

**CITY OF SIMI VALLEY**

**MANUAL & STANDARD PLANS FOR THE DESIGN AND  
CONSTRUCTION OF SANITARY SEWERAGE FACILITIES**

**UPDATED: AUGUST 28, 2006**

**CITY OF SIMI VALLEY  
DEPARTMENT OF PUBLIC WORKS  
SANITATION ENGINEERING SECTION**

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DESIGN AND CONSTRUCTION OF SANITARY  
SEWERAGE FACILITIES**

**DATE: AUGUST 28, 2006**

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## FOREWARD

Purpose: The City of Simi Valley (City), via the Department of Public Works, establishes uniform policies and procedures for the design and construction of sanitary sewerage facilities within City right-of-way and on projects subject to approval by the City, including areas outside the City limits that are within the City service area.

It is not the intent of this manual that any standard of conduct or duty toward the public be created or imposed by the publication of this manual. **The manual is not a textbook or a substitute for engineering knowledge, experience or judgment.** The methods and procedures contained herein shall be reviewed by the engineer using them to assure they are applicable to the project being worked on. The engineer may request a variance from standards as provided in the manual. Amendments to this publication may be issued from time to time. The users of this publication should check with the City to insure that they have the current edition of each page.

The following publications have been adopted by the City for regulating the design and construction of sanitary sewer systems. If there is a conflict between or among these documents, the document of highest precedence shall control. The precedence shall be:

- First: CITY Sewerage Design and Construction Standards (Manual)
- Second: Ventura County Sewerage Manual (VCSM)
- Third: Standard Specifications for Public Works Construction (SSPWC), latest edition

The scope of each publication is contained within each respective publication. The City Sewerage Manual shall be used as the general requirements in the design and construction of sewerage systems within the City of Simi Valley. With the City's approval, materials in VCSM and SSPWC may be referenced in Plans and Specifications and used to Supplement the requirements of this manual.



**SECTION 1.0**  
**INTRODUCTION AND GENERAL POLICIES**

**1.0 INTRODUCTION**

This Manual is published as a reference and guideline for design and construction of wastewater facilities. No legal liability toward the public is created or implied by its publication; the Manual is not to be interpreted as establishing legal standards.

**1.1 PURPOSE**

This Manual summarizes policy, practices and procedures developed to optimize City efficiency. The various sections of the manual as dated supersede all prior Standard Practice Instructions, Office Standards, Special Orders and all other directives relating to the material covered.

**1.2 SCOPE**

This Manual covers all phases of work relating to the City sewer system. Sound judgment must be exercised in the application of the Manual's provisions to specific circumstances. Requests to modify or deviate from a standard within this manual may be made. Such requests must be presented in writing for the City's approval, through the Director of the Public Works Department, clearly specifying the modifications or deviations, clearly describing the nature and purpose of the modification or deviation, and citing the standard to which such change applies. References to other published engineering standards (not other municipal standards, rather general engineering standards) are encouraged where applicable.

**1.3 REVISIONS**

The City will revise the Manual as needed to keep it current and to include new or changed policy, data and/or methods. The Public Works Director shall have the primary responsibility for the coordination and preparation of new material or revisions to the Manual.

**1.4 DISTRIBUTION**

The City will make the Manual and its revisions available to outside agencies and individuals. The Manual is intended to be used primarily for work within the boundaries of the sewer service area of the City of Simi Valley. It is available for purchase by all interested parties. The sale of the Manual, and any revisions will be available at rates established by the City.

## 1.5 DEFINITIONS AND TERMS

Whenever in these specifications the following terms, abbreviations or definitions are used, the intent and meaning shall be interpreted as follows:

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
"Manual"	Term referring to "Sewerage Design and Construction Standards" (this book)
"Tract Sewers"	The system of street sewers, house laterals, and other sewer facilities constructed by a developer within an approved tract.
"Trunk Sewer"	A main sewer which receives flow from tracts and other collecting sewers.
"Principal/Senior Engineer"	A registered civil engineer employed by the City and designated by the City to manage the daily operation of the Sanitation system.
"Sewer Main"	Wastewater Main
"Sewerage"	Wastewater Collection System
"City"	City of Simi Valley

## 1.6 APPLICABLE CODES AND POLICY

- A. Ordinances, requirements and applicable standards of governmental agencies having jurisdiction within the City service area shall be observed in the design and construction of sewers. Such requirements include but are not limited to the latest edition of the following:
- The Uniform Building Code as amended by the local authorities (City, County, State, etc.).
  - The Uniform Plumbing Code as amended by the local authorities (City, County, State, etc.).
  - Road Encroachment Regulations of the City and the County of Ventura.

- Standard Specifications - State of California Business and Transportation Agency, Department of Transportation Standard Specifications, current edition (CALTRANS).
- Ventura County Sewerage Manual.
- The City Road Standards.
- Standard Specifications for Public Works Construction.
- City of Simi Valley "Suggested BMP's for erosion and sedimentation control."
- Reclaimed Water Standards, Ventura County Waterworks District No. 8.
- Water Standards, Ventura County Waterworks District No. 8.

## 1.7 PUBLIC/PRIVATE SEWAGE DISPOSAL

A public sewer connection is required where any one or more of the following situations exist:

- A. The City or County Health Department declares a private disposal facility within the City sewer service area to be a public nuisance or health hazard.
- B. Septic tank system fails and needs replacement and a public sewer is accessible within 200 feet.
- C. All new developments, all individual single-family lot developments, except for an individual single-family lot development, with its property line being greater than 200 feet away from accessible public sewer. Connections of any cesspool seepage pit, septic tank or any other private disposal system to any sewer main line or service lateral is strictly prohibited.

