COUNTY OF SANTA CRUZ

DESIGN CRITERIA

CONTAINING STANDARDS FOR
THE CONSTRUCTION OF

STREETS
STORM DRAINS
SANITARY SEWERS
WATER SYSTEMS
DRIVEWAYS

WITHIN THE UNINCORPORATED PORTION OF
SANTA CRUZ COUNTY

FEB 2018 EDITION
PRICE: $15.00
APPLICABILITY

The Design Criteria standards contained herein, in addition to the latest edition of Caltrans Standard Specifications and Standard Plans, are minimum requirements for development within the unincorporated areas of Santa Cruz County. In the event of conflict, this Design Criteria shall control over Caltrans Standard Specifications and/or Standard Plans. In addition to being required standards for subdivision development, these standards shall apply to all other forms of development under the jurisdiction of the County Department of Public Works, including but not limited to encroachment permits, storm drainage improvement within drainage districts, and water and sewer line construction in County Service Areas and Sanitation Districts.

By reference, the Pleasure Point Community Plan is incorporated into this Design Criteria.

By reference, this Design Criteria is incorporated as part of the subdivision ordinance as set forth in Section 14.01.501 of the Santa Cruz County Code. Exceptions and/or conditional exceptions for subdivisions may be authorized by the approving body and must be reflected in the development use permit and/or the tentative map approval conditions.

The standards included in this Design Criteria are intended to comply with all applicable portions of the Americans with Disabilities Act and of Title 24, the State of California Administrative Code. Questions regarding compliance with these laws or the relationship of these laws to the standards contained herein should be directed to the Department of Public Works, by mail at 701 Ocean Street, Room 410, Santa Cruz, California 95060, or by telephone at (831) 454-2160.

General Announcement

The County of Santa Cruz does not discriminate on the basis of disability, and no person shall, by reason of a disability, be denied the benefits of its services, programs, or activities. Information concerning the provisions of the Americans with Disabilities Act of 1990, and the rights provided thereunder, are available from the ADA Coordinator at (831) 454-2160, TDD number (831) 454-2123.
A NOTE ON METRIC CONVERSION

Users of this edition of the Design Criteria manual will note that in addition to revisions to the text and standard details, dual units of measure are used. The text and figures call out dimensions and quantities in the International System of Units (SI or “metric” units) followed by United States Standard Measures (“English” units) in parentheses, e.g.,

300 mm (12 in)

The use of dual units herein is for transitional purposes only and should not be taken as a format to be used by designers. Improvement plans should avoid use of dual units. The inclusion of metric units in the Design Criteria is a step in the conversion to exclusive uses of metric units in all publicly approved construction projects in Santa Cruz County. Most of the unit conversions herein are rounded-off translations from English to metric units, so-called “soft” conversions. For example, pipe manufactured with an inside diameter of two feet, with a nominal pipe size (NPS) of 24 inches in English units, will henceforth be known as 600 mm pipe, the diameter nominal (DN) metric equivalent. “Hard” conversions have been made, however, where the nominal designation of an item has actually changed.
PART 1. GENERAL ........................................................................................................8
Section A - Improvement Plan Preparation ................................................................9
Section B - Improvement Plan Processing ..................................................................3
Section C - Erosion Control Requirements ..................................................................4

Figure G-1: Typical Sheet Layout for Improvement Plans ...........................................6
Figure G-2: Agency Approval Blocks On Land Division Improvements Plans ............7
Figure G-3: Agency Approval Blocks on Commercial Development Improvement Plans ...8

PART 2. STREET DESIGN .................................................................................................9
Section A - Street Widths ............................................................................................10
Section B - Street Alignment and Grades ...................................................................10
Section C - Structural Section ..................................................................................11
Section D - Grading ..................................................................................................13
Section E - Planting ..................................................................................................13
Section F - Curbs, Gutters, and Sidewalks .................................................................13
Section G - Minor Land Division Road Requirements ................................................15
Section H - Landscaping ............................................................................................15
Section I - Curb Ramps .............................................................................................16
Section J - Inlet Location ...........................................................................................16
Section K - Survey Monument Boxes .......................................................................16
Section L - Placement of Utility Poles, Fire Hydrants, and Other Roadside Facilities ...16
Section M - Street Lighting ........................................................................................17
Section N - Retaining Walls .......................................................................................17
Section O – Physical Speed Control Devices (Road Bumps and Speed Tables) ............18
Section P - Street Plan Lines .......................................................................................19

Figure ST-1a: Geometric Cross-Sections ....................................................................20
Figure ST-1b: Standard Public Street Widths ...............................................................22
Figure ST-2: General Street Requirements ..................................................................25
Figure ST-3: Minimum Landscape Clearances ............................................................26
Figure ST-4a: Curb, Gutter, Sidewalk and Dike Details .............................................27
Figure ST-4b: Under Sidewalk Drain ..........................................................................28
Figure ST-5: Concrete Cross Gutter ............................................................................29
Figure ST-6a: Typical Driveway Depression ...............................................................30
Figure ST-6b: Driveway Curb Depression, Standard Separated Sidewalk and Rolled (Type B) Curb ........................................................................................................31
Figure ST-6c: Driveway Curb Depression, 1.2 m and 1.8 m Sidewalk .......................32
Figure ST-7: Road Barricade .......................................................................................33
Figure ST-8a: Curb Ramp Type A ..............................................................................34
Figure ST-8b: Curb Ramp Type B ..............................................................................35
Figure ST-8c: Curb Ramp Type C ...............................................................................36
Figure ST-8d: Curb Ramp Type D ...............................................................................37
Figure ST-8e: Curb Ramp Type E ...............................................................................38
Figure ST-9a: Tree Planting in Tree Well or Planting Strip ..........................................39
Figure ST-9b: Tree Planting in Landscape Area ..........................................................40
Figure ST-10: Pavement Grinding Detail .....................................................................41
Figure ST-11: Standard Street Monument ...................................................................42
Figure ST-12: Sidewalk Transition at Obstruction ......................................................43
Figure ST-13A: Physical Speed Control Devices (Road Bumps) .................................44
Figure ST-13B: Physical Speed Control Devices (Speed Tables) ...............................45
Figure ST-14: Transition From Contiguous to Separated Sidewalk ............................46
PART 3. STORMWATER MANAGEMENT

Section A - Submittal Requirements ................................................. 47
Section B - Design References ..................................................... 49
Section C – Mitigation Requirements .............................................. 50
  Figure SWM-1: 10-Year Runoff Coefficients ................................ 59
  Figure SWM-2: Rainfall Intensity Isopleths .................................. 60
  Figure SWM-3: Rainfall Intensity - Duration Curves ...................... 61
  Figure SWM-4: Time of Concentration Nomograph ......................... 62
Section D - Hydrology - Minimum Design Requirements ................... 63
  Figure SWM-5: Pipe and Channel Roughness Coefficients ............... 64
  Figure SWM-6: Drainage System Calculation Sheet ......................... 65
  Figure SWM-7: Instruction for Drainage System Calculations ............ 66
Section E - Hydraulic Requirements ................................................ 67
  Figure SWM-8a: County Standard GO Inlet .................................. 68
  Figure SWM-8b: Frame and Grate for GO Inlet ............................... 69
  Figure SWM-9: Pipe Connection to Existing Inlet ......................... 70
  Figure SWM-10: Storm Drain Manhole ........................................ 71
  Figure SWM-11: Water Quality Treatment Unit in Manhole .............. 72
  Figure SWM-12: Water Quality Treatment Unit in Inlet .................. 73
  Figure SWM-13: Longitudinal Trench Detail ................................ 74
  Figure SWM-14: Cross Trench Detail ........................................... 75
Section F - Storm Drainage Facilities .............................................. 76
Section G - Right-of-Way and Easement Dedications .......................... 77
Section H - On-Site Detention of Stormwater Runoff .......................... 79
  Figure SWM-15a: Detention Storage Volume Graph ......................... 84
  Figure SWM-15b: Detention Storage Volume Graph ......................... 85
  Figure SWM-15c: Detention Storage Volume Graph ......................... 86
  Figure SWM-15d: Detention Storage Volume Graph ......................... 87
  Figure SWM-16: Detention Volume Design Example ......................... 88
  Figure SWM-17: Sample Detention Calculation Form on County Website .... 89
Section I - On-Site Retention of Stormwater Runoff .......................... 90
  Figure SWM-18: Selection of Perforated Pipe Length ...................... 97
  Figure SWM-19a: Estimated Velocity Attained for Overland Flows ....... 98
  Figure SWM-19b: Permissible Velocity for Bare Soils .................... 99
  Figure SWM-20: Water Supply Watershed Detention Storage Volume ...... 100
  Figure SWM-21: Retention by the Slope Infiltration Method ............. 101
  Figure SWM-22: Sample Retention Calculation Form on County Website .... 102
  Figure SWM-23: Retention by the Storage Percolation Method .......... 103
  Figure SWM-24: Sample Retention Calculation Form on County Website .... 107
  Figure SWM-25: Stormwater Treatment System Maintenance Agreement .... 108
Section J - Stormwater Runoff from Individual Parcels ...................... 110

PART 4. SANITARY SEWER DESIGN .................................................. 111
Section A - Submittal Requirements .............................................. 111
Section B - Reference Manuals .................................................... 111
Section C - Design Flow Rates .................................................... 111
Section D - Design of Sewer Systems .......................................... 112
Section E - Sewer Easement Requirements ..................................... 113
Section F - Sewer Plan Layout ..................................................... 114
Section G - Lift Stations .............................................................. 115
Section H - Construction Standards .............................................. 116
  Figure SS-1: Design Flow Flow Graph ....................................... 118
Figure SS-2A: Sanitary Sewer Standard Longitudinal Trench Backfill Section ...........................................119
Figure SS-2B: Sanitary Sewer Standard Cross Trench Backfill for Laterals or Sewer Structures .................................................................120
Figure SS-3: County Criteria for Sewer Layouts .........................................................................................121
Figure SS-4: Standard Main Manhole ....................................................................................................122
Figure SS-5: Standard Trunk Manhole ....................................................................................................123
Figure SS-6A: Outside Drop Manhole Connection ..................................................................................124
Figure SS-6B: Inside Drop Manhole Connection .....................................................................................125
Figure SS-7: Cul-de-sac Manhole .............................................................................................................126
Figure SS-8: Lift Station ............................................................................................................................127
Figure SS-9: Lift Station ............................................................................................................................128
Figure SS-10: Standard Cleanout ...............................................................................................................129
Figure SS-11: Concrete Encasement - Slurry Cap ......................................................................................130
Figure SS-12: Sewer Lateral Connection Details ......................................................................................131
Figure SS-13: Residential Sewage Pump Station ......................................................................................132
Figure SS-14: Backflow Preventive Devices ..............................................................................................133
Figure SS-15: Lateral Abandonment Details ............................................................................................134
Figure SS-16: Exterior Grease Interceptor Specifications ........................................................................135
Figure SS-17: Exterior Grease Interceptor (Plan & Section) ....................................................................136
Figure SS-18: Interior Grease Trap ...........................................................................................................137
Figure SS-19: Specifications for Clarifier .................................................................................................138
Figure SS-20: Standard Clarifiers .............................................................................................................139
Figure SS-21: Sewer Lateral or Main Repair .............................................................................................140
Figure SS-22: Industrial Waste Sampling Manhole ................................................................................141
Figure SS-23: Standard Manhole Cover ..................................................................................................142
Figure SS-24: Standard Manhole Frame ..................................................................................................143

PART 5. WATER SYSTEMS .........................................................................................................................144
Section A - Purpose of Water Standards ................................................................................................145
Section B - Domestic Water System ........................................................................................................145
Section C - Use of Existing Domestic Water Systems - Availability and Capability ................................145
Section D - Use of Existing Domestic Water Systems - Quality Standards ............................................145
Section E - Use of Individual Springs or Wells .......................................................................................146
Section F - Water System Improvement Plans .......................................................................................146
Section G - Quantity of Water for Domestic Service ..............................................................................146
Section H - Continuity of Service ...........................................................................................................146
Section I - System Pressure and Facilities Requirements .........................................................................146
Section J - Distribution System Requirements .......................................................................................148
Section K - Water Treatment ..................................................................................................................153
Section L - Abandoned Wells ...................................................................................................................154
  Figure W-1: Maximum Demand Graphs .................................................................................................155
  Figure W-2: Maximum Demand Graphs .................................................................................................156
  Figure W-3: Storage Capacity Graphs ....................................................................................................157
  Figure W-4: Storage Capacity Graphs ....................................................................................................158
  Figure W-5A: Standard Water Service Connection ..............................................................................159
  Figure W-5B: Backflow Prevention Assembly ......................................................................................160
  Figure W-6: Standard 3” and Larger Fire Service Installation ...............................................................161
  Figure W-7: Standard Fire Hydrant Installation ....................................................................................162

PART 6. DRIVEWAYS AND ENCROACHMENTS .........................................................................................163
Section A - Driveway Regulations ...........................................................................................................164
Section B - Trench Backfill .......................................................................................................................166
PART 1. GENERAL
PART 1. GENERAL

Section A - Improvement Plan Preparation

1. The improvement plans shall be prepared by a Registered Civil Engineer, and shall be drafted on good grade vellum or better material (mylar, linen, etc.). The following are some of the items which must be included on the plans:
   
a. Project vicinity map on the title sheet.

   b. Locations of existing utilities. Utilities requiring relocation should be identified and their final locations shown on the plans.

   c. Stationing along road and/or sewer and storm drain line, where applicable.

   d. Location of sewer, storm drain, curb and gutter, and other proposed improvements and utilities with respect to road or utility easement centerline.

   e. Benchmark datum. This must be County datum unless prior approval has been secured from the Director of Public Works.

   f. Driveway plans and profiles.

   g. Sufficient topographic information to make clear the purpose and extent of proposed grading. Topographic information shall extend a minimum of 15 m (50 ft) beyond the limits of work in all directions in order to show the effect of the proposed grading on adjacent property and to identify local drainage patterns. Abrupt changes in grade and existing retaining structures at property lines shall be clearly identified in plan and section views. Typically, existing and final contours, together with significant spot elevations, should appear on the plans. In cases where significant grading is required, cut and fill lines may be required.

   h. When road or roadside work is required, existing centerline and flowline profiles for a minimum of 30 m (100 ft) beyond the limits of work in both directions. In any case, the extent of profiles shall be such that good drainage and road design are possible. Offsite improvements may be required to provide adequate drainage or roadway transitions.

