SECTION 5.1
PRESSURE PIPELINE DESIGN

5.1.1 PURPOSE

The purpose of this section is to provide general guidelines for open trench pressure pipeline design. These design criteria should be considered in the appropriate stage of the design submittals for a pipeline project.

5.1.2 STANDARD TERMS AND DEFINITIONS

Wherever technical terms occur in these guidelines or in related documents, the intent and meaning shall be interpreted as described in Standard Terms and Definitions.

5.1.3 GENERAL

It is the responsibility of the user of these documents to make reference to and/or utilize industry standards not otherwise directly referenced within this document. The Engineer of Work may not deviate from the criteria presented in this section without prior written approval of the District's Engineer.

5.1.4 GUIDELINES

This section covers general design parameters for pipelines installed in trenches with minimum depth of cover over top of the pipelines at three to five feet (3' to 6'). Any variance of these depths requires special design approval by the District Engineer.

A. To the extent possible, distribution and transmission pipelines shall be laid out in the public right-of-way.

B. Pipeline design plans and specifications shall reference Standard Drawings and Standard Specifications where appropriate.

C. Pipeline plans shall be prepared in digital format, in accordance with Section 1.2 or Section 1.3.

D. Pipelines shall be designed in accordance with the requirements of the California Safe Drinking Water Act and the California Water Works Standards, Title 22 of the California Code of Regulations "Blue Book".

E. Pipeline plans shall conform to the latest standards of the State of California, Department of Health Services, "Criteria for the Separation of Water Mains and Sanitary Sewers".

F. Geotechnical evaluations may be required in order to determine appropriate trench loading and pipeline material selection.

5.1.5 PIPELINE LAYOUT

A. For new development the designer must consult with the respective water district as well as the local City and County government, utility companies (e.g., SDG&E, Cable TV, SBC) to determine the standard for location of new facilities.
B. For existing development the designer must research existing utility information by reviewing available record drawings from local City and County government, utility

companies (e.g.; SDG&E, Cable TV, PacBell, County Water Authority), and other governmental agencies with jurisdiction within the pipeline alignment. The designer shall contact all utility companies and municipal agencies to request record drawings of existing and future planned utilities and verify ownership of facilities. Research with municipalities should include future road and utility improvement and master planned land development projects.

C. Obtain and review right-of-way and road boundaries. Verify right-of-way or easement acquisition requirements, as identified in the Design Report or Sub-Area Master Plan (SAMP).

D. With the above information, plot existing utilities and right-of-ways on base maps. Identify potential utility conflicts and pipeline tie-in points. Complete additional field research including pothole information to verify record drawing information.

E. Dead-end distribution systems (those with a single supply pipeline) tend to reduce water quality and system reliability; therefore, distribution systems shall be designed with two or more separate supply pipelines whenever it is feasible. Distribution systems located in that serve twenty (20) or more DU, must be designed with two or more separate supply pipelines unless otherwise approved by the District Engineer.

F. Confirm that the proposed alignment complies with the separation requirements of the State Health Department with respect to separation between water, sewer, and recycled water pipelines. There will also be a minimum horizontal separation of five feet and a vertical separation of one foot between pipelines and other utilities e.g., SDG&E utilities and storm drains. The Design Engineer shall consult with the respective utilities for larger size pipelines and utilities as they may require these separations be expanded.

G. Provide final right-of-way requirements for permanent and temporary easements to the District Engineer as noted in Section 1.5.

H. Perform a final field check of the alignment to determine if any field changes have occurred since the previous check. Update plans to reflect field conditions.

I. Horizontal and vertical curves for PVC pipelines shall be in accordance with Specification Section 15064. Horizontal and vertical curves for pipeline materials other than PVC shall follow the manufacturer's recommendations.

J. Where the future main is in a major street that would be difficult and expensive to access a pipe stub and cap shall extend out to the edge of pavement or out ten feet (10') from the main, whichever is the greater distance.

K. In General, no portion of the main or appurtenance laterals shall be placed under concrete road surfaces, such as cross gutters, medians, and other similar hardscapes. Design engineer shall adjust alignment as necessary to avoid these circumstances.

5.1.6 PLAN AND PROFILE

A. Complete a preliminary alignment with horizontal control data, using the available information from the Design Report or SAMP and as obtained during the record drawing reviews and field investigations.

B. Confirm point of connection (POC) and obtain pothole information at potential utility conflicts. If the alignment of the existing main is in question, additional potholes should be performed to determine the horizontal and vertical alignment of the existing main at the

POC location. Pothole data should be obtained as necessary for utility mains, conduits, and service laterals that are six inch (6") and larger, that cross or are parallel to the proposed pipeline. Pothole data should include depth to top of pipe, pipe diameter, pipe material, and length to nearest point.