## 1.8 CITY JURISDICTION

The City must approve design plans and specifications of all wastewater facilities within the public right-of-way. Custody of all drawings reviewed and accepted by the Engineer, as evidenced by the Engineer's signature, shall be with the City. This shall apply to all City funded or developer funded and constructed projects. Reproduces of the original drawings shall be provided to the developer. The developer shall be charged for the reproduction costs of the aforementioned reproducible drawings.

Where repairs or replacement of a lateral is required subsequent to initial construction, it shall be the responsibility of the property owner, including that section between the main sewer and the property line, unless the property owner can clearly demonstrate that the damage was caused to the section of the lateral outside the property line by factors such as public tree root intrusion and/or excessive street loads.

## **1.9 RESPONSIBILITY OF DEVELOPER'S ENGINEER**

These standards establish uniform policies and procedures for the design and construction of the City's wastewater system. They are not intended to be a substitute for engineering knowledge, judgment, or experience. If a deviation from a standard is necessary or desirable, the engineer of design (developer's engineer) shall inform the City in writing, of such deviation so that it can be evaluated for a possible change. The procedures contained in this manual shall be reviewed by the developer's engineer and shall be applied as necessary to the project. The contents of this manual do not preclude use of different methods when special or emergency conditions warrant and when authorized by the Engineer.

The developer's engineer needs to be familiar with the City's Master Plan for the wastewater system, and to indicate mainline relocations, extensions, or over sizing on the tentative tract conditioned by the City. Verification of the adequacy of the downstream or surrounding wastewater system rests with the developer.

All plans, specifications, reports or documents shall be prepared, signed, and stamped by a registered civil engineer licensed to practice in California.

Acceptance of Plans does not in any way relieve the developer's engineer of the responsibility to meet the requirements of the City and good engineering practices. The plans shall be revised or supplemented at any time if it is determined that the City requirements have not been met.

## **1.10 REFERENCED SPECIFICATION**

References to any other standards shall refer to the latest edition of such standards.

## **1.11 ACCEPTANCE OF SEWER SYSTEM**

The City will inspect and approve sewer installations. Acceptance by the City will be provided after all work has been inspected and accepted by the City and after all fees, permits, video tapes, testing results, and record drawings have been submitted, reviewed, and accepted by the City.

**SECTION 2.0**  
**DESIGN CRITERIA**

**2.1 WASTEWATER CAPACITIES, HYDRAULICS AND SIZES**

- A. Quantity of Flow: Sewage flows shall be determined from maximum potential sewage generation of the tributary area. Average flow rates shall be determined using the designated land use (Table 2.1) or number of equivalent dwelling units (EDU) assigned (Table 2.2). The method which produces the greater rate of flow shall be used as the governing factor. The peak flow rate at any point shall be the average flow of all tributary areas times the peak factor using the Average Flow - Peak Flow Graph (Standard Plan No. SV 40-310).

Sample Calculation:

Use of the Average Flow - Peak Flow Graph (Standard Plan No. SV 40-310)

To determine the peak sewage flow from an average flow, project the average flow value on the ordinate to the flow curve and read the peak sewage flow on the abscissa. To determine the peak factor, project the average flow value to the factor curve and read the peak factor on the abscissa.

Example: A local sewer with an average flow of 2.5 cfs is to discharge into an interceptor where the average flow is 5.4 cfs.

Find: The peak flow in the interceptor sewer below the confluence point.

Average Flows

$$\begin{array}{r} 2.5 \text{ cfs} \\ +5.4 \text{ cfs} \\ \hline 7.9 \text{ cfs} \end{array}$$

The resulting flow below the confluence point is 7.9 cfs average, which converts to 17 cfs peak by use of the Average Flow - Peak Flow Graph. All flow computations should be made with average flows and converted to peak only for final results.

**Table 2.1**

<b><u>LAND USE</u></b>	<b><u>ABR.</u></b>	<b><u>AVERAGE COEFFICIENT</u></b>
High Density	H.D.	140 People/Acre (100 gpcd)
Medium Density	M.D.	75 People/Acre (100 gpcd)
Low Density	L.D.	20 People/Acre (100 gpcd)
Suburban	Sub	10 People/Acre (100 gpcd)
Hillside	H.S.	7 People/Acre (100 gpcd)
Agriculture	Agr	2.5 People/Acre (100 gpcd)
Light Industry	L.I.	0.008 cfs/Acre
Heavy Industry	H.I.	0.008 cfs/Acre
General Commercial	Gen	0.006 cfs/Acre
Limited Commercial	Ltd	0.006 cfs/Acre
Hospital	H	0.387 cfs/Hospital
School	S	0.062 cfs/school
University or College	U	0.371 cfs/Univ.
Civic or Administrative Center	C.C.	0.006 cfs/Acre
Airport	A	0.001 cfs/Acre
Park	P	0.0003 cfs/Acre
Future Park	F.P.	0.0003 cfs/Acre
Golf	G	0.0003 cfs/Acre

B. Hydraulics: Sewers shall be designed to accommodate future tributary flows, in addition to those from the project. Pipe capacities shall be determined from peak

flow rates by Manning's Formula using an "n" value of 0.011 (or higher when appropriate) for all pipelines. Sewers less than 12 inches in diameter shall be designed to flow half full at peak flow rates. Sewers 12 inches and larger shall be designed to flow two-thirds full at peak flow rate.