2. The scale of the improvement plan shall not exceed 1:600 (1" = 50') horizontal and 1:60 (1" = 5') vertical unless prior approval is obtained from the Director of Public Works. Note that the preferred scales are dimensionless true ratios.
3. Arrangement of the improvement plans shall conform to Figure G-1 of this
*Design Criteria*. Approval blocks for Public Works’ signoff, per Figures G-2 and G-3, shall be included on the title sheet of the improvement plans. Approval blocks for the Planning Department, the appropriate Fire District, and the appropriate Water District shall also be included.

4. In some instances, the amount of information required on improvement plans makes division of the information into separate corresponding sheets or series of sheets advisable. Layout sheets containing complex surface work will appear less cluttered, and thus less subject to misinterpretation by contractors, if some or all of the subsurface work is shown elsewhere. Refer to Caltrans’ “Project Plan Preparation,” or to Chapter 4 of Caltrans’ *Drafting and Plans Manual of Instruction.*

**Section B - Improvement Plan Processing**

1. The initial submittal of improvement plans for checking shall be made to the Director of Public Works and shall consist of five sets of prints for land divisions and two sets of prints for encroachment permits. Public Works will forward the improvement plans to the appropriate fire agency and to the Planning Department for their comments to facilitate a coordinated review of the proposed improvements. Other agencies, including the water purveyor and utility companies, should be served with improvement plan sets by the developer.

2. The developer shall submit with the improvement plans a signed copy of the conditions of approval for the project from the Planning Department and the approved tentative map or other exhibits relevant to the development approval. All reports and letters of compliance from third parties required by the conditions of approval shall also be submitted with the improvement plans. In no case will improvement plans be reviewed without these supporting documents in their final approved form.

3. Upon completion of the checking process, the original drawings (not sepias) shall be submitted for approval signatures. The original drawings will be signed by Public Works engineers in stormwater management, sanitation, road planning, and survey; by Environmental Planning and by the Planning Director; by the appropriate fire agency; and by the water purveyor prior to signature by the Director of Public Works. The original drawings shall be accompanied by an engineer’s estimate to be used to establish construction security requirements. After the Director of Public Works has approved the plans and reproducible copies have been made for the County’s files, the original plans will be returned to the Engineer.

4. Subdivisions will be scheduled for the Board of Supervisors’ approval when all deficiencies identified during the review process are addressed, and the plans and following items are deemed complete and acceptable by Public Works. In no case will subdivisions be scheduled for approval by the Board of Supervisors until all items are complete.
a. Planning Department letter of compliance with the tentative map and conditions of approval.

b. Final map and related conditions thereto met and approved by the County Surveyor.

c. Subdivision agreement and securities based on approved improvement plans, recorded agreements, and payment of all fees.

5. Refer to Section 14.01.501, et seq., of the County Code regarding fees, agreements, and construction securities for land divisions and Section 9.70, et seq., for encroachment permits.

6. As-built digital file for all drainage facilities shall be submitted prior to the Board of Supervisors’ acceptance of subdivisions, or prior to permit final and occupancy for other types of projects. The submittal shall contain the following criteria:

Projection: State Plane Coordinate System - California III - Feet
Horizontal Datum: NAD 83
Vertical Datum: NAD 83
Any CAD is acceptable. AutoCAD is preferred.
The file can be emailed to the GIS staff or be submitted on a compact disc.

Section C - Erosion Control Requirements

1. The following requirements are made pursuant to Section 16.22, “Erosion Control,” of the Santa Cruz County Code.

2. No land clearing, grading, or excavating shall be done between October 15 and April 15, without review and approval of a separate winter erosion control plan by the Environmental Planning Section of the Planning Department prior to beginning such construction. Winter erosion control plans shall be submitted to the Environmental Planning Section a minimum of 30 days before construction is to begin.

3. Disturbance and removal of vegetation shall not exceed the minimum necessary to complete operations. All disturbed soil (particularly cut and fill slopes) shall be seeded and mulched in an approved manner prior to project completion but in no case later than October 15. The mulch cover shall be maintained until a good vegetative cover has been established. When permanent landscaping has been installed but is not fully established, any exposed soil shall be mulched between October 15 and April 15.
4. Unless specific measures are shown or noted on the approved plans, all collected or concentrated runoff shall be percolated into the ground, carried to drainage courses in lined conduits, or dispersed over dense vegetation in an approved manner that will not cause erosion.

5. The desired end result of these measures is to control site erosion and prevent sediment transport off the site. It shall be the developer’s responsibility to see that any additional measures necessary to meet this goal are implemented. If field inspections by County staff show this goal is not being met, additional measures will be required.

6. Pamphlets detailing seeding and mulching, runoff control, and winter erosion control plan requirements are available on request from the Environmental Planning Section of the Planning Department, and are available on the County’s internet site, www.co.santa-cruz.ca.us, under Planning Department, Brochures.

7. The following wording shall appear as a standard note on all stormwater, street, or other improvement plans submitted to the Department of Public Works or the Planning Department for review and approval:

**EROSION CONTROL PLAN**

All construction shall conform to Part 1, Section C, “Erosion Control Requirements,” of the County Design Criteria. No clearing, grading, or excavation shall take place between October 15 and April 15 unless there is an approved winter erosion control plan. All disturbed soil shall be seeded, mulched, or otherwise protected by October 15.
Figure G-1: Typical Sheet Layout for Improvement Plans
Figure G-2: Agency Approval Blocks On Land Division Improvements Plans
Figure G-3: Agency Approval Blocks on Commercial Development Improvement Plans

SANTA CRUZ COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT, ZONE ____
STORMWATER PLAN

REVIEWED BY:

APPROVAL RECOMMENDED ________ ASST. DIR., SPECIAL SERVICES DATE

APPROVED ________ DISTRICT ENGINEER DATE

FOR INSPECTIONS, CONTACT PUBLIC WORKS CONSTRUCTION ENGINEER AT (831) 454–2160
48 HOURS PRIOR TO START OF WORK

SANTA CRUZ COUNTY SANITATION DISTRICT

REVIEWED BY:

APPROVAL RECOMMENDED ________ ASST. DIR., SPECIAL SERVICES DATE

APPROVED ________ DISTRICT ENGINEER DATE

AGENCY APPROVAL BLOCKS ON COMMERCIAL DEVELOPMENT IMPROVEMENT PLANS

REV. 12/05 FIG. G–3
PART 2. STREET DESIGN
Section A - Street Widths

1. Recommended standard and minimum rights-of-way and elements of geometric cross section shall be as shown in Figures ST-1a and ST-1b.

2. Existing County roads within the project shall be improved to the geometric, right-of-way, and structural standards of this Design Criteria. In the event an existing County road is on the boundary of a proposed improvement, the half of the road adjacent to the improvement shall be improved to the County standards, as specified in the conditions of approval, or as directed by the Director of Public Works.

Section B - Street Alignment and Grades

1. General requirements shall be no less than the minimum set forth in Figure ST-2.

2. Vertical curves are required for all grade breaks of one percent or more.

3. The gradient of a street entering an intersection shall not be more than three percent within a distance of 6 m (20 ft) from the curb line of the intersected street.

4. Streets shall be superelevated only if required by the Director of Public Works.

5. Whenever possible, the crown should be at the design centerline of the road. However, the crown may be shifted to within 2.5 m (8 ft) of the face of curb, at the discretion of the Director of Public Works.

6. Minimum curb return radii shall be 9 m (30 ft) measured at face of curb for arterial and collector streets and 6 m (20 ft) for residential streets. At the intersection of a residential street with an arterial or a collector, the lesser standard will apply at the discretion of the Director of Public Works.

7. Minimum cul-de-sac radii shall be 9.8 m (32 ft), measured at curb flowline and 12.8 m (42 ft), measured at the right-of-way line.

8. On County roads and in rights-of-way offered to the County for dedication, dead-end streets shall be provided with a paved cul-de-sac of standard radius. Other dead-end streets longer than 45 m (150 ft) shall be provided with barricades and turnarounds that meet the requirements of the appropriate fire agency, the Planning Department, and the Director of Public Works.
9. Dead-end streets shall not exceed 150 m (500 ft) in length unless an emergency access road acceptable to the appropriate fire protection agency and the Director of Public Works is provided.

10. Streets and highways shall intersect one another at angles as near to a right angle as practical, and no intersections shall be at angles of less than 60 degrees.

11. Streets intersecting at an angle other than 90 degrees may require the use of setback lines, special rounding of corners, traffic circle, or other design details to assure desirable results as to traffic movement, visibility, and safety.

12. If the painted center lines of two streets intercepting the same street from opposite directions are offset from each other, said offset shall be a maximum distance of three meters (10 ft), or a minimum distance of 60 m (200 ft), measured along the center line of the street intercepted.

13. The maximum cross slope for any pavement widening shall be 4%. The widening or other conform section shall be extended into the existing road as far as necessary to achieve a finished cross slope within tolerable limits (generally 2% to 4%), with the Director of Public Works’ approval. Improvement plans shall reflect the fact that the actual width of the new section depends upon this requirement.

14. Typical street sections appearing on improvement plans shall show the entire section, fully dimensioned, even though the plans may call for improving only a portion of the street section. Typical sections should show existing as well as proposed conditions, including lane striping.

15. When feasible, lane widths will be adjusted to account for striping width and provide for enhanced bike lane width up to 1.8 m (6 ft).

Section C - Structural Section

1. The total structural section shall be designed by R-value (Test Method Calif. 301). The total structural section should be the reasonable result of a rational design method, such as Caltrans’ flexible pavement design procedure. (See Section 608.4 et seq., of Caltrans’ Highway Design Manual.)

2. Traffic Index values for new roads shall be based on the type of road and number of lots served in ultimate developments, and approved by the Director of Public Works.

3. Traffic Index values for existing County roads to be improved shall be determined by the Director of Public Works.

4. Except for minor private roads and driveways, the minimum required surface course shall be 75 mm (3 in) asphalt concrete Type B, 12.5 mm (½ in) maximum, medium aggregate gradation. A prime coat shall be applied before paving.
5. Except for minor private roads and driveways, the minimum required base course shall be 225 mm (9 in) of Class 2 aggregate, for all non-engineered road sections.

6. The balance of the pavement structural section may be comprised of aggregate subbase with a minimum R-value of 50.

7. With the approval of the Director of Public Works, the minimum structural section for minor private roads and driveways shall be 50 mm (2 in) asphalt concrete Type B on 150 mm (6 in) of Class 2 aggregate base.

8. The minimum structural section for paving adjacent to a designated bus stop or turnout shall be 100 mm (4 in) asphalt concrete Type B on 300 mm (12 in) of Class 2 aggregate base or approved equivalent. This strengthened pavement section shall extend 3 m (10 ft) from the lip of gutter or other street improvements.

9. The number and location of soils tests shall be subject to the approval of the Director of Public Works, the minimum being one test for each 150 linear meters (500 linear ft) of proposed street. The R-value used for design purposes shall be the lowest test result, unless sufficient tests and soils investigations are made to determine the limit of the various soil types tested.

10. Relative compaction shall conform to the latest Caltrans specification. As a minimum standard the top 150 mm (6 in) of subgrade and the aggregate base material under all paved surfaces subject to vehicular use (including curbs, gutters, and driveway approaches) shall be compacted to a minimum 95% relative compaction. The top 150 mm (6 in) of subgrade under concrete sidewalks shall be compacted to a minimum 90% relative compaction, except where sidewalk is constructed next to Type B curb and gutter, in which case the top 150 mm (6 in) of subgrade under the sidewalk shall be compacted to a minimum 95% relative compaction.

11. In addition to R-value tests to determine the structural section, further soils tests may be required by the Director of Public Works to determine erosion control, stability, or subdrainage requirements.

