting, shoring, or bracing is required, require Contractor to submit shop drawings of the sheeting, shoring, or bracing system, as required. Contractor shall sheet, shore, and brace trenches, as necessary, in accordance with approved shop drawings and requirements of the Contract Documents, to prevent caving or sliding of trench walls, to provide protection for workers and the pipe, and to protect adjacent structures and facilities.

19) Solid sheeting shall be removed in accordance with the requirements of the Contract Documents.

20) If a movable shield is used, the pipe already laid shall be securely blocked or braced to prevent opening of pipe joints when the shield is advanced in the trench.

21) Line and Grade.

    (a) All pipe shall be laid true to line and grade, as presented on the requirements of the Contract Documents. The District shall be notified of clearance of less than 12 inches to any other utility. The owner of the other utility may also require notification. All new pipe shall be laid with no less than 12 inches clearance to existing utilities, unless otherwise directed by the District. Each pipe length shall be checked for grade and alignment as it is placed.

    (b) Measure for grade at the pipe invert, not at the top of the pipe.

    (c) Establish line and grade for pipe by the use of lasers or by transferring the cut from offset stakes to batter boards set in the trench at maximum intervals of 25 feet. Maintain a minimum of three sets of batter boards with string line ahead of the pipe laying at all times. If batter boards in the trench prove impractical because of trench conditions, submit other methods of grade and alignment control to the District for approval.

22) Laying and Joining Pipe.

    (a) A thin film of lubricant shall be applied to surface of gasket. Do not allow the pipe to touch the ground or the trench side after lubricating. Use only the lubricant furnished with the pipe. The plain end of the pipe shall be aligned and carefully entered into the socket until it just makes contact with the gasket. Joint assembly shall then be completed by pushing the plain end of the entering pipe past the gasket until the plain end makes contact with the bottom of the socket. If assembly is not accomplished with the application of reasonable effort, the plain end of the pipe shall be removed to check for the proper positioning of the gasket, adequate lubrication, and removal of foreign matter in the joint.

    (b) Joints shall be assembled without "stabbing," "swinging in," or "popping on" the spigot ends of the pipe into bell ends. After joint assembly, bedding material shall be carefully placed and compacted against the haunch of the pipe to provide critical lateral support. Care shall be used

to not displace or damage the pipe or bedding when compacting trench backfill.

(c) After the joint has been made, check pipe for alignment and grade. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between joints. Pipe shall be laid on compacted bedding material and shall have full bearing over its entire length between the bell holes, which must be excavated in the bedding to permit proper assembly of the bell and spigot joints. No blocking or wedging of the pipe to achieve proper grade will be permitted. Place and compact bedding to achieve proper grade. Apply sufficient pressure in making the joint to assure that the joint is "home," as defined in the standard installation instructions provided by the pipe manufacturer. To ensure proper pipe alignment and joint makeup, place sufficient pipe zone material to secure the pipe from movement before the next joint is installed.

(d) When pipe is laid within a movable trench shield, take all necessary precautions to prevent pipe joints from pulling apart when moving the shield ahead.

(e) Take the necessary precautions required to prevent excavated or other foreign material from getting into the pipe during the laying operation. At all times, when laying operations are not in progress, at the close of the day's work, or whenever the workers are absent from the job, close and block the open end of the last laid section of the pipe to prevent entry of foreign material or creep of the gasketed joints.

(f) Backfilling shall not commence until the pipe installation has been visually inspected and accepted by the District. After approval of the connection, the trench shall be backfilled as specified.

(g) When cutting and/or machining the pipe is necessary, use only tools and methods recommended by the pipe manufacturer and approved by the District.

(h) Detectable warning tape shall be laid continuously over centerline of pipe at location shown in trench detail in Appendix A.

23) All rigid polyvinyl chloride (PVC) pipe shall be cut square, burrs removed, made up, and installed in accordance with the pipe manufacturer's recommendations, as approved. Offset shall be as recommended by the manufacturer for the maximum temperature variation between time of solvent welding and final use.

24) Pipe shall not be laid when the temperature is below 40 degrees F nor above 120 degrees F when exposed to direct sunlight. Ends to be joined shall be shielded from direct sunlight prior to, and during, the laying operation.

25) Pipe Handling.

(a) All pipe shall be handled and packaged in such a manner so as to provide adequate protection for the pipe and the pipe ends during transportation from manufacturer and supplier to the site.