C. Plot pothole data on the plan and profile drawings.

D. Check the proposed alignment for conflicts and make revisions as required.

E. Add stationing and horizontal control data to the pipeline plan and profile views in accordance with Section 1.1.

F. Accurately detail and locate tie-in connections and appurtenances. Provide coordinates and vertical control data to provide precise locations of tie-ins, valves, blow-offs, air valves, vaults, fire hydrants and etcetera. Review location and layout of appurtenances to determine accessibility for operations and maintenance personnel and ensure constructability.

G. The Engineer of Work shall arrange for the preliminary alignment centerline (P-line) to be marked-out in the field by a land surveying crew. Mark-out of the P-line shall consist of spray paint within paved or developed area or wood lath and flagging for undeveloped areas. The Engineer of Work and the District Engineer (when applicable) shall field check the P-line layout for constructability issues.

H. Identify conflicts between existing utilities and appurtenant facilities. Revise design to address utility conflicts. District utilities shall be designed to cross over top of other utilities when possible.

5.1.7 PIPELINE MATERIALS

A. General: The material for pressure pipelines shall be in accordance with the Approved Materials List for Water Facilities.

1. In general, pipelines used for distribution 12 inch and under shall be PVC. Certain circumstances such as shallow depth, above ground, or high pressure installations may require other materials to be used. Engineer of Work shall determine the most appropriate material for review by the District Engineer.

The Engineer of Work should consider the following factors in determining the appropriate material including lining and coatings:

- Fabrication and installation costs
- Flow conditions (e.g., higher velocity flows or periods of dry pipe conditions)
- Potential conflicts with existing and future utilities
- Safety and security of the pipeline
- Geotechnical conditions
- Maintenance

B. PVC Pipe: A dimension ratio (DR) is used to standardize the specification of PVC pipe. Dimension ratios (DR=O.D./t) provide a method of specifying product dimensions to maintain mechanical properties regardless of size. For a given dimension ratio, pressure capacity and pipe stiffness remain constant for all pipe sizes.

PVC pipe for distribution mains six inches (6") through twelve inches (12") in diameter shall conform to AWWA C900 (Standard for Polyvinyl Chloride Pressure (PVC) Pressure

Pipe, 4 In. through 12 In., for Water Distribution), Class determined based on operating pressure.

PVC pipe fourteen inches (14") through thirty inches (30") in diameter used for transmission mains shall conform to AWWA C905 (Standard for Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 In. through 36 In.), Class determined based on operating pressure.

Solvent cement are not acceptable for pipe-to-pipe connections. Use bell and spigot pipe only. Use of restrained joints may be required where stated on the plans. Pipe-to-fitting connections shall be in accordance with the latest edition of Approved Materials List for Water Facilities.

Concrete encasement is typically not allowed, specific cases must be presented to District Engineer for evaluation.

C. Steel Pipe: Steel pipe shall be designed per "AWWA Manual of Water Supply Practices, Steel Pipe - A Guide for Design and Installation, M-11." Minimum pipe wall thickness for distribution and transmission mains shall be one quarter inch (¼") unless otherwise directed by the District Engineer. Minimum pipe wall thickness for pump station, pressure reducing valve station, and all above ground pipe applications shall be one quarter inch (¼"). Non-Welded (push-on joints) steel pipe shall not be allowed.

    1. Lining: Steel pipe shall be designed with a cement lining. However, cement material will not be used when the pipeline is design for intermittent use only resulting in being out of service for extended periods of time. The alternative material (e.g., polyurethane) design will be submitted to the District Engineer for approval.

    2. Coatings: For below ground applications, the coating of steel pipe can be cement, poly tape, or a combination of these materials. For above ground applications the steel pipe shall be paint-coated unless otherwise directed by the District Engineer.

    3. Cathodic Protection (CP): Steel pipe that is subjected to corrosion may require the installation of either a passive or active CP system.

D. Ductile Iron Pipe (DIP): Minimum thickness design shall conform to AWWA C150 (American National Standard for Thickness Design for Ductile Iron Pipe) and AWWA C151 (American National Standard for Ductile Iron Pipe, Centrifugally Cast, for Water and Other.

    1. Lining: All DIP shall be designed with a cement lining. However, cement material will not be used when the pipeline is design for intermittent use only resulting in being out of service for extended periods of time. The alternative material (e.g., polyurethane) design will be submitted to the District Engineer for approval.

    2. All ductile pipe installed underground shall be factory-coated with a bituminous material in accordance with AWWA C151 (American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids) and polyethylene film wrap per AWWA C105 (American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems), Installation Method A. The polyethylene film wrap shall be a minimum eight (8) mil thick, overlapped by twelve inches (12") at joints and secured with two inch (2") wide black polyethylene adhesive tape.