12. Redwood headers with minimum dimensions of 50 mm x 150 mm (2 in x 6 in) shall be installed along all exposed edges of asphalt concrete paving, when deemed necessary by the Director of Public Works.

13. When overlaying existing asphalt concrete pavement next to existing concrete curb and gutter, the pavement next to the edge of the gutter shall be removed by grinding (See Figure ST-10) before applying the new surface course. Any traffic signal detector loops damaged by grinding shall be replaced at the developer’s expense. The contractor shall notify the Department of Public Works at least 48 hours prior to grinding near traffic signals.
14. For access roads serving more than one dwelling where portland cement concrete (PCC) is to be used, the minimum structural section shall be 150 mm (6 in) PCC on 100 mm (4 in) of sand or Class 2 aggregate base with 150 mm x 150 mm (6 in x 6 in) welded wire fabric placed appropriately in the PCC. Use of the minimum or other structural section shall be at the discretion of the Director of Public Works.

15. Concrete grass pavers shall not be used in County maintained right-of-way as part of a structural section subject to vehicular or pedestrian traffic.

16. Concrete grass pavers installed to manufacturers’ specifications, and as shown on plans approved by the Director of Public Works, may be used for restricted use secondary access roads, or for other traffic surfaces when warranted by significant environmental conditions, subject to the following:

   a. The Director of Public Works may disapprove the use of concrete grass pavers on access roads that slope towards the street, if the department determines that their use could result in the deposit of sediment on the street, or could otherwise cause significant problems within a County maintained right-of-way.

   b. If appropriate, the Director of Public Works may require provisions be made to accommodate pedestrian traffic, with a minimum 1.2 m (4 ft) wide asphalt concrete or portland cement concrete walkway.

   c. The Director of Public Works may require that compaction test results of the subgrade soil be submitted for review and that adequate compaction be demonstrated to the satisfaction of the department.

Section D - Grading

1. Santa Cruz County’s grading ordinances as set forth in Chapter 16.20 of the County Code shall regulate all excavation, grading, and filling of land within the County.

Section E - Planting

1. Slope planting shall be performed, if required by soils report, tentative map, use permit, or the Director of Public Works.

Section F - Curbs, Gutters, and Sidewalks

1. Portland cement concrete Type A curbs, gutters, and sidewalks shall be constructed for all development projects, unless, for reasons such as accessibility, preservation of rural character, nature of existing improvements, etc., a variation from this standard is approved through the Street Plan Line or roadside exception process.
2. Curb returns shall include ramps to provide access to the roadway grade and provide continuity of safe access for pedestrians. (See Figures ST-8a through ST-8e.)

3. Sidewalks shall be constructed to meet accessibility standards set forth in this Design Criteria. Sidewalk cross slopes shall not exceed two percent.

4. Sidewalk material and width requirements are as follows:
   
a. Portland cement concrete, Class 3 (Class B), on all arterial, collector, and local streets within the Urban Services Line.
   
b. Certain residential streets have been designated to include colored concrete sidewalk or curb, gutter, and sidewalk. On streets which have been so designated and on all new local streets either the color pigment “Mesa Buff” produced by Davis Colors, or the color “Natural Honey” produced by Q.C. Construction Products shall be used to color this concrete. A list of existing streets which have been designated to include colored concrete improvements is maintained on file in the Planning and Public Works Departments.
   
c. Sidewalks shall be 1.2 m (4 ft) wide (unobstructed) in residential areas and 1.8 m (6 ft) wide (1.2 m (4 ft) unobstructed) in commercial areas; except that sidewalk widths shall match existing widths in various areas as appropriate and shall vary per accessibility standards set forth in this Design Criteria with the separated sidewalk design (Figure ST-6) being the standard design.
   
d. When new sidewalk terminates without connecting to existing sidewalk, an asphalt concrete conform section shall be constructed to provide a transition to existing grade at the termination. The slope of the conform section shall meet accessibility standards set forth in this Design Criteria.

5. Portland cement concrete Type B curb shall be permitted for use in residential infill areas only as necessary to conform to existing Type B curb on adjoining parcels or where other accessibility standards set forth in this Design Criteria are not practical, as determined through the roadside exception or Street Plan Line process.

6. Portland cement concrete Type C curb shall be permitted on privately maintained driveways and parking areas at the discretion of the Director of Public Works (Figure ST-4). Type C curb shall be permitted on County maintained roads only for median islands or similar installations, where the road surface drains away from the curb.

7. Portland cement concrete curb, curb and gutter, or valley gutter shall be required on paved surfaces having a longitudinal slope of less than 1.5%.
Section G - Minor Land Division Road Requirements

1. Road requirements for minor land divisions will be determined on a case by case basis and will be noted on the approved tentative map and conditions.

Section H - Landscaping

1. Where landscaping is required, a landscape plan shall be prepared by a Licensed Architect or Licensed Landscape Architect. The plan shall show the species, location, number, and size of plants to be installed. Specifications for installation and establishment of plant materials shall be included. The landscape plan shall be coordinated with the site grading and drainage plans.

2. Where regular periodic irrigation of the established landscaping is necessary, an irrigation plan shall be prepared. The plan shall show the location, size, and type of materials to be installed.

3. Street trees shall be required as part of all projects on public streets inside the Urban Services Line. These trees shall be chosen, planted, and maintained in accordance with the Santa Cruz County Urban Forestry Master Plan, when applicable, chosen from the County Street Tree List, or approved by the County’s Urban Designer. Trees shall be planted at a minimum rate of one tree per 7.6 lineal meters (25 lineal ft) of frontage, with tree cluster an option for placement. Planting shall be done according to Figures ST-9a and ST-9b.

4. Street trees shall be maintained by the property owners and as directed by the approving body, unless the property is located on a “Primary Street Tree Street,” as defined by the Urban Forestry Master Plan, and that street has been accepted into the regular street tree maintenance program administered by the Santa Cruz County Redevelopment Agency.

5. Street trees in residential projects shall be planted in County right-of-way in a minimum 1.2 m (4 ft) wide planting strip between the curb and the sidewalk. Where separated sidewalks are not possible, trees shall be planted per the Urban Forestry Master Plan or per the approving body. Trees shall be maintained by the County where applicable, or as directed by the approving body.

6. Street trees in commercial areas shall be planted in County right-of-way in a minimum 1.2 m (4 ft) wide planting strip between the curb and sidewalk, or where 1.2 m (4 ft) of unobstructed sidewalk can be obtained, in a minimum 1.2 m (4 ft) wide by 1.8 m (6 ft) long rectangular tree well cut out of the sidewalk behind the curb. Where separated sidewalks or tree wells are not possible, trees shall be planted outside the right-of-way or as recommended in the Urban Forestry Master Plan. Street trees shall be planted according to provisions of the Urban Forestry Master Plan and Figures ST-9a and ST-9b. Trees shall be maintained by the County where applicable, or as directed by the approving body.
7. Adequate sight distance shall be assured where landscaping is planted in or near the public right-of-way. Vegetation shall be maintained in a manner that will insure adequate sight distance.

Section I - Curb Ramps

1. Curb ramps shall be constructed at all crosswalks and at all curb returns where there is existing sidewalk or sidewalk is constructed, and necessary to provide continuity of safe travel for pedestrians. (See Figures ST-8a through -8e.)

Section J - Inlet Location

1. Drainage inlets shall be placed outside the wheel path of passing vehicles. If this is not possible, the grate must be set to match the slope of the roadway.

2. Drainage inlets shall not be located within curb returns at intersections.

Section K - Survey Monument Boxes

1. A cast iron monument box (Forni type 80-60-03, Phoenix type P-2001, D&L type K-6001-2, or approved equal) shall be set, together with a standard bronze monument, at all beginning of curve, end of curve, and intersection points along the centerline of the right-of-way of all new roads intended to be County maintained. Street centerline monuments shall establish both vertical and horizontal control. (See Figure ST-11.)

Section L - Placement of Utility Poles, Fire Hydrants, and Other Roadside Facilities

1. Utility poles shall be located behind a sidewalk built adjacent to the curb, or in the planting strip between the curb and a separated sidewalk. Where it is not practical to place a utility pole behind the back of sidewalk, it may be located 300 mm (1 ft) from face of curb to face of pole, provided that a minimum of 1.2 m (4 ft) of clear sidewalk width is constructed in conformance with Figure ST-12.

2. Fire hydrants shall be located behind a sidewalk built adjacent to the curb, or in the planting strip between the curb and a separated sidewalk. At midblock fire hydrant locations the curb shall be painted red to ensure visibility. Fire hydrant location shall be indicated by installation of a blue reflective pavement marker at street centerline.

3. Where road widening, sidewalk construction, or other work of improvement is required of a development, it is the sole responsibility of the developer to relocate all affected surface utilities on the developer’s property frontage and along off-site improvements, in conformance with the requirements of the County and the applicable utility agencies.
4. Individual and cluster mailboxes shall be located behind a sidewalk built adjacent to the curb, or in the planting strip between the curb and a separated sidewalk, or as determined by the decision making body.

5. Traffic signage shall be located behind a sidewalk built adjacent to the curb, or in the planting strip between the curb and a separated sidewalk, except where such placement would conflict with good traffic engineering practice.

**Section M - Street Lighting**

1. Except as provided below, residential street lighting improvement standards apply to all residential development located within the County Urban Services Line on a County road, or on a road to be offered for dedication to the County. Residential development may be required to construct off-site street lighting improvements.

2. The developer of property within an area that does not currently have residential street lighting because of the historical opposition of residents to the installation of lighting may seek a variance from the residential street lighting requirements. A variance will be granted only if the applicant’s engineer can satisfactorily document to the Department of Public Works that the failure to install lighting will not create a dangerous condition on public property that could have been avoided by the installation of lighting.

3. A street lighting plan shall be prepared by a Registered Civil Engineer or other appropriately licensed individual. The plan and design shall be in accordance with published Pacific Gas and Electric (PG&E) standards, or the Association of Illumination Engineers’ standards. The plan shall also be consistent with County Service Area 9 - Highway Safety Lighting, and/or County Service Area 9, Zone A, Residential Street Lighting standards, before being approved by the County.

4. Appropriate street lights shall be installed at the developer’s expense.

**Section N - Retaining Walls**

1. Retaining walls are not allowed in County right-of-way without substantial proof that justifies the location. If allowed they shall be constructed of reinforced concrete or reinforced masonry and conform with current Uniform Building Code Standards, unless prior approval of an alternate material is obtained from the Director of Public Works.
Section O – Physical Speed Control Devices (Road Bumps and Speed Tables)
(See Figure ST-13A and Figure ST-13B)

1. The length of the installation shall be 3.6 m (12 feet) for road bumps and 6.6 m (22 feet) for speed tables from the beginning of rise from the pavement surface to return to the pavement surface, with a profile view that is generally parabolic (a 3.0 m (10 feet) middle flat segment is required for speed tables).

   The height of the road bump and the speed table shall be 100 mm (4 inches) per the template approved by the Director of Public Works.

3. Road bumps and speed tables shall be tapered from zero elevation at the lip of gutter to the full height approximately 600 mm (2 feet) from the gutter and shall not interfere with drainage.

4. Road bumps or speed tables shall not be placed over manholes, water valves, utility vaults or other underground structures.

5. Whenever possible, the edge of a road bump or speed table shall be at least 1.5 m (5 feet) from the edge of a driveway.

6. Whenever possible, road bumps and speed tables shall be placed adjacent to street lights for better visibility.

7. Whenever possible, road bumps and speed tables shall be placed opposite property lines rather than mid-lot.

8. Whenever possible, road bumps and speed tables shall be placed at least 60 m (200 feet) away from intersections and sharp horizontal curves and located to provide adequate sight distance in either direction. Road bumps and speed tables may be closer to intersections and curves with approval from the Director of Public Works. Whenever possible road bumps and speed tables shall be placed at least 90 m (300 ft) apart.

9. Warning signs and markings shall be used as follows:

   a. “BUMPS AHEAD” warning signs at the beginning of the road bump and speed table area and at all entrances.

   b. Speed advisory plates (15 MPH) mounted below the “BUMPS AHEAD” warning sign.

   c. Pavement markings at the road bump and speed table (“BUMP”).

   d. Double yellow centerline in the vicinity of the road bump and speed table where adequate width will allow (approximately 15 m (50 feet) on either side).

   e. "V" shaped white reflective pavement markings on the road bump and speed table for each direction of travel.
10. Road bumps and speed tables may be constructed out of asphalt or concrete as directed by the Director of Public Works.

11. Road bumps and speed tables shall not interfere with street and sidewalk access for pedestrians.

Section P - Street Plan Lines

1. In instances where the proposed improvements for a particular development application based upon the standards in the Design Criteria would not be practical or feasible due to existing roadway alignment, topographical or environmental constraints, or would not be compatible with adjacent improvements or previously approved route concepts, a plan line study will be required by the Director of Public Works.

A plan line study would provide guidelines for the proposed improvements in relation to other development, or to public improvements which will be constructed in the future.

A plan line is a graphical representation on an aerial photograph (1:240 [1 inch=20 ft])* of an approved route concept or Design Criteria standards, as approved by the Board of Supervisors, depicting the ultimate improvement guidelines for a specific street segment, a written summary of potential impacts and, if required, an engineer’s estimate for improvement costs. The plan line shall include the number and location of travel and turn lanes, bike lanes, on-street parking, roadside improvements, transit facilities, utility corridors, and estimates of required right-of-way.