(b) Pipe, fittings, and accessories shall be carefully inspected before and after installation and those found defective shall be rejected. Pipe and fittings shall be free from fins and burrs. Before being placed in position, pipe, fittings, and accessories shall be cleaned and maintained in a clean and sanitary condition. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings, or any other material be dropped or dumped into trenches.

(c) The pipe shall be handled by devices designed and constructed to prevent damage to the pipe.

(d) The Contractor is fully responsible for replacement or repair of pipe that is damaged.

(e) Stockpiled pipes shall be supported on wood supports. Space supports to prevent pipe bending. When pipes are stacked, the weight of the upper pipes shall not cause deformation of the lower pipes.

(f) Pipe shall be stored, if possible, at the jobsite in unit packages provided by the manufacturer. Caution is to be exercised to avoid compression damage or deformation to bell ends of the pipe. Pipe shall be stored in such a way as to prevent sagging or bending and protected from exposure to direct sunlight by covering with an opaque material, yet permitting adequate air circulation above and around the pipe. Gaskets shall be stored in a cool, dark place, out of the direct rays of the sun, preferably in the original cartons. Pipe, fittings, or accessories improperly stored are subject to rejection by the District.

(g) Carefully examine each pipe and fitting prior to installation for soundness and compliance with specifications. Damaged pipe shall be replaced with pipe that meets the specifications.

(h) No tie-ins shall be made or existing flows diverted into the new pipeline until the Contractor has an approved tie-in plan and all downstream pipeline and structures have been completed, tested, and accepted.

(i) The District shall be notified 48 hours in advance before starting any work on an existing sewer.

(j) All pipe openings shall be blocked and braced at the end of each day to prevent foreign material from entering the pipe.

26) Inspection.

(a) All pipe shall be subject to inspection at the place of manufacture. During the manufacturing of the pipe, the District shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with the specifications.

(b) The Contractor shall notify the District of the production schedule in sufficient time so that factory inspection can be arranged.

(c) The manufacturer shall make available for the District's use such gauges as are necessary for inspection. The manufacturer shall provide the District with such assistance as is necessary for the handling of pipe and fittings.

(d) Approval of pipe at the factory only allows the manufacturer to ship the equipment to the site and does not constitute final acceptance by the District.

27) Delivery, Storage, and Handling.

(a) Delivery at Site. All materials that will not be installed the same day as delivered to the site shall be stored in the original manufacturer's packaging. Loose items with no original packaging shall be boxed to protect the products from scratches, abrasion, or breakage.

(b) All plastic materials should be stored out of direct sunlight.

(c) Protection Prior to Installation.

(1) All products shall be protected from excessive heat and from moisture during storage and handling.

(2) Store pipe and fittings on suitable supports to prevent damage, rolling, and contamination from dirt. Protect

all machined surfaces exposed during shipment and storage from weather and dirt by bolting on plywood covers and covering with membrane covers. Protect all exposed gaskets from weather and dirt with membrane covers. Loose gaskets shall be properly stored in boxes to protect them from damage and the sun.

(3) Bedding material may be stockpiled on the jobsite or may be arranged to be delivered as the need occurs. The project schedule shall not be impeded due to insufficient materials on the jobsite.

(4) Damaged and unprotected or improperly stored materials will not be accepted for payment as materials on hand.

28) Cleanup.

(a) After completion of the work, all remaining pipe cuttings, joining and wrapping materials, and other scattered debris, shall be removed from the site. The entire piping system shall be handed over in a clean and functional condition.

(b) Following assembly and testing, but prior to final acceptance, all pipelines shall be flushed with high velocity water or flushed with a cleaning ball. All accumulated construction debris and other foreign matter shall be removed. Flushing velocities shall be a minimum of 3 feet per second. Accumulated debris shall be removed through drains 2 inches and larger or by dropping spools and valves.

3. Compaction Testing.

a) The Design Engineer shall include requirements within the Contract Documents for compaction testing of trench materials during construction in accordance with the requirements of trench detail(s) in Appendix A. Compaction testing shall be provided by an independent firm and compaction test reports shall show conformance with the requirements of the Contract Documents and shall be submitted to the District.

J. COMBINATION AIR RELEASE AND VACUUM VALVES

1. Combination air release and vacuum valves shall be provided at all high points within pump discharge piping and sewer forcemain piping. Combination air release and vacuum valves shall be sized and specified for the exact application. All valves shall be specifically designed and recommended for use on raw wastewater.

2. High points shall be minimized.

3. The piped distance from the forcemain connection to the combination air release and vacuum valve shall be minimized as much as possible.