When the design involves nonuniform flow, backwater calculations shall be made to the extent necessary to locate hydraulic jumps, to assure that the limiting design depth of flow is not exceeded, and to assure that flow conditions meet all preceding design requirements for the conduit and structures.

The invert drop across junction (confluence) and transition structures shall be calculated and not arbitrarily established. Where calculations indicate a rise of the invert across the structure from the inlet to outlet, the structure shall be designed with the invert level. An additional amount for infiltration shall be added when a sewer is to be constructed below the ground water level. This amount must first be approved by the City.

Table 2.2

**EQUIVALENT DWELLING UNIT ASSIGNMENT**

<u>CATEGORY</u>	<u>EDU'S</u>
<u>Residential</u>	
Single Family Detached/Attached	1.00
Multiple Family (Condos, Apts., Airspace Townhouses)	0.75
Mobile Home	0.60
<u>Commercial</u>	
Hotel/Motel	
Per unit without kitchen	0.33
Per unit with kitchen	0.55
Churches/Theatres/Auditoriums	
110 seats or less	1.00
Each additional seat	0.00091
Restaurants	
42 seats or less	2.60
Each additional seat	0.0625
Bars, Cocktail Lounge per seat	0.06
Automobile Service Stations	
Per restroom	0.33
Auto service & repair shops (additional)	0.34

Table 2.2

**EQUIVALENT DWELLING UNIT ASSIGNMENT**

<u>CATEGORY</u>	<u>EDU'S</u>
Comfort Station	
Per water closet or urinal	0.33
Self-Service Laundry/Car Wash per washer/day	0.40
Shop and Store Buildings (gross bldg. sq. ft.)	
10,000 sq. ft. or less - per 1,000 sq. ft.	0.33
Each additional area - per 1,000 sq. ft.	0.22
Office Buildings	
Medical - per 1,000 sq. ft.	0.60
All other - per 1,000 sq. ft.	0.33
Industrial/Manufacturing	
Dry Industry - per 1,000 sq. ft.	0.36
Wet Industry - case-by-case determination	--
Warehouse - per 1,000 sq. ft.	0.08
<u>Institutional</u>	
Schools	
Elementary/Nursery, Etc. - 60 students or less	1.00
Each additional student	0.02
High School - 30 students or less	1.00
Each additional student	0.033
Hospitals - per bed	0.60

Categories not covered by the above table shall require special approval.

NOTE: Equivalent dwelling unit (EDU) is defined as the unit of measure, which is based on the flow characteristics of an average single-family residence in terms of sewage quantity and constituent quality. QEDU = 275 gal/day (2.75 persons/DU x 100 gal/person/day).

- C. Velocity: A main line sewer shall be designed to provide a mean velocity of not less than 2.5 feet per second flowing one-half full. Where there is conflict between design by velocity and design using minimum slopes in Section 2.4, the design resulting in the steepest slope shall be used.
- D. Inverted Siphons: Inverted siphons are not allowed. If an exception is to be considered, the following minimum conditions must be met:

1. Maintaining an adequate scouring velocity for at least several hours each day. A minimum velocity of 3 fps is recommended to provide adequate scouring.
2. Limiting the rising slope of the downstream leg to a maximum of 0.15 foot per foot.
3. Providing a sufficient number of barrels to ensure flexibility for operation under varying flow conditions.

Gate Structures: The inlet and outlet structures shall be smoothly transitioned to prevent excessive head loss and turbulence. Inverts of all barrels at the inlet or outlet shall be the same elevation. Under no circumstances shall steps be provided in the inverts. The protection of the exposed concrete or mortar from a corrosive sewer atmosphere must be provided.

The Siphon: Vertical curves shall be used for all changes of slope. Maximum radius of curvature should be sought.

Air Lines: The necessity for a conduit between the inlet and outlet structures of the siphon to provide for movement of a corrosive or offensive sewer atmosphere must be analyzed. If an airline is required, it shall have a cross sectional area at least equal to one-half the cross sectional area of the inlet sewer.

Air lines shall be constructed of corrosion resistant pipe or fully lined pipe approved by the Engineer. The air line shall be laid on as straight an alignment and profile as practicable. Sufficient slope or slopes shall be provided to drain the water from condensation or infiltration.

- E. Oversizing and Extra Depth: Oversizing of certain tract sewers may be required where such sewers can logically serve an upstream tributary area.
- F. Minimum Diameter: The minimum diameter for wastewater main shall normally be 8 inches.

## 2.2 LOCATION OF LINES (STREETS)

- A. In streets (including hillside streets): Sewers designed to serve the adjacent property on both sides of the street shall usually be located parallel to and 5 feet southerly or easterly of the street center line. Exceptions to these location requirements may only be made upon approval by the Public Works Director.

Because large trenching equipment may have a side overhang of approximately 7 feet from the trench centerline, deep or large sewers requiring such equipment should be located, where practical, in the roadway a minimum of 7 feet from the

curb face in order to avoid interference from poles, signs, electroliers, traffic signals, etc., placed immediately behind the curb.

Where existing concrete pavement has a longitudinal construction joint on the street centerline and the sewer needs to be placed in the center of the street, the sewer should be offset far enough laterally to insure that only the slabs on one side of the centerline is cut. If practical, in order to reduce the amount of resurfacing required, one edge of the trench should be on or near the longitudinal joint.

If the sewer will serve the property on one side of the street only, it shall be located on that side of the street and five feet off the centerline.

Sewers may be located between the curb and property line only if conditions will not permit location within the roadway, and only upon approval by the Public Works Director.

A sewer which will serve only the high side of a hillside street shall have a depth sufficient to provide a house connection sewer depth of 3½ feet minimum at the curb or other similar grade line.