* The existing aerial photographs will remain at 1:240. Future aerial photographs for plan lines may be required to be at a more standard true ratio scale, such as 1:250.
Figure ST-1a: Geometric Cross-Sections
TYPICAL SECTION A-3
MINIMUM RURAL LOCAL STREET

ALTERNATE SIDEWALK LOCATION

NOTE: ALTERNATE SIDEWALK LOCATION ADJACENT TO CURB
MUST BE APPROVED BY THE PUBLIC WORKS DIRECTOR.

GEOMETRIC CROSS SECTIONS
Figure ST-1b: Standard Public Street Widths

STANDARD PUBLIC STREET WIDTHS

URBAN ARTERIAL STREET WITH BIKE LANES - NO PARKING:

<table>
<thead>
<tr>
<th></th>
<th>2-LANE STREET</th>
<th>3-LANE STREET</th>
<th>4-LANE STREET</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STANDARD SECTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel lane (12’)</td>
<td>24.00</td>
<td>36.00</td>
<td>48.00</td>
</tr>
<tr>
<td>Bike lane (5’)</td>
<td>10.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>Landscape strip/curb (4.625')</td>
<td>9.25</td>
<td>9.25</td>
<td>9.25</td>
</tr>
<tr>
<td>Sidewalk (6’)</td>
<td>12.00</td>
<td>12.00</td>
<td>12.00</td>
</tr>
<tr>
<td>Remainder</td>
<td>4.75</td>
<td>4.75</td>
<td>4.75</td>
</tr>
<tr>
<td>Required R/W (ft)</td>
<td>60.00</td>
<td>72.00</td>
<td>84.00</td>
</tr>
</tbody>
</table>

URBAN COLLECTOR STREET WITH PARKING AND BIKE LANES:

<table>
<thead>
<tr>
<th></th>
<th>2-LANE STREET</th>
<th>3-LANE STREET</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STANDARD SECTION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel lane (12’)</td>
<td>24.00</td>
<td>36.00</td>
</tr>
<tr>
<td>Parking/bike lane (12’)</td>
<td>24.00</td>
<td>24.00</td>
</tr>
<tr>
<td>Landscape strip/curb (4.625')</td>
<td>9.25</td>
<td>9.25</td>
</tr>
<tr>
<td>Sidewalk (4’)</td>
<td>8.00</td>
<td>8.00</td>
</tr>
<tr>
<td>Remainder</td>
<td>2.75</td>
<td>2.75</td>
</tr>
<tr>
<td>Required R/W (ft)</td>
<td>68.00</td>
<td>80.00</td>
</tr>
</tbody>
</table>

URBAN COLLECTOR STREET WITH PARKING - NO BIKE LANES:

<table>
<thead>
<tr>
<th></th>
<th>2-LANE STREET</th>
<th>3-LANE STREET</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STANDARD SECTION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel lane (12’)</td>
<td>24.00</td>
<td>36.00</td>
</tr>
<tr>
<td>Parking (8’)</td>
<td>16.00</td>
<td>16.00</td>
</tr>
<tr>
<td>Landscape strip/curb (4.625')</td>
<td>9.25</td>
<td>9.25</td>
</tr>
<tr>
<td>Sidewalk (4’)</td>
<td>8.00</td>
<td>8.00</td>
</tr>
<tr>
<td>Remainder</td>
<td>2.75</td>
<td>2.75</td>
</tr>
<tr>
<td>Required R/W (ft)</td>
<td>60.00</td>
<td>72.00</td>
</tr>
</tbody>
</table>
STANDARD PUBLIC STREET WIDTHS

URBAN COLLECTOR STREET WITH BIKE LANE AND PARKING ONE SIDE:

2-LANE STREET

<table>
<thead>
<tr>
<th>STANDARD SECTION</th>
<th>WIDTH REQ’D (FT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel lane (11.5’)</td>
<td>23.00</td>
</tr>
<tr>
<td>Parking/bike (12’)</td>
<td>12.00</td>
</tr>
<tr>
<td>Bike (5’)</td>
<td>5.00</td>
</tr>
<tr>
<td>Landscape strip/curb (4.625’)</td>
<td>9.25</td>
</tr>
<tr>
<td>Sidewalk (4’)</td>
<td>8.00</td>
</tr>
<tr>
<td>Remainder</td>
<td>2.75</td>
</tr>
<tr>
<td>Required R/W (ft)</td>
<td>60.00</td>
</tr>
</tbody>
</table>

URBAN LOCAL STREET WITH PARKING:

2-LANE STREET

<table>
<thead>
<tr>
<th>STANDARD SECTION</th>
<th>WIDTH REQ’D (FT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel lane (12’)</td>
<td>24.00</td>
</tr>
<tr>
<td>Parking (6’)</td>
<td>12.00</td>
</tr>
<tr>
<td>Landscape strip/curb (4.625’)</td>
<td>9.25</td>
</tr>
<tr>
<td>Sidewalk (4’)</td>
<td>8.00</td>
</tr>
<tr>
<td>Remainder</td>
<td>2.75</td>
</tr>
<tr>
<td>Required R/W (ft)</td>
<td>56.00</td>
</tr>
</tbody>
</table>

MINIMUM URBAN LOCAL STREET - PARKING AND SIDEWALK ONE SIDE:
(Requires an exception from the urban local street standard per County Code Section 15.10.050 (e) 6.)

2-LANE STREET

<table>
<thead>
<tr>
<th>STANDARD SECTION</th>
<th>WIDTH REQ’D (FT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel lane (12’)</td>
<td>24.00</td>
</tr>
<tr>
<td>Parking (6’)</td>
<td>6.00</td>
</tr>
<tr>
<td>Landscape strip/curb (4.625’)</td>
<td>4.63</td>
</tr>
<tr>
<td>Sidewalk (4’)/ curb (0.625’)</td>
<td>4.63</td>
</tr>
<tr>
<td>Remainder</td>
<td>0.75</td>
</tr>
<tr>
<td>Required R/W (ft)</td>
<td>40.00</td>
</tr>
</tbody>
</table>
STANDARD PUBLIC STREET WIDTHS

RURAL ARTERIAL AND COLLECTOR STREETS:

2-LANE STREET

<table>
<thead>
<tr>
<th>STANDARD SECTION</th>
<th>WIDTH REQ’D (FT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel lane (12’)</td>
<td>24.00</td>
</tr>
<tr>
<td>Bike lane/shoulder (5’)</td>
<td>10.00</td>
</tr>
<tr>
<td>Remainder</td>
<td>6.00</td>
</tr>
<tr>
<td>Required R/W (ft)</td>
<td>40.00</td>
</tr>
</tbody>
</table>

MINIMUM RURAL LOCAL STREET:

2-LANE STREET

<table>
<thead>
<tr>
<th>STANDARD SECTION</th>
<th>WIDTH REQ’D (FT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel lane (12’)</td>
<td>24.00</td>
</tr>
<tr>
<td>Remainder</td>
<td>16.00</td>
</tr>
<tr>
<td>Required R/W (ft)</td>
<td>40.00</td>
</tr>
</tbody>
</table>

ADDITIONAL RIGHT-OF-WAY REQUIREMENTS:

The following components may be added to the standard improvements previously listed. Additional right-of-way will be required to accommodate these additional improvements as appropriate.

Additional components

Parking lane - 8 feet
Bike lane - 5 feet
Parking/bike lane - 12 feet
Sidewalk - 4 feet to 6 feet
Landscape strip - 4 feet
Median - 4 feet to 15 feet
Bus turnout - 5 feet to 18 feet
Turn lane - 12 feet
Cul-de-sac - 42 foot radius (right-of-way), 32 foot radius (at gutter flowline)
Utility corridor - as necessary/6-foot PUE on new developments

EXCEPTIONS TO THE STANDARD REQUIREMENTS:

The above tables indicate standard County requirements. Exceptions to the standards must be approved by the Public Works Director pursuant to County Code Section 15.10.050
### Figure ST-2: General Street Requirements

<table>
<thead>
<tr>
<th>Type of Street</th>
<th>Min Length Vertical Curves *</th>
<th>Min Sight Distance Horiz. Curves</th>
<th>Min Radii Horizontal Curves</th>
<th>Minimum Grades (%)</th>
<th>Maximum Grades (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over 500 lots served</td>
<td>60 m (200 ft)</td>
<td>110 m (350 ft)</td>
<td>200 m (650 ft)</td>
<td>0.2</td>
<td>8</td>
</tr>
<tr>
<td>51 to 500 lots served</td>
<td>30 m (100 ft)</td>
<td>60 m (200 ft)</td>
<td>60 m (200 ft)</td>
<td>0.2</td>
<td>15</td>
</tr>
<tr>
<td>26 to 50 lots served</td>
<td>30 m (100 ft)</td>
<td>60 m (200 ft)</td>
<td>60 m (200 ft)</td>
<td>0.2</td>
<td>15</td>
</tr>
<tr>
<td>25 or less lots served</td>
<td>15 m (50 ft)</td>
<td>25 m (80 ft)</td>
<td>25 m (80 ft)</td>
<td>0.2</td>
<td>20</td>
</tr>
</tbody>
</table>

* SIGHT DISTANCE CONTROLS OVER MINIMUM LENGTH OF VERTICAL CURVE WHERE THERE IS A CONFLICT.
Figure ST-3: Minimum Landscape Clearances

**INTERSECTION:**
The minimum standard requires 30 feet of visibility along each curb line/edge of pavement.

Trim all landscaping (except trees) to a height of not more than 30 inches above the curb.

Low or overhanging tree branches shall be removed to allow drivers an unobstructed view, and shrubbery shall not be allowed to encroach into the street or sidewalk.

**CONDITION A**

**CONDITION B**

**CONDITION C**

**CONDITION D**

**CONDITION E**

**CONDITION F**

**VEGETATION:** All growth shall be trimmed back so as not to encroach into the curb, sidewalk, or roadway. It's recommended that you trim an extra couple of feet to minimize the frequency of trimming.

**MINIMUM LANDSCAPE CLEARANCES**

12/05
Figure ST-4a: Curb, Gutter, Sidewalk and Dike Details

**Typical Curb, Gutter, & Sidewalk Section**

**Notes**

1. Type A, B, & C curb, gutter, & sidewalk shall be constructed of Class 3 (Class B) concrete.

2. Weakened plane joints shall be constructed at maximum 3.6m (12') intervals.

3. Type B curb shall be used only to conform to existing Type B curb where specifically approved by the Director of Public Works.

4. If sidewalk is not installed monolithically with curb & gutter, place #15 metric (#4) dowels in 1.2 m (4') 450 mm (18") long at 1.2 m (4') o.c. in back of curb 50 mm (2") down from top of curb, 150 mm (6") into curb.

**Curb, Gutter, Sidewalk, and Dike Details**

N.T.S.

All dimensions in millimeters unless noted otherwise.

---

Rev. 12/05

FIG. ST-4a
Figure ST-4b: Under Sidewalk Drain

NOTE: AS A GENERAL RULE 75 mm (3") I.D. SMOOTH, SOLID WALL SCH. 80 PLASTIC PIPE SHALL BE USED FOR UNDER SIDEWALK DRAINS. HOWEVER, WHEN HYDRAULIC REQUIREMENTS OR MULTIPLE PIPES OR LARGER DRAINS ARE USED AT THE DISCRETION OF THE DIRECTOR, THE MINIMUM DRAINS BETWEEN THE OUTSIDE WALLS OF THE PIERS SHALL BE 50 mm (2").

FLOW LINE

PIPE TO HAVE 50 mm (2") MIN. COVER

SLOPE TO DRAIN

SCHEDULE 80 PLASTIC PIPE

SECTION A-A

UNDER SIDEWALK DRAIN

N.T.S.

ALL DIMENSIONS IN MILLIMETERS UNLESS NOTED OTHERWISE
Figure ST-5: Concrete Cross Gutter
Figure ST-6a: Typical Driveway Depression

NOTES:

THE WIDTH OF THE DRIVEWAY IS THE DISTANCE ‘W’.

THE MAXIMUM WIDTH FOR RESIDENTIAL DRIVEWAYS IS 7.3 m (24').
THE MAXIMUM WIDTH FOR COMMERCIAL DRIVEWAYS IS 12 m (40').

DRIVEWAY CONCRETE SHALL BE 150 mm (6") THICK.

WHEN MORE THAN ONE DRIVEWAY IS TO SERVE A GIVEN PROPERTY FRONTAGE, THE WIDTH OF ALL DRIVEWAYS SHALL NOT EXCEED 70 PERCENT OF THE FRONTAGE FOR COMMERCIAL PARCELS OR 50 PERCENT OF THE FRONTAGE FOR RESIDENTIAL PARCELS. NOT LESS THAN 6m (20') OF FULL HEIGHT CURB SHALL BE PROVIDED BETWEEN DRIVEWAYS.

THE SIDELINE OF ANY DRIVEWAY SHALL NOT BE LESS THAN 2.4 m (8') FROM THE INTERSECTION CURB RETURN.