4. Design of installation for combination air release and vacuum valves shall include isolation plug valve.

5. If high water table is below bottom of valve (per geotechnical report), then valve may be placed within below-grade precast box (with adequate space in the box for maintenance and removal). Box shall be located out of main traffic ways, but shall be rated for H2O loadings. If high groundwater precludes the installation of the valve below grade, then valve shall be located above grade in a padlockable enclosure suitable for outdoor exposure. Adequate space within enclosure shall be provided for maintenance and removal.

6. All piping between sewer forcemain piping and combination air release valves shall be Type 316 stainless steel piping and fittings rated for the sewer forcemain test pressure.

7. Combination air release and vacuum valves shall be manufactured by A.R.I. USA, Inc., or approved equal. Valves shall be made of stainless steel.

K. PROTECTIVE COATINGS

1. Materials and any associated coatings for PVC pipe and Type 316 stainless steel miscellaneous items and hardware are outlined in this section.

2. All surfaces require protective coatings, except the following surfaces that shall not require protective coatings:

   a) Concrete, unless otherwise specified

   b) Stainless steel

   c) Machined surfaces and bearings

   d) Grease fittings

   e) Glass

   f) Plastic

   g) Equipment nameplates and tags

   h) Traffic boxes

   i) Gratings and frames, checker plates, hatches, stair treads, door thresholds, and other walk surfaces.

j) Aluminum handrails

k) Rubber hoses and rubber skimmer assemblies

l) Motor drive shaft and chains

m) Fiberglass, unless otherwise specified

n) Wiring

o) Existing surfaces, unless specifically identified to be recoated or if existing coatings are damaged due to the work of this contract.

3. For any items where protective coatings are not outlined within this Section, but are required to be coated per the above list, refer to the Protective Coatings section of the Design Standards for Submersible Wastewater Pump Stations within this document.

L. CATHODIC PROTECTION

1. Based on the design standards outlined, cathodic protection is not envisioned for the sewer forcemain facilities. If metallic materials are used for any reason, such as , fittings, ARVs, blow offs, casing pipe, etc., a cathodic protection study and cathodic protection system may be required as directed by the District. If required by the District, cathodic protection shall be implemented, as approved by the District.

M. TESTING OF FACILITIES

1. Requirements to be specified for field testing of PVC pipe are outlined herein. If pipeline material other than PVC pipe is directed to be used by the District, then Design Engineer shall contact the District for requirements. Design Engineer shall include the following testing requirements in the Contract Documents.

2. Flushing and Cleaning of Pipe.

   a) Care shall be exercised during fabrication to prevent the accumulation of pipe cuttings and filings, gravel, cleaning rags, etc., within piping sections. All piping shall be examined to assure removal of these and other foreign objects prior to assembly. Shop cleaning may employ any conventional commercial cleaning method if it does not corrode, deform, swell, or otherwise alter the physical properties of the pipe being cleaned.

   b) Prior to performing any testing, the pipe installation shall be thoroughly cleaned. Cleaning shall be performed by the Contractor by means of a method acceptable to the District.

3. Contractor shall conduct pressure and leakage tests on all newly installed sewer forcemain pipelines and furnish all necessary equipment, instrumentation, and material, including temporary plugs and blind flanges

and make all taps in the pipe, as required. The District shall monitor the tests.

4. Where any section of pipe is provided with concrete thrust blocking, do not make the pressure test until at least 5 days have elapsed after the thrust blocking is installed. If high-early cement is used for thrust blocking, the time may be reduced to 3 days. Prior to testing PVC piping, slowly fill the section of pipe to be tested with water and allow to stand for 24 hours under slight pressure to allow the PVC pipe to accommodate swelling/absorption. Refill with makeup water before test.

5. Conduct the tests on piping after the piping has been completely installed.

6. Repairs of defects that are discovered as a result of inspection or tests shall be made with new materials. Caulking of screwed joints, cracks, or holes will not be accepted. Tests shall be repeated after defects have been eliminated.