E. Other material: For pipeline material designed for other than those listed above the designer must be submit a request to the District Engineer for approval.

5.1.8 Buried Pipeline Design

F. General:

1. Depth of pipe: The minimum depth of cover for potable water pipelines up to fourteen inches (14") is generally 36 inches within paved roadways or 42 inches for unpaved roadways. The minimum depth of cover for recycled water pipelines up to sixteen inches (16") is generally 48 inches. Water mains sixteen inches (16") and larger shall have minimum depth of 48 inches within paved roadways and 52 inches for unpaved roadways. Maximum depth shall not exceed 6 feet to the invert of the pipe. Special consideration will be given where deeper crossings are required to avoid existing utilities.

2. Pipeline alignment shall be within existing or proposed paved road limits, located no less than 5 feet from the road edge to the pipe centerline.

3. Pipeline shall avoid crossing under medians or other permanent structures. When crossing gutters or other concrete pavement surfaces wider than 5ft, cold joints shall be used to follow the trench line.

4. The Engineer of Work must perform calculations to determine the appropriate wall thickness of a pipeline where there are unusual external (i.e., depths less than three feet (3') or greater than eight feet (8') and bridge installations), internal conditions (e.g., surge pressure), and/or use of steel or ductile iron pipe.

5. The Engineer of Work shall recognize that in order to calculate trench loads, both dead loads and live loads must be considered.

6. Water and sewer trench dead loads shall be calculated using the Prism Load Method.

7. Geotechnical investigations shall be completed to determine unit soil weights for soil load calculations.

G. Dead Loads:

1. The prism load is the superimposed load due to the weight of the soil column for the full height of the backfill directly above the pipe. The prism load is considered to be the maximum load that will be imposed by the soil on a buried pipe. The prism load condition provides a conservative design approach.

2. The unit weight of the soil shall be determined during the geotechnical investigations completed for the pipeline design.

3. The Prism Load Method: The design trench loads shall be calculated using the following equation:

$$W_c = HwB_c$$

Where:

W_c = Design Trench Load on Conduit (lbs/lf)

H	=	Depth of Cover over Pipe (ft)
w	=	Unit Weight of Soil (lb/cf)
B_c	=	Outside Diameter of Pipe (ft)

4. The design trench load (Wc) shall be used in the pipe strength and deflection calculations to determine the appropriate pipe strength and wall thickness for flexible pipe materials.

H. Live Loads:

1. Live loads shall be calculated using standard H20 highway loading for pipe depths of up to eight feet (8').

2. For depths greater than eight feet (8'), live loads can be assumed to be negligible when compared to dead loads.

I. Internal Pressure:

1. Operating Pressure

2. Field Testing Pressure

3. Surge Pressure

J. Assumptions for Pipeline Installation:

The Engineer of Work shall assume that the contractor of work installing pipelines will follow the technical specification for methods related to trench preparation, backfill material, and methods and relative compaction.

K. Other Construction:

Refer to Section 9 for design of pipelines at pump stations and Section 12 for design for other conditions (e.g., trenchless, highlining) of the Design Guidelines.

5.1.9 REFERENCE

The publications listed below form a part of this section to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said publications unless otherwise called for. The following list of publications, as directly referenced within the body of this document, has been provided for the user's convenience. It is the responsibility of the user of these documents to make reference to and/or utilize industry standards not otherwise directly referenced within this document.

1. Valley Center Municipal Water District Standards:

A. Design Guidelines

i. Section 1.1, Drafting Guidelines
ii. Section 1.2, AutoCAD Guidelines
iii. Section 1.5, Easements and Encroachments

B. Standard Drawings

i. W-17

C. Approved Materials List for Water Facilities

D. Technical Specifications

i. Section 15064, Polyvinyl Chloride (PVC) Pressure Pipe

2. American Water Works Association (AWWA)

A. AWWA Manual M11, Steel Pipe; A Guide for Design and Installation

B. AWWA Manual M23, PVC Pipe; Design and Installation

C. AWWA C105, Standard for Polyethylene Encasement for Ductile Iron Pipe

D. AWWA C110, Standard for Ductile Iron and Gray Iron Fittings 3" through 48"

E. AWWA C150, Standard for Thickness Design of Ductile Iron Pipe

F. AWWA C151, Standard for Ductile Iron Pipe, Centrifugally Cast, for Water

G. AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings 4" through 12" for Water Distribution

H. AWWA C905, Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings 14" through 48" for Water Transmission and Distribution

3. Others

A. California Safe Drinking Water Act

B. California Water Works Standards, Title 22 of the California Code of Regulations "Blue Book"

C. State of California, Department of Health Services, Criteria for the Separation of Water Mains and Sanitary Sewers

END OF SECTION