TYPICAL DRIVEWAY DEPRESSION

N.T.S.

ALL DIMENSIONS IN MILLIMETERS UNLESS NOTED OTHERWISE

REV. 12/05

FIG. ST-6a
Figure ST-6b: Driveway Curb Depression, Standard Separated Sidewalk and Rolled (Type B) Curb
Figure ST-6c: Driveway Curb Depression, 1.2 m and 1.8 m Sidewalk
Figure ST-7: Road Barricade

NOTE: 1. PAINT WITH 2 COATS OF WHITE PAINT.
2. THE W31 AND TYPE CHY-3 SIGNS SHALL
BE INSTALLED AT ALL BARRICADES,
BOTH WOOD OR METAL.
Figure ST-8a: Curb Ramp Type A

NOTES:

1. THE CURB AND GUTTER ADJACENT TO THE RAMP LANDING SHALL BE MODIFIED SO THAT THE CROSS SLOPE OF THE GUTTER DOES NOT EXCEED FIVE PERCENT.

2. THE RAMP SURFACE SHALL HAVE A ROUGH TRANSVERSE BROomed TEXTURE.

3. THE RAMP LANDING SHALL INCLUDE AN AREA OF TRUNCATED DOMES TWO FEET WIDE BY THE FULL WIDTH OF THE LANDING. THE DOMES SHALL CONFORM TO ALL REQUIREMENTS OF THE AMERICANS WITH DISABILITIES ACT AND SHALL BE DARK GRAY. THE CONTRACTOR SHALL SUBMIT A PRODUCT SAMPLE TO THE COUNTY FOR APPROVAL PRIOR TO DELIVERY TO THE SITE.

Curb Flowline: 5% Max

Gutter: 2% Max

Curb Ramp Landing: 5 mm (1/4")

Grooving Detail: 20 mm (3/4") at Border

Section A-A:

Curb Ramp Type A

REV. 5/06

FIG. ST-8a
Figure ST-8b: Curb Ramp Type B

NOTES:

1. THE CURB AND GUTTER ADJACENT TO THE RAMP LANDING SHALL BE MODIFIED SO THAT THE CROSS SLOPE OF THE GUTTER DOES NOT EXCEED FIVE PERCENT.

2. THE RAMP SURFACE SHALL HAVE A ROUGH TRANSVERSE BROomed TEXTURE.

3. THE RAMP LANDING SHALL INCLUDE AN AREA OF TRUNCATED DOMES TWO FEET WIDE BY THE FULL WIDTH OF THE LANDING. THE DOMES SHALL CONFORM TO ALL REQUIREMENTS OF THE AMERICANS WITH DISABILITIES ACT AND SHALL BE DARK GRAY. THE CONTRACTOR SHALL SUBMIT A PRODUCT SAMPLE TO THE COUNTY FOR APPROVAL PRIOR TO DELIVERY TO THE SITE.

CURB FLOWLINE

DETAIL

GROOVING DETAIL

SECTION A-A

CURB RAMP
TYPE B

REV. 5/06

FIG. ST-8b
Figure ST-8c: Curb Ramp Type C

NOTES:

1. THE CURB AND GUTTER ADJACENT TO THE RAMP LANDING SHALL BE MODIFIED SO THAT THE CROSS SLOPE OF THE GUTTER DOES NOT EXCEED FIVE PERCENT.

2. THE RAMP SURFACE SHALL HAVE A ROUGH TRANSVERSE BROOMED TEXTURE.

3. THE RAMP LANDING SHALL INCLUDE AN AREA OF TRUNCATED DOMES TWO FEET WIDE BY THE FULL WIDTH OF THE LANDING. THE DOMES SHALL CONFORM TO ALL REQUIREMENTS OF THE AMERICANS WITH DISABILITIES ACT AND SHALL BE DARK GRAY. THE CONTRACTOR SHALL SUBMIT A PRODUCT SAMPLE TO THE COUNTY FOR APPROVAL PRIOR TO DELIVERY TO THE SITE.

DETAIL

GROOVING DETAIL

SECTION A-A

CURB RAMP

TYPE C

REV. 5/06 FIG. ST-8c
Figure ST-8d: Curb Ramp Type D

NOTES:
1. THE CURB AND GUTTER ADJACENT TO THE RAMP LANDING SHALL BE MODIFIED SO THAT THE CROSS SLOPE OF THE GUTTER DOES NOT EXCEED FIVE PERCENT.
2. THE RAMP SURFACE SHALL HAVE A ROUGH TRANSVERSE BROOMED TEXTURE.
3. THE RAMP SURFACE SHALL INCLUDE AN AREA OF TRUNCATED DOMES TWO FEET WIDE BY THE FULL WIDTH OF THE RAMP. THE DOMES SHALL CONFORM TO ALL REQUIREMENTS OF THE AMERICANS WITH DISABILITIES ACT AND SHALL BE DARK GRAY. THE CONTRACTOR SHALL SUBMIT A PRODUCT SAMPLE TO THE COUNTY FOR APPROVAL PRIOR TO DELIVERY TO THE SITE.
Figure ST-8e: Curb Ramp Type E

NOTES:

1. THE CURB AND GUTTER ADJACENT TO THE RAMP LANDING SHALL BE MODIFIED SO THAT THE CROSS SLOPE OF THE GUTTER DOES NOT EXCEED FIVE PERCENT.
2. THE RAMP SURFACE SHALL HAVE A ROUGH TRANSVERSE BROomed TEXTURE.
3. THE RAMP TO THE STREET SHALL INCLUDE AN AREA OF TRUNCATED DOMES A MINIMUM OF TWO FEET WIDE BY THE FULL WIDTH OF THE RAMP. THE DOMES SHALL CONFORM TO ALL REQUIREMENTS OF THE AMERICANS WITH DISABILITIES ACT AND SHALL BE DARK GRAY. THE CONTRACTOR SHALL SUBMIT A PRODUCT SAMPLE TO THE COUNTY FOR APPROVAL PRIOR TO DELIVERY TO THE SITE.
Figure ST-9a: Tree Planting in Tree Well or Planting Strip
Figure ST-9b: Tree Planting in Landscape Area
Figure ST-10: Pavement Grinding Detail

NOTES:
1. Grinding shall provide the depth for placement of A.C. paving to prevent fracture of the P.C.C. gutter during rolling.
2. The contractor shall notify the Department of Public Works at least 48 hours prior to grinding so as to warn roadway users of the grinding. Grinders shall be roped off, and signers shall be used when grinding in an area where the public is present. A.C. Overlay shall be replaced at the developer’s expense.

FOR A.C. OVERLAY

1.8 m (6') MIN.
Figure ST-11: Standard Street Monument

NOTE
MONUMENT BOX SHALL BE D&L No. K-6001-2
(TRAFFIC RATED AND WATER TIGHT) OR APPROVED EQUAL
PRESSED INSIDE A 150 mm (6") PVC PIPE. COVER SHALL
HAVE THE WORD "MONUMENT" ENGRAVED ON TOP.

STANDARD STREET MONUMENT
Figure ST-12: Sidewalk Transition at Obstruction

NOTE: PROVIDE A 1.2 m (4') CLEAR SIDEWALK PER THIS DETAIL AT ALL UTILITY POLES OR OTHER OBSTRUCTIONS WHICH CANNOT BE PLACED BEHIND THE SIDEWALK.
Figure ST-13A: Physical Speed Control Devices (Road Bumps)
Figure ST-13B: Physical Speed Control Devices (Speed Tables)

SAWCUT OR GRIND EACH TRANSVERSE JOINT AT SPEED TABLE EDGE AND REMOVE EXISTING ASPHALT FOR 2' WIDE KEYWAY MINIMUM DEPTH 2'' FOR ASPHALT AND 6'' FOR CONCRETE.
Figure ST-14: Transition From Contiguous to Separated Sidewalk
PART 3. STORMWATER MANAGEMENT
General - Part 3 applies to new or redevelopment projects that require a County development or building permit and/or result in an increase in impervious area or will alter drainage patterns on or from the project sites. In addition, larger projects, as decided by the City of Capitola staff, located in the City of Capitola, and not reviewed by the City of Capitola staff, are subject to these criteria.

Section A - Submittal Requirements

1. Topographic maps showing the existing and proposed boundaries of the drainage area used for design, the project boundaries, and existing and proposed drainage patterns. Projects must accommodate existing upstream runoff in the project design without impact to upstream properties. Diversion of runoff resulting in altered drainage patterns from the project site is not allowed without prior approval by the Director of Public Works.

2. Design computations for:
   a. Hydrology (design flows)
   b. Hydraulics (channel, structure & piping sizing)
   c. Hydraulic gradients (for proposed structures or systems)

   Calculations shall be submitted on a form similar to Figure SWM-6 when applicable.

3. Stormwater Management Plan showing existing and proposed impervious, semi-pervious and disturbed areas, best management practice (BMP) proposals(s), and associated supporting analysis where applicable. The stormwater management plan may be combined with other plan sheets as long as all pertinent information is clearly depicted.

4. A soils report or additional soils information regarding permeability of the site soils where applicable. Saturated soil permeability and hydraulic conductivity values may be used conservatively from the published physical properties table within the USDA-NRCS soil survey, or use actual test values. Other soil information may be found within this survey, including engineering index properties, restrictive layers and high groundwater occurrence. A web site link to the soil survey is provided from the County DPW Stormwater Management web page. Site-specific soil data from geotechnical or septic system investigations shall be used when available and appropriate.

5. If the project disturbs one acre or more, the applicant may be required to obtain coverage under the Construction General Permit from the State Water Resources Control Board (SWRCB).
6. If this project involves industrial/commercial activities, the applicant may be required to obtain coverage under the Industrial General Permit from the State Water Resources Control Board (SWRCB).

7. If the project is located in Santa Cruz County Flood Control and Water Conservation District Zones 5, 6, 7A or 8 impact fees based on the net increase in permitted impervious area will be assessed based on the current Unified Fee Schedule. The project may be eligible for fee credits for existing impervious areas previously permitted or built prior to the establishment of the flood control zone. To establish credit eligibility, documentation should be submitted with the project plans. Documentation such as assessor’s records, survey records, permit records, dated aerial photographs or other official records that will help establish and determine the construction date, structure/impervious area footprint, or to confirm that a permit was previously issued is acceptable. Zones 5, 6, 7A and 8 were established in 1969, 1986, 2005 and 1977, respectively. The County GIS may be used to determine the flood control district within which the project is located.

Section B - Design References

1. The design of storm drainage facilities shall conform to standard accepted engineering practice. Common reference texts are:
   a. “Handbook of Hydraulics;” King & Brater
   b. “Street and Highway Drainage;” The Institute of Transportation, University of California
   c. “Highway Design Manual;” Caltrans
   i. “Stormwater Best Management Practice Handbook,” 2 Vols.: Construction, New Development & Redevelopment; California Stormwater Quality
j. “City of Santa Barbara Storm Water BMP Guidance Manual;” City of Santa Barbara, July 2013


m. California Environmental Protection Agency State Water Resources Control Board Phase II Small Municipal Separate Storm Sewer System General Permit 2013-0001-DWQ


n. Central Coast Regional Water Quality Control Board Post Construction Stormwater Management Requirements for Development Projects in the Central Coast adopted by Resolution R3-2013-0032.

http://www.waterboards.ca.gov/centralcoast/water_issues/programs/stormwater/docs/lid/lid_hydromod_charrette_index.shtml

2. Requirements set forth in the Design Criteria shall prevail over those set forth in the above or any other publications.

**Section C – Mitigation Requirements**

All new development and redevelopment* projects shall incorporate Best Management Practices (BMPs) to minimize the generation, transport and discharge of pollutants, to prevent runoff in excess of pre-development conditions, and to maintain pre-development groundwater recharge consistent with County Code Chapter 7.79. Interior remodel and maintenance and/or repair projects are specifically excluded from these requirements. In addition, projects with pollutant generating activities are required to implement source control measures as described in no. 2 below.

1. Thresholds for Mitigation

a. Small Projects - Projects that add or replace less than 500 square feet of impervious** area on a project site with adequate existing on and off site drainage are exempt from mitigation requirements. It is recommended that these projects incorporate BMPs to limit pollutant and hydrologic impacts such as pervious pavement, disconnection of runoff from impervious surfaces, etc. Safe stormwater overflow shall be incorporated into the project design.

b. Medium Projects – Projects that add or replace between 500 square feet and 5,000 square feet of impervious area shall incorporate BMPs to minimize and mitigate pollutant and hydrologic impacts due to development. These BMPs shall include Low Impact Development (LID) measures that emphasize the minimization of impacts as a first priority consistent with General Plan Policy 7.23.2 for Minimizing Impervious Surfaces. Safe stormwater overflow shall be incorporated into the project design.
c. Large Projects – Projects that add or replace more than 5,000 square feet of impervious area must incorporate BMPs to minimize and mitigate pollutant and hydrologic impacts due to development. These BMPs shall include LID measures that emphasize minimization of impacts as a first priority consistent with General Plan Policy 7.23.2 for Minimizing Impervious Surfaces. Detailed site assessment and BMP analysis is required to demonstrate adequate mitigation design for large projects so that pre-development runoff rates are maintained for a range of storms while also maintaining pre-development groundwater recharge. Safe stormwater overflow shall be incorporated into the project design.