7. Hydrostatic testing shall be performed for all new sewer forcemains in accordance with AWWA C605.

    a) To prevent pipe movement, sufficient backfill shall be placed prior to filling the pipe with water and field testing. When local conditions require that the trenches be backfilled immediately after the pipe has been laid, the testing may be carried out after backfilling has been completed, but before placement of permanent surfacing. The Contractor shall ensure that thrust blocking or other types of restraining systems will provide adequate restraint prior to pressurizing the pipeline.

    b) The following procedure is based on the assumption that the pressure and leakage tests will be performed at the same time. Separate tests may be conducted if desired. If separate tests are conducted, the pressure test shall be performed first. Tests shall be performed only after the pipeline has been properly filled, flushed, and purged of all air. The specified test pressure shall be applied by means of an approved pumping assembly connected to the pipe in a manner satisfactory to the District. The test pressure shall not exceed pipe or thrust-restraint design pressures. If necessary, the test pressure shall be maintained by additional pumping for the specified time during which the system and all exposed pipe, fittings, valves, and hydrants shall be carefully examined for leakage. All visible leaks shall be stopped. All defective elements shall be repaired or removed and replaced and the test repeated until the allowable leakage requirements have been met.

    c) The Contractor may perform simultaneous pressure and leakage tests or perform separate pressure and leakage tests on the installed system at test durations and pressures specified in Table 4. Tests

shall be witnessed by the District and the equipment used for the test shall be subject to the approval of the District.

d) The Contractor shall furnish the gauges and measuring devices for the leakage test, pump, pipe, connections, and all other necessary apparatus, as well as furnish the necessary assistance to conduct the test. The duration of each leakage test shall be 2 hours. During the test, the pipeline shall be subjected to the pressure listed in Table 4. Leakage shall be defined as the quantity of water that must be supplied into the pipe section being tested to maintain a pressure within 5 psi of the specified leakage-test pressure after the pipe has been filled with water and the air in the pipeline has been expelled. No installation will be accepted if the leakage is greater than that determined by the formula:

$$L = \frac{ND\sqrt{P}}{7{,}400}$$

Where

$L =$ allowable leakage, in gallons per hour

$N =$ number of joints in the length of pipeline tested

$D =$ nominal diameter of the pipe, in inches

$P =$ average test pressure during the leakage test, in pounds per square inch (gauge)

Table 4. System Test Methods

Procedure	Pressure	Duration of Test
Simultaneous Pressure and Leakage Tests	150% of working pressure* at point of test, but not less than 125% of normal working pressure at highest elevation.†	2 hours
Separate Pressure Test	150% of working pressure* at point of test, but not less than 125% of normal working pressure at highest elevation.†	1 hour
Separate Leakage Test	150% of working pressure* of segment tested.†	2 hours

*Working pressure is defined as maximum anticipated sustained operating pressure.

†In no case shall the test pressure be allowed to exceed the design pressure for pipe, appurtenances, or thrust restraints.

1) When testing against closed metal-seated valves, an additional leakage per closed valve of 0.078 gph/in. of nominal valve size shall be allowed.

2) All visible leaks shall be repaired, regardless of the amount of leakage.

8. The Contractor shall dispose of all water so as not to cause a public nuisance and as acceptable to the District.

N. COORDINATION WITH CITY AND COUNTY REQUIREMENTS/ STANDARDS

1. In addition to the design standards outlined herein, the project shall meet the requirements set forth by the City of Fairfield/City of Suisun City/Solano County (as applicable). Standard specifications and details for design shall be obtained from the appropriate agencies.

2. All work shall be submitted to the City of Fairfield/City of Suisun City/ Solano County (as applicable) for review and approval, including any architectural approvals. If the City of Fairfield's/City of Suisun City's/ Solano County's (as applicable) comments conflict with the District's design standards outlined herein, such conflicts shall be discussed and resolved with the District and the City of Fairfield/City of Suisun City/Solano County (as applicable).

3. In general, the following items are not covered within these design standards and shall meet all requirements of the City of Fairfield/City of Suisun City/Solano County (as applicable).

a) Architectural requirements.

b) Landscape and irrigation requirements, including planting.

c) Traffic control, including road closures, detours, flagmen, warning signs, and construction signage.

d) Street design/replacement, including engineering fabrics, aggregate subbase, aggregate base, asphaltic concrete, signage, stripping and pavement markings, traffic signals, adjustments of manholes, water valves and survey monument boxes, concrete curb, gutter, sidewalk, and driveways.

e) Street lighting.

f) Storm drainage.

g) Potable and non-potable water systems.

h) Testing of materials.

O. NON-OPEN CUT PIPELINE INSTALLATIONS

1. The design standards outlined within this document are intended for open cut pipeline installations. If non-open cut pipeline installations are proposed or required for installation of the pipeline such as jack and bore, microtunneling, etc., the Design Engineer shall contact the District for specific requirements. In addition, the Geotechnical Report shall address the non-open cut pipeline installation(s) providing recommendations for the materials and installation operation to be used.

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