- B. In Alleys: Sewers in alleys which contain power or telephone poles should be located on the side of the alley opposite the poles.

Where possible, the center of the manhole covers should be located at least 3 feet from the center of the alley or flow line of the alley and at least 4 feet from the property line.

- C. Substructure Interference: The maximum practical distance between proposed sewers and parallel existing substructures is desirable. A minimum of 5-feet of horizontal clearance shall be maintained between proposed sewer lines and any existing or proposed storm drain pipelines in a parallel alignment. The clearance shall be measured from the nearest outside edges of the facilities. Another factor which must be considered when setting clearance distances is the relative depths of the sewer and substructure involved.

Except under very unusual circumstances, the sewer shall be located so that no portion of existing structures lie closer than five foot from the limits of the sewer trench. The width of the sewer trench, for this purpose, is defined as the diameter of the outside of the barrel of the sewer pipe plus 8 inches on each side (see Standard Plan No. SV 40-20). It is assumed that the trench walls are plumb for this purpose.

Close proximity to parallel power conduits and to high pressure water, gas, gasoline and other high pressure mains shall be avoided if possible because of the hazards involved in disturbing them. If the sewer to be constructed is in proximity to a thrust block at a bend in a pressure main, consult the owner of the main involved.

Where a proposed sewer line crosses another pipeline, or another pipeline is to cross a sewer line, special care is required to prevent loading and deflecting or damaging the pipeline being crossed. See Standard Plan Nos. SV 40-20, SV 40-50 and SV 40-220.

D. Criteria for the Separation of Sanitary Sewers and Water Mains:

1. Basic Separation Standards:

- a. Horizontal Separation: The horizontal distance between sewer line and any existing or proposed water mains shall be at least 10 feet measured from the nearest outside edges of the facilities.
- b. Crossing: Water mains shall be at least one foot (measured edge to edge) above sewer lines where these lines must cross.
- c. Common Trench: Water mains and sewer lines must not be constructed in the same trench.

2. Alternate Criteria for Construction:

The construction criteria for sewer lines where the basic separation standards cannot be attained are shown in Standard Plan No. SV 40-10.

3. Special Provisions:

- a. The Basic Separation Standards are applicable under normal conditions for sewage collection lines and water distribution mains.  
  
More stringent requirements may be necessary if conditions such as high groundwater exist.
- b. Sewer lines shall not be installed within 25 feet horizontally of a low head (5 psi or less pressure) water main.
- c. In the installation of sewer lines, measures should be taken to prevent or minimize disturbances of the existing line. Disturbance of the supporting base of this line could eventually result in failure of this existing pipeline.
- d. Special consideration shall be given to the selection of pipe materials if corrosive conditions are likely to exist. These conditions may be due to soil type and/or the nature of the fluid conveyed in the conduit, such as a septic sewage which produces corrosive hydrogen sulfide.

4. Sewer Force Mains:

- a. Sewer force mains shall not be installed within ten feet (horizontally) of a water main.
- b. When a sewer force main must cross a water line, the crossing should be as close as practical to the perpendicular. The sewer force main should have at least a one foot clear separation below the water line.
- c. When a new sewer force main crosses under an existing water main, all portions of the sewer force main within 10 feet (horizontally) of the water main shall be enclosed in a continuous sleeve.
- d. When a new water main crosses over an existing sewer force main, the water main shall be constructed of a pipe material with a minimum rated working pressure of 200 psi pressure rating and per Ventura County Waterworks District No. 8 Standard.

E. Unless within the City sewer easements, all sewer lines located in private property shall be privately owned and shall be governed by Building and Safety Design and Construction Criteria.

**2.3 LOCATION OF LINES (EASEMENTS)**

Easements should be avoided where a reasonable alternative solution exists. Unless there are either physical limitations or extreme economic penalties, wastewater lines should be installed within streets. When easements are required, there shall be careful consideration of how the line is to be maintained and/or replaced, if necessary. Where easements are necessary and where the slope of the natural ground exceeds 1 vertical to 2 horizontal then the plans shall clearly indicate contours within the easement.

In general, all manholes within easements shall be accessible by conventional maintenance vehicles traveling over paved roads or driveways unless otherwise approved. Manholes within private property are discouraged and subject to special approval.

Laterals should not be connected to a main line within an easement unless specifically approved.

- A. Width: Wastewater easements for pipes up to 15 inches in diameter should normally be a minimum of 20 feet wide. However, additional easement width shall be required where the depths of pipe exceed 15 feet or as deemed necessary by the Engineer. The plans should clearly indicate any known block walls, trees, pavement or other obstruction within the proposed easement. Such items are contrary to the City policy and require a special approval. Included with such approval may be monetary obligation toward the operation and maintenance of the wastewater line within easement.

- B. Pipeline Location: Pipelines shall generally be placed 3-feet from the center of an easement; only under special circumstances will a line be approved which is closer to the centerline. Unless specifically approved otherwise by the City, the line shall be straight without horizontal bends or deflections.
- C. Easement Location: The full easement width shall be on one lot or property in such manner that access to manholes will not be obstructed by walls, trees or permanent improvements. Where this requirement cannot be met without interfering with existing buildings, easements may straddle lot lines provided that approval is received from the Engineer and the sewer line itself does not straddle the lot lines.
- D. Oversizing of Line: If a sewer line within an easement is over 15 feet deep, the City may require the oversizing of the sewer line (such as from 8-inch to a 10-inch line) to facilitate future slip lining.
- E. Deeds: Deeds for easements shall provide for restriction of permanent construction within the easement to provide ingress and egress for maintenance.
- F. Easement Provisions: Easements shall be provided as follows:
  - 1. For subdivision maps - The owner of land shall dedicate for City use, the wastewater easements so designated on the final map.
  - 2. For other than subdivision maps - Dedication of sewer rights-of-way shall occur by means of deeds of conveyance to the City. For all dedications other than those dedications created by subdivision map.