* For stormwater management purposes redevelopment means land disturbing activity that results in the creation, addition, or replacement of exterior impervious surface area on a site on which some past development has occurred. Replacement of impervious surface is the removal of existing impervious surfaces down to bare soil or base course, and replacement with new impervious surface. Replacement of impervious surfaces that are part of routine maintenance activities are not considered replaced impervious surfaces. Redevelopment does not include trenching, excavation and resurfacing associated with linear underground projects; pavement grinding and resurfacing of existing roadways; construction of new sidewalks; pedestrian ramps, or bike lanes on existing roadways; or routine replacement of damaged pavement such as pothole repair or replacement of short, non-contiguous sections of roadway. Where a redevelopment project results in an increase of more than 50 percent of the permitted impervious surface of a previously existing development, runoff from the entire project, consisting of all existing, new, and/or replaced impervious surfaces, must be included in the mitigation design to the extent feasible. Where a redevelopment project results in an increase of less than 50 percent of the permitted impervious surface of a previously existing development, only runoff from the new and/or replaced impervious surface of the project must be included. Unpermitted impervious surface shall not be considered in calculating the existing impervious surface area.

**Impervious surfaces are hard, non-vegetated surfaces that prevent or significantly limit the entry of water into the soil mantle, as would occur under natural conditions, prior to development. Common impervious surfaces include, but are not limited to, roof tops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, oiled, macadam, compacted soils, or other surfaces which similarly impede the natural infiltration of stormwater. Open, uncovered retention/detention facilities that are uncompacted shall not be considered as impervious surfaces for purposes of determining the thresholds of mitigation for the project. However, for modeling purposes, open, uncovered facilities that retain/detain water (e.g. retention ponds, pools) shall be considered impervious surfaces.
2. Source Control Measures

All new development and redevelopment projects with pollutant generating activities and sources as listed below shall implement permanent and/or operation source control measures as applicable. Measures for the following pollutant generating activities and sources shall be designed consistent with recommendations from the California Stormwater Quality Association (CASQA) Stormwater BMP Handbook for New Development and Redevelopment or equivalent manual (see reference section B.1.i). These activities and sources include:

a. Accidental spills or leaks  
b. Interior floor drains  
c. Parking/storage area maintenance  
d. Indoor and structural pest control  
e. Landscape/outdoor pesticide use  
f. Pools, spas, ponds, decorative fountains, and other water features  
g. Restaurants, grocery stores, and other food service operations  
h. Refuse areas  
i. Industrial processes  
j. Outdoor storage of equipment or materials  
k. Vehicle and equipment cleaning  
l. Vehicle and equipment repair and maintenance  
m. Fuel dispensing areas  
n. Loading docks  
o. Fire sprinkler test water  
p. Drain or wash water from boiler drain lines, condensate drain lines, rooftop equipment, drainage sumps, and other sources  
q. Unauthorized non-stormwater discharges  
r. Building and grounds maintenance

3. Design Standards Applicable to All Categories

a. Stormwater Discharge Rates and Volumes

Quantification demonstrating compliance with this section is required for all large projects as defined in Section C.1 above where there are known downstream restrictions, and others at the discretion of the Director of Public Works.

The project shall be designed to maintain pre-development discharge rates for a range of storms while maintaining pre-development groundwater recharge rates. Quantification demonstrating maintenance of the pre-development 2 year, 2-hour as well as the 10 year, 15-minute discharge rates is required. Pre-development discharge rates shall be evaluated based on reasonable assumptions of natural site conditions. The project shall conduct a downstream impact assessment in accordance with Sections D and E of the Design Criteria. If downstream restrictions are/have been identified the project shall include the improvements needed to upgrade the storm drain system such that local flooding due to insufficient capacities would be
eliminated for the appropriate design rainstorm and/or the allowable post-
development discharge rate shall be limited at the discretion of the Director of
Public Works and the project reviewer. On-site retention and percolation of
increased runoff from development shall be incorporated into the project
design as feasible to meet this requirement. The use of detention, particularly
in a closed system (pipe, lined basin, etc.) shall only be used if all other BMPs
are demonstrated to be technically infeasible and is required to employ
additional BMPs for small storm mitigations. (also see General Plan Policies
5.5.12 and 7.23)

Guidance for design of detention and retention systems is available in
Sections H and I of this part of the Design Criteria.

b. Minimize Stormwater Pollutants of Concern

All development shall be designed to minimize the generation, transport and
discharge of pollutants. Quantification demonstrating compliance with this
section is required for all large projects (as defined in Section C.1 above).

The project shall be designed to treat runoff using one of the onsite measures
below, listed in the order of priority (highest to lowest).

i. Retention Treatment Systems: Infiltration of the 2 year, 2 hour storm
consistent with Section I of these criteria. The use of measures other than
retention treatment systems shall only be used after technical infeasibility has
been established:

ii. Low Impact Development (LID) Treatment Systems: Implement
harvesting and use, infiltration, and evapotranspiration measures that
collectively achieve the following sizing criteria:

(1) LID systems shall be designed to retain the volume of runoff
generated by the 85th percentile 24-hour storm event based on local
rainfall data. See:
  http://www.waterboards.ca.gov/centralcoast/water_issues/programs/stormwater/docs/lid/lid_hydromod_charette_index.shtml

iii. Biofiltration Treatment Systems: Implement biofiltration treatment
systems that are demonstrated to meet or be at least as effective as a
system with the following design parameters:

(1) Maximum surface loading rate appropriate to prevent erosion, scour
and channeling within the biofiltration treatment system itself and
equal to 5 inches per hour, based on the flow of runoff produced from
a rain event equal to or at least:

(a) 0.2 inches per hour intensity; or

(b) Two times the 85th percentile hourly rainfall intensity for the
applicable area, based on analysis of historical records of hourly
rainfall depth.
(2) Minimum surface reservoir volume equal to the biofiltration treatment system surface area times a depth of 6 inches.

(3) Minimum planting medium depth of 24 inches. The planting medium must sustain a minimum infiltration rate of 5 inches per hour throughout the life of the project and must maximize runoff retention and pollutant removal. A mixture of sand (60%-70%) meeting the specifications of American Society for Testing and Materials (ASTM) C33 and compost (30%-40%) may be used. Projects may utilize an alternative planting medium if it is demonstrated that the alternative is equal or more effective at attenuating pollutants as the specified medium mixture.

(4) Proper plant selection (see Central Coast Plant Guidance for Bioretention available from the Central Coast LID Initiative at: http://www.centralcoastlidi.org/Central_Coast_LIDI/LID_Structural_BMPs.html).

(5) Subsurface drainage/storage (gravel) layer with an area equal to the biofiltration treatment surface area and having a minimum depth of: 12 inches or the calculated depth that will drain within 48 hours, whichever is greater. To calculate the depth that will drain within 48 hours the designer may utilize the saturated soil permeability and hydraulic conductivity values from the published physical properties table within the USDA-NRCS soil survey, or actual test values from a standardized testing procedure.

(6) Underdrain with discharge elevation at top of gravel layer.

(7) No compaction of soils beneath the biofiltration facility (ripping/loosening of soils required if compacted).

(8) No liners or other barriers interfering with infiltration.

iv. Non-Retention Based Treatment Systems – Implement stormwater control measures that collectively achieve at least one of the following hydraulic sizing criteria for non-retention based treatment system:

(1) Volume Hydraulic Design Basis – Treatment systems whose primary mode of action depends on volume capacity shall be designed to treat stormwater runoff equal to the volume of runoff generated by the 85th percentile 24-hour storm event, based on local rainfall data.

(2) Flow Hydraulic Design Basis – Treatment systems whose primary mode of action depends on flow capacity shall be sized to treat:

(a) The flow of runoff produced by a rain event equal to at least two times the 85th percentile hourly rainfall intensity for the applicable area, based on historical records of hourly rainfall depths; or
(b) The flow of runoff resulting from a rain event equal to at least 0.2 inches per hour intensity.

The BMP(s) used for water quality treatment may be the same as those used to mitigate for stormwater discharge rates and volumes. When choosing BMP(s), emphasis should be placed on source control BMPs rather than treatment BMPs.

c. Site Design and Runoff Reduction

All medium and large projects (as defined in section C.1 above) shall incorporate the following minimum site design and runoff reduction strategies as feasible:

i) Limit disturbance to creeks and natural drainage features.

ii) Minimize compaction of soils.

iii) Limit clearing and grading of native vegetation at the site to minimum area needed to build the project, allow access, and provide fire protection.

iv) Minimize impervious surfaces by concentrating improvements on the least-sensitive portions of the site, while leaving the remaining land in a natural undisturbed state.

v) Minimize stormwater runoff by implementing the following site design measures as feasible:

1) Direct roof, driveway, parking lot, sidewalk, walkway, patio and other impervious surface runoff onto vegetated areas safely away from building foundations and footings, consistent with the California building code.

2) Construct bike lanes, driveways, uncovered parking lots, sidewalks, walkways, patios and other hardscapes with permeable surfaces.

3) Direct roof runoff to cisterns or rain barrels for reuse.

d. Provide Storm Drain System Marking and Signage

All storm drain inlets and catch basins within commercial, industrial and multi-residential developments should be marked with prohibitive language (such as: “No Dumping – Drains to Ocean. No Tire – Desecho Corre al Mar”) and/or graphical icons to discourage illegal dumping. Signs and prohibitive language and/or graphical icons, which prohibit illegal dumping must be posted at public access points along channels and creeks within the project area. Legibility of markings and signs must be maintained by the property owner.
e. Provide Proof of Ongoing BMP Maintenance

It is important to consider who will be responsible for maintenance of a permanent BMP, and what equipment is required to perform the maintenance properly. As part of project review, if a project applicant has included or is required to include, structural or treatment control BMPs in project plans, the County will require that the applicant provide verification of maintenance provisions through such means as may be appropriate, including, but not limited to legal agreements, covenants, CEQA mitigation requirements and/or Conditional Use Permits.

Figures SWM-25A and SWM-25B are example Stormwater Management Maintenance Agreements for medium and large projects that can be updated for use on a specific project. The project designer shall establish specifications and requirements for the ongoing maintenance and monitoring to ensure proper functioning of stormwater management facilities and practices proposed as part of a development application and consistent with County Code 7.79. A Stormwater Management Maintenance Agreement shall be recorded by the property owner with the County Recorder’s Office on the deed of any property to be served by a stormwater management facility. The Stormwater Management Maintenance Agreement shall include the following information:

i) Statement of the operating requirements to ensure proper performance of the stormwater management facility.
ii) Specification of any Best Management Practices that must be implemented and maintained.

iii) Specification of any restriction on system use or property use, such as limitations on amount of impervious surface, limits on fertilizer or pesticide use, limits on vehicle parking or maintenance, restrictions on building additions, etc.

iv) Notification that County staff may conduct routine inspections of the facility to ensure that the stormwater facilities are functioning properly and being maintained as needed.

v) Notification that the property owner may be assessed an annual service charge and/or re-inspection fee to cover the County costs of inspection and oversight. See the current Unified Fee Schedule for Stormwater Management Maintenance inspection and oversight fees.

vi) Notification that the property owner may be required to report to the County on the management and maintenance of the stormwater management facility. All large projects are required to report on at least an annual basis regarding system maintenance and are expected to be assessed an annual service charge.

vii) All large projects shall include an attached exhibit that shows the stormwater management facility location/s on the project site along with delineations of the subwatershed area/s draining to each facility.

viii) All large projects shall include an attached exhibit that lists at a minimum for each stormwater mitigation: the operation and maintenance requirements, inspection and maintenance intervals, and symptoms of system failure or not functioning as designed. The annual report shall address each item from the attached exhibit and shall include date/s of inspection, name/s of inspector/s, and a detailed list of maintenance and repairs completed. The annual report shall include photos, as necessary, to document operation, maintenance and repairs completed. See Section B Design References, references j (Appendix H) and l (Chapter 6) for examples.

ix) The maintenance agreement shall be binding on and shall inure to the benefit of the successors, heirs, executors, administrators, and assigns of the owner.