## 2.4 SLOPES OF WASTEWATER LINES

Minimum slope requirements are necessary to assure self-cleaning velocities and to avoid significant generation of hazardous, odorous, and corrosive sulfur compounds. Where possible, use of the minimum slopes should be avoided and should not be constructed as guidelines for system design.

- A. Minimum Slopes: The minimum slopes for commonly used pipe sizes are as follows:

<u>Pipe Size (Inches)</u>	<u>Slope (Foot per Foot)</u>
8	0.0044*
10	0.0036
12	0.0024

<u>Pipe Size</u> <u>(Inches)</u>	<u>Slope</u> <u>(Foot per Foot)</u>
15	0.0016
18	0.0014
21	0.0010

\*The City may require a slope of 0.006 or greater for an 8-inch sewer main if physically attainable.

- B. Maximum Grades: The maximum grade for sewers shall normally be 15 percent except in steep terrain where the sewer grade may approximate the finished grade over the sewer. In no case shall the grade exceed 45 percent without special approval. Prior to the design of any sewer on a slope over 30 percent, Section 2.11 and Standard Plan Nos. SV 40-20 and SV 40-30 should be referred to for typical details. To minimize the turbulence in manholes, the grade of any incoming sewer shall not exceed the grade of the outgoing sewer by more than 10 percent. Refer to Section 2.11 for further discussion of steep grades. This approval shall be designated on the construction plans.
- C. Substandard Grades: If grades below the standard minimum must be used in order to avoid pumping, the designer shall advise the City and obtain approval from the Engineer before proceeding with design.

## 2.5 DEPTH OF LINES

Depth of cover is measured as the distance to the top of pipe from the finished grade surface over the sewer centerline.

Sewers shall be installed at a depth which shall provide suitable service to the properties connected and will allow subsequent installation of water lines and other substructures. Refer to the Water/Wastewater Separation Standard Plan No. SV 40-10.

- A. Standard depth of cover is 7 feet. Where deeper cover must be maintained, other details may be required, such as higher strength pipe, pipe encasements, special backfill, or concrete trench slabs (see Standard Plan Nos. SV 40-60 and SV 40-70). Depths of cover less than 7 feet require special approval and are discouraged. The use of concrete encasements or trench slabs will in general be required for depths of cover less than 3 feet.
- B. Maximum depth of cover is detailed in Standard Plan No. SV 40-30 and SV 40-35. For ductile iron pipes, the maximum depth of cover shall be in accordance with the requirements of ANSI/AWWA C150/A21.50 and the manufacturer's recommendations. Bedding for DI pipes shall be as shown on Standard Plan No. SV 40-30.

- C. Designs not in accordance with standard depths shall be submitted to the Engineer for approval.

## 2.6 HORIZONTAL AND VERTICAL CURVES

Sewers Constructed on Curves: In general, it is most desirable to have sewers constructed with a straight alignment between manholes. Straight sewers are easier to inspect after construction, and it is easier to clean or to locate a sewer main that is straight between manholes.

There are, however, situations where it is necessary to construct sewer lines with curves between manholes. These situations might be to avoid other substructures, to avoid an excessive number of manholes in curved and hillside streets or to avoid short radius curves in manholes where high velocity flow may overtop the channel. In this latter case, the designer should calculate the super elevation of the water surface in the manhole.

In curved streets, the sewer shall follow the street curvature without crossing the centerline. In general, combination of vertical and horizontal curves will not be allowed between manholes unless it is demonstrated that another solution is not reasonably feasible. Vertical curves should not be used unless excessive depth would occur. See Section 2.6-C below, for further discussion of vertical curves. Allowable joint deflections shall be the more stringent of those set forth below and the manufacturer's recommendations.

- A. Curves - PVC Pipe: Deflection at the joints is very limited due to the joint design. Curvature can be obtained by bending the pipe along its length within the trench. Beveling pipe ends is not allowed. The following table should be used to establish curvature:

**Table 2.6A**  
**CURVES FOR PVC PIPE**

Pipe Size (Inches)	Minimum Radius of Curvature (Feet)
6	175
8	225
10	275
12	325
15	400

The above values are independent of pipe length since curvature is not achieved through joint deflection. Curves with smaller radii require deflection fittings or smooth curve "sweeps."

- B. Curves- Ductile Iron Pipe: The deflections listed in the following Table are maximum deflections for push-on-joint pipe and should not be exceeded. For design purposes, deflections should be limited to 80 percent of the values shown.

**Table 2.6B**

**CURVES FOR DUCTILE IRON PIPE**

Nominal Pipe Size (Inches)	Deflection Angle (Degree)	Approx. Radius of Curvature Produced by Succession of Joints for Pipe Length of:	
		18 Feet	20 Feet
3" to 12"	5°	205'	230'
14" to 36"	3°	340'	380'

Ref: Handbook of Ductile Iron Pipe  
Ductile Iron Pipe Association

- C. Vertical Curves: Vertical curves in sewers shall conform to the requirements for horizontal curves except that the radius shall not be less than 400 feet. Vertical curves may be either circular or parabolic in profile. An approximate formula for determining the required minimum length of a parabolic curve is:

**Formula**

$$L \text{ min.} = (S1 - S2)(R\text{min.})$$

Where:

L min. = Minimum horizontal length of vertical curve (feet).

R min. = Minimum radius of curvature permitted (feet); based on type of joint, pipe size, and maximum pipe length.

S1 and S2 are the two sewer grades being used (expressed in feet per foot), with S1 being the steeper grade.

In addition to the above guidelines, the following requirements shall be met in the design of curved sewer.

1. Minimum invert slope of horizontally curved sewer shall be 0.01 except that sewers with a radius of 200 feet or more will have the same requirements as straight sewers.
2. Vertical curves may be used in combination with horizontal curves where invert slopes exceed 0.01 throughout the reach between manholes.
3. Maximum combined horizontal and vertical deflection at any joint shall in no case be more than  $3^\circ$ .
4. The arithmetic sum of all horizontal and vertical deflections in curved sewers between adjacent manholes shall not exceed  $60^\circ$ .

D. The following data shall be shown for each sewer to be constructed on a horizontal curve:

The central angle, delta; for example,  $= 32^\circ 36' 43''$

The radius of curvature; for example,  $R = 120.00'$

The tangent length; for example,  $T = 35.10'$

The length of curve; for example,  $L = 68.30'$

The P.I., B.C. or E.C. shall be tied to the nearest street or alley centerline monument by right angle ties as described. The B.C. and E.C. shall be shown by fine dashed lines plotted at right angles to the tangent sewer or radially to the curved portion. The B.C. and the E.C. shall be stationed and the abbreviation "B.C." or "E.C.," as appropriate, shall be shown on the line.

## 2.7 SELECTION OF PIPE MATERIAL

The designer is referred to Section 3.3 and 3.4 "Materials," for discussion of this subject.

## 2.8 MANHOLES

The maximum distance between manholes shall be as shown in the following table, although the approved distance for any particular reach may be modified by the items listed below. Brick and mortar blockouts for future extensions are preferred over stub and capped pipes except where the exact orientation and slope of the future extension is known at the time of plan submittal.

**Table 2.8A**

**SPACING OF MANHOLES**

<b>Size Sewer (in inches)</b>	<b>Maximum Distance Between Manhole Center Line (in feet)</b>
8" - 24"	350'
27" - 48"	400'
Over 48"	Greater intervals depending on local circumstances.

On large diameter sewers, manholes shall be placed at the beginning or end of each curve.

Unless otherwise approved, all manholes should be accessible to standard maintenance vehicles. Therefore, manholes should not be placed in back or side yards. Every reasonable effort should be made to provide a paved or gravel roadway to manholes in open space areas.

For a discussion of materials to be used in the construction of manholes, see Section 3.9.

A. Location: Manholes shall be located at the following locations:

1. At all abrupt grade changes (too large for a vertical curve).
2. At all changes in horizontal alignment (except on curves).
3. At all changes in pipe size.
4. At the terminal end of all lines exceeding 100 feet in length from the next downstream manhole. Manholes will be required in cul-de-sacs which have three (3) or more fronting lots.
5. At all junctions of main sewers.
6. At the point of tangent of each reverse curve. (No reverse curves will be allowed between manholes, except where the Engineer determines that the nature of the reverse curve will not be significant or detrimental to the system.)
7. At all changes in pipe materials.

Manholes shall generally be located no less than 15 feet from the curb line when within a cul-de-sac. Also, manholes shall not be located within the street such that runoff is directed to the manhole.

Manholes (and cleanouts) shall generally be located at least 10 feet upstream of the downstream property line of the last property served. Where future extensions of the wastewater line will be required, then the manhole shall be located parallel with the upstream property line, if required (i.e., within the street along the property's entire frontage).

B. Slope of Manhole Channels: Grades of the channels within manholes shall be as follows:

1. When sewers of uniform size and slope pass through a manhole, the slope shall be maintained and the invert at the center of the manhole shall be given.
2. In sewers that change slope but are uniform in size, the slope of the incoming sewer(s) shall be carried through to the outlet and the invert elevations at the inlet(s) and outlet shall be given.
3. When diameters of sewer pipes change, and in junctions involving major direction or slope changes, additional fall in the invert equal to the loss in energy head shall be provided for continuity of the water surface profile.

The slopes in manhole channels indicated below are minimum values and must be increased where required by hydraulic considerations with the manholes.

**Table 2.8B**

**ADDED DROP THROUGH MANHOLES (in feet)**

Diameter of Inlet Pipe	DIAMETER OF OUTLET PIPE				
	8"	10"	12"	15"	18"
8"	--	.10	.33	.50	.67
10"	--	--	.25	.42	.58
12"	--	--	--	.17	.33
15"	--	--	--	--	.17

When the incoming sewer makes an angle of 45° to 90° with the outlet sewer, add 0.10' to the above values with the exception that the minimum drop shall be 0.20'. When the angle is 15° to 45°, add 0.05 to the tabulated value with a minimum drop of 0.15'. In all cases, the minimum drop shall be 0.10'.

- C. Drop Manholes: While not encouraged, drop manholes may be required because of some physical constraint or if the difference in elevation inflow and outflow sewers exceeds 12 inches. They should not be used to merely avoid extra depth in

trenches unless unusual circumstances exist on prior written City approval, the drop shall be constructed in accordance with Standard Plan No. SV 40-290.