If structural or treatment control BMPs are located within a public area proposed for transfer, they will be the responsibility of the developer until they are accepted for transfer by the County or other appropriate public agency. Structural or treatment control BMPs proposed for transfer must meet the County’s design standards and should be approved by the County or other appropriate public agency prior to its installation.

f. Alternative Offsite Compliance
A waiver for meeting the Design Standards of this section on the project site can be granted by the Director of Public Works. In order to receive an on-site waiver, the project applicant must submit a request along with technical documentation describing reason(s) of impracticability. A waiver of impracticability shall be granted only when all other Structural or Treatment Control BMPs have been considered and rejected as infeasible. Recognized situations of impracticability include:

i) extreme limitations of space for treatment on a redevelopment project,

ii) unfavorable or unstable soil conditions at a site to attempt infiltration, and

ii) risk of groundwater contamination because a known unconfined aquifer lies beneath the land surface or an existing or potential underground source of drinking water is less than 10 feet from the soil surface.
Off-site compliance with Section 3 of these criteria will be required when technical impracticability limits or prevents compliance with on-site facilities. Off-site compliance will only be considered after on-site technical impracticability has been demonstrated by meeting the above requirements. Allowable off-site compliance must be located in the same watershed as the proposed development project, must be located on private property, must be built prior to final construction approval of the proposed development, and must be accompanied by recorded maintenance and easement agreement(s) that guarantee the function and maintenance of the off-site mitigations for the development project lifetime. Allowance of off-site compliance is subject to approval by the Director of Public Works and the CCRWQCB Executive Officer.
Figure SWM-1: 10-Year Runoff Coefficients

<table>
<thead>
<tr>
<th>TYPE OF AREA</th>
<th>10-YEAR RUNOFF COEFFICIENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural, park, forested, agricultural</td>
<td>0.10 - 0.30</td>
</tr>
<tr>
<td>Low residential (Single family dwellings)</td>
<td>0.45 - 0.60</td>
</tr>
<tr>
<td>High residential (Multiple family dwellings)</td>
<td>0.65 - 0.75</td>
</tr>
<tr>
<td>Business and commercial</td>
<td>0.80</td>
</tr>
<tr>
<td>Industrial</td>
<td>0.70</td>
</tr>
<tr>
<td>Impervious</td>
<td>0.90</td>
</tr>
</tbody>
</table>

REQUIRED ANTECEDENT MOISTURE FACTORS (Ca) FOR THE RATIONAL METHOD*

<table>
<thead>
<tr>
<th>Recurrence Interval (Years)</th>
<th>Ca</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 to 10</td>
<td>1.0</td>
</tr>
<tr>
<td>25</td>
<td>1.1</td>
</tr>
<tr>
<td>50</td>
<td>1.2</td>
</tr>
<tr>
<td>100</td>
<td>1.25</td>
</tr>
</tbody>
</table>

*APWA Publication "Practices in Detention of Stormwater Runoff"

Note: Application of antecedent moisture factors (Ca) should not result in an adjusted runoff coefficient (C) exceeding a value of 1.00
Figure SWM-2: Rainfall Intensity Isopleths
Figure SWM-3: Rainfall Intensity - Duration Curves

Rainfall Intensity - Duration Curves
10 Yr. Return Period

\[
((4.29112)^{(1.1952)^{P60 \_VALUE}})/(DURATION^{(0.60924)^{(0.78522)^{P60 \_VALUE}}})
\]

Return Period Factors
- 2 Yr. 0.64
- 5 Yr. 0.65
- 10 Yr. 1.00
- 15 Yr. 1.05
- 25 Yr. 1.20
- 50 Yr. 1.35
- 100 Yr. 1.50

To convert intensities to return periods other than 10 years, multiply by the following factors:

Intensity (in/hr.)

Duration or Tc (min.)

See Figure SWM-2 to select P60 values

FIG. SWM-3

Rev. 11-05
Figure SWM-4: Time of Concentration Nomograph
Section D - Hydrology - Minimum Design Requirements

1. All drainage improvements shall be designed to convey a minimum 10-year storm. In addition, means of conveying flood overflows from the site as well as the total tributary drainage basin with full build-out based on current zoning or general plan land use shall be designed for in accordance with the following criteria:

<table>
<thead>
<tr>
<th>TRIBUTARY DRAINAGE AREA</th>
<th>FLOOD OVERFLOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 0 - 40 hectares (ha) (0 - 100 acres)</td>
<td>25 year</td>
</tr>
<tr>
<td>b. 41 - 160 ha (101 - 400 acres)</td>
<td>50 year</td>
</tr>
<tr>
<td>c. over 160 ha (over 400 acres)</td>
<td>100 year</td>
</tr>
<tr>
<td>d. Cross culverts on publicly maintained roads</td>
<td>100 year</td>
</tr>
<tr>
<td>e. Bridge structures</td>
<td>100 year or flood of record, if greater</td>
</tr>
</tbody>
</table>

2. The return period used may be required to be greater than the minimum cited above, if in the opinion of the Director of Public Works, project failure would cause unreasonable economic loss.

3. The method of calculating storm runoff shall be based on the size of the tributary basin. The Rational Method, \( Q = C_i A \), may be used for basins less than 80 hectares (200 acres). For larger areas, the Unit Hydrograph Method, Soil Conservation Service Methods, USGS Regional Regression Equations for the Central Coast Region (with a 25 percent safety factor), or other methodology approved in advance by the Director of Public Works may be required.

*In metric units, the equation takes the form \( Q = 0.0028 C_i A \), where \( "i" \) is in mm/hr and \( "A" \) is in ha, to yield a result in m³/s.

4. Runoff coefficients to be used with the Rational Method are given in Figure SWM-1, or they may be calculated by the engineer subject to approval by the Director of Public Works. Antecedent moisture conditions shall be taken into account in using the Rational Method. Factors are included in Figure SWM-1.

5. Rainfall intensity shall be determined by using the isopleths and the intensity and duration curves given in Figures SWM-2 and SWM-3. Alternatively, an equation is provided with Figure SWM-3 that can be used to compute intensity.

6. Minimum time of concentration used for intensity calculations shall be 10 minutes to the first inlet or culvert entrance, or less at the discretion of the Director of Public Works.

7. Time of concentration for overland flow in a drainage basin with defined channels shall be determined by using the nomograph in Figure SWM-4, or by other methods approved in advance by the Director of Public Works.
Figure SWM-5: Pipe and Channel Roughness Coefficients

<table>
<thead>
<tr>
<th>TYPE OF CONDUIT OR CHANNEL</th>
<th>ROUGHNESS COEFFICIENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic (PVC, ABS, or HDPE)</td>
<td>0.010 to 0.012</td>
</tr>
<tr>
<td>Concrete gutters</td>
<td>0.015</td>
</tr>
<tr>
<td>Corrugated metal (annular corrugations)</td>
<td>0.024</td>
</tr>
<tr>
<td>Reinforced concrete pipe 300 to 525mm (12 to 21 in)</td>
<td>0.015</td>
</tr>
<tr>
<td>Reinforced concrete pipe 600 to 825mm (24 to 33 in)</td>
<td>0.013</td>
</tr>
<tr>
<td>Reinforced concrete pipe 900 mm (36 in) and larger</td>
<td>0.011</td>
</tr>
<tr>
<td>Lined channels</td>
<td></td>
</tr>
<tr>
<td>Concrete</td>
<td>0.014</td>
</tr>
<tr>
<td>Air blown mortar</td>
<td>0.016</td>
</tr>
<tr>
<td>Bituminous</td>
<td>0.018</td>
</tr>
<tr>
<td>Sacked concrete</td>
<td>0.025</td>
</tr>
</tbody>
</table>

To determine roughness coefficients for natural channels, refer to “Handbook of Hydraulics,” King & Brater; “Open-Channel Hydraulics,” V.T. Chow; or “Street and Highway Drainage,” Institute of Transportation, University of California.
Figure SWM-6: Drainage System Calculation Sheet

<table>
<thead>
<tr>
<th>PROJECT:</th>
<th>DRAINAGE SYSTEM CALCULATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet or Junction Structure</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>Area</td>
<td>2</td>
</tr>
<tr>
<td>Year</td>
<td>3</td>
</tr>
<tr>
<td>Design Storm</td>
<td>4</td>
</tr>
<tr>
<td>Return Period Factor</td>
<td>5</td>
</tr>
<tr>
<td>Accumulated Flow</td>
<td>6</td>
</tr>
<tr>
<td>ΔTc</td>
<td>7</td>
</tr>
<tr>
<td>Tc (min)</td>
<td>8</td>
</tr>
<tr>
<td>Q (cfs)</td>
<td>9</td>
</tr>
<tr>
<td>ΔA/C</td>
<td>10</td>
</tr>
<tr>
<td>ΔQ</td>
<td>11</td>
</tr>
<tr>
<td>Pipe Line Designation</td>
<td>12</td>
</tr>
<tr>
<td>Pipe Line Designation</td>
<td>13</td>
</tr>
<tr>
<td>DRAINAGE SYSTEM CALCULATION</td>
<td>14</td>
</tr>
<tr>
<td>PIPE FLOW</td>
<td>15</td>
</tr>
<tr>
<td>D</td>
<td>16</td>
</tr>
<tr>
<td>D (ft)</td>
<td>17</td>
</tr>
<tr>
<td>D/D</td>
<td>18</td>
</tr>
<tr>
<td>Sn</td>
<td>19</td>
</tr>
<tr>
<td>V</td>
<td>20</td>
</tr>
<tr>
<td>V</td>
<td>21</td>
</tr>
<tr>
<td>PIPE FLOW</td>
<td>22</td>
</tr>
<tr>
<td>Pipe Flow</td>
<td>23</td>
</tr>
<tr>
<td>Antecedent Moisture Factor (Ca)</td>
<td>24</td>
</tr>
<tr>
<td>Call by</td>
<td>25</td>
</tr>
<tr>
<td>Check by</td>
<td>26</td>
</tr>
<tr>
<td>Date</td>
<td>27</td>
</tr>
<tr>
<td>Date</td>
<td>28</td>
</tr>
</tbody>
</table>

Rev. 11-05

FIG. SWM-6
Figure SWM-7: Instruction for Drainage System Calculations

COUNTY OF SANTA CRUZ

DEPARTMENT OF PUBLIC WORKS

Instructions and notes for "DRAINAGE SYSTEM CALCULATION" sheet (SWM-6).
Circled numbers below refer to circled numbers shown in column headings on the calculation sheet.

1. **AREA DESIGNATION** — Designate each drainage area beginning with the uppermost reach by a letter (e.g., B).

2. **AREA A** — Areas in acres of each drainage area draining to inlet 7.

3. **Q** — Runoff coefficient for drainage AREA A 2. See County Design Criteria (CDC). Future land use shall be taken into account.

4. **A*C** — Drainage AREA A 2 multiplied by runoff coefficient C 3.

5. **Tc** — Time of concentration in minutes for drainage AREA A 2. See CDC. Minimum time is 10 minutes, or less if required by the County.

6. **I** — Rainfall intensity in inches per hour for Tc 5. See CDC.

7. **Q** — Runoff flow in cubic feet per second from Q = CIA (Rational Formula). Multiply A*C 4 by lower portion of I 5.

8. **JUNCTION DESIGNATION** — Designate each inlet and manhole by a number (e.g., 3) and each junction (more than one inlet pipe) by a number and J (e.g., 4J).


10. **Σ Tc** — Progressive accumulation of time of concentration to upstream end of pipe to be sized beginning with Tc 5.

11. **I** — Rainfall intensity in inches per hour for Σ Tc 9. See CDC.


13. **PIPE LINE DESIGNATION** — Designate each pipe line by number designation of upstream inlet and downstream inlet (e.g., 2 - 3).

14. **L** — Length of pipe in feet. Maximum inlet spacing is 500 feet.

15. **D** — Diameter of pipe in inches. Minimum diameter is 18 inches. Designate type (e.g. RCP, PVC).

16. **PIPE AREA** — Cross-sectional area of pipe in square feet. See King’s Handbook.

17. **n** — Manning's n, roughness coefficient of pipe. See CDC.


19. **V (fpm)** — Velocity of flow in feet per minute. Multiply V (fps) 16 by 60 sec/min.

20. **S** — Neutral slope in feet per foot. Identical to friction slope, slope of energy grade line, or slope from Manning’s equation. See King’s Handbook.


22. **HI** — Entrance and exit head loss of pipe in feet. Usually equal to 1.4 V^2/2g for CMP, and 1.1V^2/2g for other types of pipes. See King’s Handbook.

23. **Σ H** — Summation of head losses in feet. 18 + 19 if flow is subcritical.

24. **W.S. ELEVATION** — Outlet Control. Water surface elevation at inlet, manhole or junction. Calculate by adding Σ H 20 to known downstream water surface elevation and progress upstream.

25. **T.G. ELEVATION** — Top of grate elevation, or top of cover for manholes and junction boxes.

26. **W.S. ELEVATION** — Inlet Control. Calculate by adding PIPE F.L. 26 + pipe diameter 14 + HI from 19. Design value is the greater of 21 or 23.

27. **PIPE F.L.** — Elevation of pipe entrance flowline.
Section E - Hydraulic Requirements

1. Generally Manning’s equation shall be used to determine flows in pipes or channels. Values for Manning’s Roughness Coefficient \( (n) \) shall be as shown in Figure SWM-5.

2. Upstream and downstream flow conditions with associated backwater effects shall be taken into account where necessary. Hydraulic analysis of existing systems shall include verification that hydraulic capacity remains adequate by present standards throughout the system evaluated, and shall not rely solely on hydraulic structure entrance or exit dimensions. ‘As-built’ plans may be referenced, where such plans are not older than 20 years and there are no known alterations to the original system. Downstream and upstream channel or structure improvements may be required at the discretion of the Director of Public Works, subject to approval by the reviewing body.

3. Design flood overflow protection shall provide 300 mm (12 in) freeboard below the finish floor elevations of all affected existing and proposed habitable structures where possible.