- D. Undeveloped Areas: Manholes in undeveloped areas require special protection as discussed in Section 3.9, Materials.
- E. Rim Elevations of Manholes: Top elevations for all manholes shall be shown on the profile. In paved areas, the manhole rim elevation shall match the finished grade. In other than paved areas or traveled way, the height of the manhole rim will normally be 6 inches above the finished grade, high water mark, or above the top of future fill areas. The elevations shown for the tops of manholes on the design plans shall not relieve the contractor from making final adjustments to match street surfaces.
- F. Design (Size): Standard manholes (see Tables 2.8A and 2.8B) shall be in accordance with Standard Plan No. SV 40-100 (4-foot and 5-foot diameters). Shallow manholes shall be in accordance with Standard Plan No. SV 40-110. Five (5) foot diameter manholes are required if manhole has more than one main line going into manhole and also for lines 18" in diameter and larger or where the depth to pipe invert exceeds 18 feet, and as required by the City.
- G. Protection: Where new sewers are to be connected to a manhole which is in active use, the designer shall require such protection as is necessary to prevent construction debris from being washed into the active sewer. Plugged inlets or other suitable protection shall be required for the active manhole before beginning manhole modification or cleaning of new sewers. Bypass methods shall be to the satisfaction of the Engineer. A bypass submittal shall be submitted and approved by the Engineer before any bypass work can begin.

## 2.9 TERMINAL CLEANOUTS

Dead end lines under 100 feet long may terminate in a cleanout unless otherwise required. If a future extension of said dead end line will include a manhole within 400 feet of the uppermost manhole, a temporary cleanout is permitted.

- A. Location: Refer to applicable portion of Section 2.8.
- B. Design: Cleanouts shall be constructed in accordance with Standard Plan Nos, SV 40-160 or SV 40-170.

## 2.10 SERVICE LATERALS AND CONNECTION CLEANOUTS

City will inspect the construction of service laterals from the main sewer line to the property line.

Wherever it is known or can be reasonably assumed that a building sewer connection is required, a service lateral shall be shown on the plans and installed to the property line as a part of the street sewer construction prior to paving. An independent service lateral shall be provided for each owner. Service laterals shall be installed in general conformity with

Standard Plan Nos. SV 40-180 through SV 40-230. A surface cleanout shall be installed on the lateral at the property line for maintenance and for marking the location of the lateral at the property line. Cleanout location and details shall be in accordance with Standard Plan No. SV 40-230. Unless unfeasible, surface cleanouts shall not be installed in driveways.

A. Size: Service laterals shall be 6-inch minimum diameter.

The maximum size lateral connection by wye or tee fitting to a larger diameter sewer shall be six (6) inches. A manhole shall be installed when an eight (8) inch or larger sewer is connected to an equal or larger diameter sewer.

B. Depth: Service laterals shall be constructed at a 2.0 percent grade unless otherwise approved. In addition, the depth at the curb or property line shall normally be five (5) feet minimum from top of pipe to ground surface.

C. Future Connection: Unused openings shall be tightly sealed and supported in a manner to facilitate their future location and use. The developer's engineer shall select an appropriate service lateral location and shall instruct the contractor to locate the lateral according to the design elevations and locations. Likewise, the adequacy of such in place laterals shall be verified by the owner/developer prior to the future connection.

D. Laterals in Cul-de-sac Streets: Where numerous laterals connect to the end of a sewer, they shall be tied into the mainline downstream of a standard manhole.

E. Backflow Prevention: It is the designer's responsibility to recognize the possibility of reverse flow in service laterals serving lots or buildings with plumbing fixtures below the nearest upstream manhole rim. In such instances, a suitable backflow or overflow device shall be provided. Also, a backflow prevention device (backwater valve) will be required where any pad elevation is less than 6-inches above the next upstream manhole rim. The lots where prevention is required shall be indicated on the plans; the device or valve used shall be approved and inspected by the Building and Safety Department. See Standard Plan No. SV 40-240 for details regarding installation.

F. Curb Markings: The location of all sewer service laterals shall be marked on the curb at completion of construction.

## 2.11 STRUCTURAL REQUIREMENTS

A. Under Roads: All structures and pipe placed under public roads shall be of sufficient strength to support, with an adequate factor of safety, the backfill, road surfacing and H-20 loading per AASHTO Standard Specifications (truck loading with impact).

B. Other Pipes and Structures: Sewers designed to cross under or over other pipes or structures shall be protected from damage and shall be constructed to prevent endangering the other pipe or structure (see Standard Plan Nos. SV 40-50 and SV

40-220). In this regard, particular attention should be given to the possibility and prevention of settlement caused damage. Also, where future replacement of any line may be extremely difficult due to the pipe or structure, special design consideration may be required. Any of the Standard Plates which detail various encasements or other protection may be required by the Engineer in such instances.

- C. Flexible Joints: Flexible joints which will allow for differential settlements or other movement of sewer pipe, sewer structures, adjacent pipe and adjacent structures shall be provided where sewer lines enter encasements, manholes or other structures. Flexible joints shall be within 24-inches of such structure.
- D. Steep Grades: Sewers laid on grades steeper than 10 percent which are not under nor intended to be under pavement should be examined for possible erosion protection. Where the slope exceeds 30 percent (3.33 horizontal to vertical) a redwood check dam (Standard Plan No. SV 40-260) shall be installed across the trench line at 20-foot intervals to reduce erosion.

Concrete anchors in accordance with Standard Plan No. SV 40-270 will only be required in special instances, where such anchorage is deemed necessary to prevent pipe movement.

## 2.12 PRIVATE (RESIDENTIAL) PUMPING SYSTEMS

General City policy is to avoid private residential pumping systems except in those cases where such a system is either: (1) in the City's best interest (as determined by Engineer) or (2) the only method for sewerage a lot which cannot be adapted to a gravity system. In any case, the use of a private pumping system requires specific City review and approval.

Where such a system is employed, it shall be the responsibility of the private landowner to operate and maintain the private pumping system. The City will not accept responsibility for the operation and maintenance of the private system; a document recorded against the property shall confirm this.

Where a pumping unit is proposed, it shall be requested prior to tentative tract map approval, except for those cases where the City may decide to approve the unit at a later date.

## 2.13 FORCE MAINS AND LIFT STATIONS

All sewage shall reach the system by gravity flow, in a fresh (nonseptic) condition susceptible to conventional sewage treatment processes. Where extreme hardship conditions prevail and the area cannot be sewerage by gravity sewers, in accordance with these requirements, a sewage lift station may be considered. No pumping facilities shall be designed or incorporated in sewer plans without prior approval of the Engineer. While the design responsibility rests with the developer/owner, the following are considered to be minimum standards by City:

- A. Lift Stations Design: Lift stations, where permitted by the Engineer, shall be designed in accordance with the following City requirements:

1. Lift station shall be designed as a Wemco Hidrostal Prerostal System or approved equal.
2. Design shall be provided to handle ultimate peak flow from the tributary area with the standby pump out of service. Staged installation of pumps will be permitted if space is provided for future pump units.
3. Access shall be provided to the site for removal and repair of equipment.
4. Lift stations shall not be located in road right-of-way, but shall be located on a separate parcel of land and shall include fences, gates, landscaping, etc. Lift stations located in road right-of-way will only be considered when it can be demonstrated to the governing body of the road right-of-way and the Engineer that no other site is possible. Lift stations shall not be constructed in swamps or other areas susceptible to flooding. The site shall be graded with positive drainage away from the station.
5. Pumps and fittings shall be designed to permit the passage of three (3) inch diameter spheres (minimum) through the pump.
6. Standby power with automatic pump drive transfer shall be provided. Consideration should be given to alternative fuel engines when possible. Fuel capacity shall be sufficient to operate the lift station for 2 days, which operating at design conditions.
7. Overflow storage tank with 24-hour flow capacity installed adjacent to the wet well. A valving/piping system shall be design to return any overflow back to the wet well.
8. Two sets of controls must be provided. One system may either be ultrasonic or hydrostatic and the backup system shall consist of mechanical float switches.
9. Alarm redundancy will require installing two notification systems. An auto-dialer using a phone connection along with the Mission Communications cellular alarm service.
10. Backup electrical power shall be provided using a backup generator with sufficient fuel capacity to operate the lift station for 2 days while operating at design conditions.
11. A separate above ground structure should also be designed to house the generator equipment and electrical panels and controls. It will be important for the structure to provide sound attenuation for the generator as well as aesthetic treatments to minimize visual impacts to the community.

B. Force Mains: Force mains shall be designed in accordance with the requirements of City including but not limited to the following features:

1. Force main design shall be based on providing capacity for the estimated minimum and maximum pumping rates while maintaining a velocity of at least 2.5 fps to keep normal domestic waste in suspension.
2. Minimum size of force main shall be 4 inches in diameter.
3. Force mains shall be laid on a continuous positive grade and to grades designed to eliminate air pockets in the line. Where this is not possible, air release valves shall be provided at all high points in the force main to prevent air locking.
4. Force mains should enter the gravity sewer system at a point not more than 2 feet above the flow line of the receiving manhole.
5. The force main and fittings, including thrust blocks, shall be designed to withstand normal pressure and pressure surges (water hammer).

C. Construction of Special Structures: Design criteria for special facilities (i.e., junction boxes, etc.) that are not covered in previous sections are to be prepared individually for each specific job, subject to approval by the Engineer.

## 2.14 INDUSTRIAL WASTE DISCHARGE

The developer/engineer should be aware that the City regulates the physical and chemical content of wastewaters discharged to the sewerage system. If an applicant proposes to generate wastewater from other than "domestic" quality, an evaluation must be made including submittal of an application to the City Pretreatment Program. Should the wastewater generated contain hazardous/toxic materials, heavy metals, or other substances harmful to the sewage collection or treatment process, the wastewater must be pretreated or it cannot be discharged into the sewer.

Questions and further details concerning these regulations should be directed to the City Environmental Compliance Division.

Also, Standard Plan No. SV 40-250 details a sampling well which may be required of any non-domestic discharges.

## 2.15 ABANDONMENT

A. General: All existing wastewater mains/lines or structures which are to be abandoned shall be identified on the drawings by the developer's engineer. In general, it shall be demonstrated that the abandonment will not adversely affect the wastewater system.

All abandonment must be approved prior to any such work.

- B. Wastewater Mains/Lines: Wastewater mains/lines to be abandoned shall be entirely filled by pumping and/or slurry into them. The pump mix shall be a mixture sufficiently workable for the purposes intended and shall be a concrete mix of 2000 psi minimum and/or concrete slurry. Laterals to be abandoned shall be cut 6-inches from main sewer lines and at the property line plugged at both locations. The remaining portion of the lateral, between the property line and the main sewer line shall be entirely filled with concrete mix of 2,000 psi minimum and/or concrete slurry.
- C. Manholes: Manholes to be abandoned shall have all openings, inlets and outlets sealed off as set forth in Section 2.15B above. The manhole shall then be removed to a minimum depth of 4 feet below proposed finish grade and filled with imported sand (see materials section) if structure is within street right-of-way, or filled with earth and compacted if outside of street right-of-way.

## 2.16 SALVAGED MATERIAL

Disposal of salvaged materials such as frames and covers and other metal appurtenances, shall be the developer's responsibility unless otherwise specified by City.