4. In providing for design flood overflow protection, roadway overflow is not permitted, except on private roads where it can be shown that such overflow will not create an unreasonably hazardous condition.

5. The maximum water depth permitted for flood overflow on onsite parking and driveway areas is 150 mm (6 in).

6. Culverts may be designed utilizing available head at the inlet, provided that adequate slope protection and energy dissipation are placed at both ends of the culvert to prevent scour and erosion.

7. The design flow (as specified in Section C-D.1 above) of drainage pipe systems shall allow for a minimum freeboard of 200 mm (8 in) between the top of the inlet grate or manhole cover and the design water surface elevation for a 10-year storm.

8. Proper allowance for losses through junction structures, inlets, and manholes shall be made in determining the hydraulic grade line or water surface elevations.

9. Minimum velocity at design flow shall be 600 mm (2 ft) per second.

10. Gutter flow for the required design flow shall not exceed 125 mm (5 in) in depth for Type A or C curb or 100 mm (4 in) for Type B curb.

11. The effect of debris, erosion, and channel bedload during flood flows shall be considered in the design of inlets, culverts and bridge structures.
Figure SWM-8a: County Standard GO Inlet
Figure SWM-9: Pipe Connection to Existing Inlet

NOTE: FOR SMOOTH EXTERIOR WALL PIPE, INSTALL THE MANUFACTURER'S RECOMMENDED ADAPTOR OR A RUBBER RING GASKET TO INSURE A WATERTIGHT SEAL.

STORM DRAIN PIPE CONNECTION TO EXISTING INLET OR JUNCTION BOX

N.T.S.
ALL DIMENSIONS IN MILLIMETERS UNLESS NOTED OTHERWISE
Figure SWM-10: Storm Drain Manhole

2" DIA. FRAME & COVER (OR GRATE) SET IN MORTAR.
SOLID COVER MUST HAVE STORM SEWER MARKINGS.

VARES - ADJUSTING RINGS

VARES - PRECAST CONCRETE CONCENTRIC CONE

VARES - PRECAST MANHOLE RISERS
(LENGTHS OF 1, 2 OR 3 FEET OPTIONAL)

VARES - CALTRANS TYPE HALF ROUND BOTTOM
CLASS A CONCRETE BASE CAST IN PLACE

8" - M.H. DEPTH 0'-15'
10" - M.H. DEPTH 15'-25'

SECTION A-A

NOTES
1. NO WALL REINFORCEMENT REQUIRED.
2. ALL PRECAST MANHOLE SECTIONS
   SHALL CONFORM TO A.S.T.M. C 478.

CONCRETE BLOCK 4'-8" DIA.
OR 4'-8" SQUARE. SQUARE
SIDES PARALLEL TO OR AT
RIGHT ANGLES TO EDGE OF
PAVEMENT. FORM 3" VERTICAL
EDGES AROUND TOP OF BLOCK.

ROUND BLOCK

SQUARE BLOCK

ROAD SURFACE

3" A.C.

POUR CONC TO
WITHIN 3' OF TOP
OF COVER CASTING.

PRECAST GRADE
RINGS (1 MN.)

PLAN

STORM DRAIN MANHOLE
N.T.S.

REV. 12/05

FIG. SWM-10
Figure SWM-11: Water Quality Treatment Unit in Manhole

PLAN

SPECIAL MANHOLE FRAME & COVER

PRECAST CONC. CONCENTRIC MANHOLE CONE

TONGUE & GROOVE JOINTS: MORTAR ALL SECTIONS (2:1 MIX)

PRECAST CONCRETE PIPE SECTIONS

PRECAST CONCRETE BOX

1/2" STEEL PLATE (REMOVABLE), SECURE IN PLACE WITH (2) 1/2" GALVANIZED NUTS, BOLTS AND WASHERS PER SIDE.

DIRECTION OF FLOW

2" x 2" x 1/4" ANGLE BOLTED TO MANHOLE WALLS

3/4" DRAIN ROCK COMPACTED 12" ON SIDES

60" M.H.

1/4 S.D. DIA.

1/4" L.P.

54" DIA. OPENING

8" THICK CONC. BASE

SECTION 24" x 60" (54" I.D.) PRECAST LEACH PIT LINER OR CAST-IN-PLACE EQUIVALENT

CONCRETE FOOTING (60" O.D.)

NOTE:

THE PIT LINER SHALL NOT BE PERMEABLE IN PROJECTS THAT HAVE POTENTIAL FOR GROUNDWATER CONTAMINATION, SUCH AS GAS STATIONS, OR PROJECTS IN PROXIMITY TO WELLS.

SECTION A-A

WATER QUALITY TREATMENT UNIT IN MANHOLE

N.T.S.
NOTES

1. The interior dimensions (A & B) must be large enough to permit cleaning of the box, but shall not be less than 2' x 2'. The minimum wall thickness (T) shall be 6 inches in areas subject to traffic and 4 inches in areas where the box will not be subjected to wheel loads.

2. The perforated pipe and drain rock shall not be included in projects that have potential for groundwater contamination, such as gas stations, or projects in proximity to wells.

* VOL. BELOW F. ELEV.

Tee fitting (with extensions as needed)

4" Perf. P.V.C. Pipe
(see note 2 above)

3/4" Drain rock wrapped in std. geotextile filter fabric (see note 2 above)

Minimum measurements should be the same as the outside dimension of box

*Rule of Thumb: 1 cu. yd. of volume per acre of paved area

SECTION

Water Quality Treatment Unit for Small Drainage Areas

N.T.S.
Figure SWM-13: Longitudinal Trench Detail

1. PAVEMENT SHALL BE REPLACED IN KIND. HOWEVER, MINIMUM STANDARDS ARE AS FOLLOWS:
   A. PAVED ROADS - 75mm (3") A.C. TYPE B OVER 225mm (9") PRIME COATED A.B. CLASS 2.
   B. NON-PAVED ROADS - SINGLE SEAL COAT OVER 150mm (6") A.B. CLASS 2 IN TRENCH AREA,
      THEN SINGLE SEAL COAT ENTIRE ROAD SECTION.

2. CUT EXISTING PAVEMENT TO PRODUCE A STRAIGHT VERTICAL FACE AGAINST WHICH TO
   BUTT THE TRENCH PAVEMENT.

3. LONGITUDINAL TRENCHES WITHIN A PAVED AREA OR A ROAD RIGHT-OF-WAY SHALL
   BE BACKFILLED AS SHOWN ABOVE.

4. TRENCHES OUTSIDE A PAVED AREA OR A ROAD RIGHT-OF-WAY SHALL HAVE BACKFILL
   COMPACTED TO NOT LESS THAN 90% RELATIVE COMPACTION.

5. AN INSPECTOR, APPROVED BY THE DIRECTOR OF PUBLIC WORKS, SHALL BE ON SITE
   DURING ALL COMPACTION WORK TO OBSERVE UNIFORM COMPACTION METHODS AND MATERIALS.

6. IF THE EDGE OF THE ASPHALT TRENCH CAP IS WITHIN 600mm (2 FEET) OF THE EXISTING EDGE
   OF PAVEMENT OR LIP OF GUTTER, THE REMAINING PAVEMENT SHALL BE REMOVED AND THE TRENCH
   PAVING SHALL BE EXTENDED TO THE EDGE OF PAVEMENT OR LIP OF GUTTER.

LONGITUDINAL TRENCH DETAIL
Figure SWM-14: Cross Trench Detail

1. OTHER METHODS OF TRENCH BACKFILL MAY BE USED ONLY WITH WRITTEN PERMISSION FROM THE DIRECTOR OF PUBLIC WORKS.

2. CUT EXISTING PAVEMENT TO PRODUCE A STRAIGHT VERTICAL FACE AGAINST WHICH TO BUTT THE TRENCH PAVEMENT.

3. TRENCH SHALL BE CAPPED WITH 75mm (3") A.C. TYPE B MINIMUM. WHERE THE EXISTING PAVEMENT IS GREATER THAN 75mm (3") THICK, IT SHALL BE REPLACED IN KIND.

4. CEMENT/SAND SLURRY SHALL BE MIXED IN A TRANSIT MIXER (CERTIFICATION TAGS REQUIRED), SHALL CONSIST OF 55 kg OF CEMENT FOR EACH CUBIC METER OF MATERIAL (94 LBS/CY), AND SHALL HAVE A 175mm – 225mm (7–9 INCH) SLUMP.

5. PRECAUTION SHALL BE TAKEN TO AVOID FLOATING CONDUITS.

6. OPTIONAL: SHAPED BEDDING OR SAND CRADLE TO 150mm (6") ABOVE PIPE.

7. FOR TRENCHES LESS THAN 1.5m (5') DEEP, SLURRY BACKFILL SHALL EXTEND FROM 150mm (6") ABOVE TOP OF PIPE TO BOTTOM OF AC PAVEMENT.
Section F - Storm Drainage Facilities

1. Concrete valley gutters are not permitted across collector or arterial streets, or across uncontrolled intersections.

2. Pipe Systems
   a. Minimum pipe diameter shall be 450 mm (18 in) within County rights-of-way, easements, and offers of dedication. Smaller diameter pipe may be used only with prior approval of the Director of Public Works.
   b. Maximum spacing of access openings shall be 150 m (500 ft.).
   c. Access openings shall be provided at all horizontal angle points and changes in grade or pipe size.

3. Curves will be allowed in pipe systems only when the pipe diameter is 900 mm (36 in) or larger, at the discretion of the Director of Public Works. Geometry of any such curves shall conform to the pipe manufacturer’s specifications.

4. Pipe Materials
   a. Reinforced concrete, polyvinyl chloride (PVC), or high density polyethylene (HDPE) pipe shall be used for all drainage facilities constructed in County rights-of-way except where approval is obtained from the Director of Public Works for use of an alternate type of pipe. All pipes shall have smooth interior walls and shall withstand fill loads and H-20 highway loading. All joints shall be rubber-gasketed and water tight.
   b. Corrugated metal pipe (CMP) and pipe-arch may be used only with prior approval of the Director of Public Works. All CMP must be galvanized and fully coated (both interior and exterior surfaces) with a bituminous material. Hydraulic demands may also dictate that CMP be fully paved with a durable bituminous lining applied to the inside surface, filling and covering the corrugations so as to form a smooth surface.
   c. Corrugated aluminum pipe (CAP) may be used only with prior approval of the Director of Public Works. To use bare aluminum pipe, a certified report must be submitted to the Public Works Department, showing that the pH of the soil is between 5.5 and 8.5 and the resistivity is 1500 ohm-cm or greater. Additionally, the average velocity through the pipe shall be less than 3 m/s (10 ft/s) with no significant abrasive channel bedload.
   d. All culvert materials and trench backfill shall conform to the manufacturer’s specifications, the provisions set forth in the latest edition of Caltrans’ Standard Specifications and Standard Plans, and Figures SWM-13 and SWM-14 of this Design Criteria.
   e. Minimum pipe size is 450 mm (18 in) for road culverts.
f. Minimum pipe size is 300 mm (12 in) for driveway culverts.

g. Minimum pipe size is 300 mm (12 in) for road cross drains with catch basins at both ends.

h. As a general rule a bridge structure will be required at drainage channel crossings where the peak design flow dictates an culvert 1.8 m (6 ft) in diameter or greater. At the discretion of the Planning Department, exceptions to this rule may be made based on drainage basin characteristics, such as slash and debris, soil type, bedload and channel geometry.

5. Headwalls, downdrains, rip-rap and/or other adequate channel slope and bottom protection measures shall be required at the inlet and outlet of all proposed drainage facilities that produce velocities greater than those shown in SWM-19b for the corresponding soil type. Erosion protection facilities shall be incorporated for design flood overflow conditions where reasonably possible.

6. Inlets and Structures

a. County standard type GO inlets shall be used within County rights-of-way whenever possible (Figures SWM-8a and SWM-8b).

b. Caltrans type G1 and G2 inlets (without curb openings) may be used where County standard inlets are not practical and with prior approval of the Director of Public Works.

c. Caltrans type GDO inlets may be used when larger inlets are needed.

d. Storm drain manholes may be used as junction structures, or as inlets where inlet capacity is not critical (Figure SWM-10).

e. Smaller precast concrete catch basins are permitted on private property where appropriate.

f. Connections of new pipes to existing catch basins or other structures shall conform to Figure SWM-9.

**Section G - Right-of-Way and Easement Dedications**

1. The minimum width for easements to be dedicated for stormwater pathways shall be:

   | Conduits                  | 3 * Depth + O.D.,  |
   |                         | (Minimum 10 feet)  |
   | Earth and Lined Channels| Bottom Width + 3 * Depth, |
   |                         | (Minimum 5 feet)  |
The above minimum easement requirements are results of the requirements in the California Code of Regulations (CCR), Title 8, Section 1541.1 Requirements for Protective Systems for Excavations.
Earth and lined channels shall be located within easements as follows:

2. Drainage improvements not within County right-of-way that are to be County maintained shall be accompanied by corresponding reservations or dedications to the County of drainage easements of a minimum 15 feet width or as otherwise specified in the above section, or as specified by the Director of Public Works. These drainage easements shall generally contain the improvements and any necessary appurtenances. The County will accept easements only when they are wide enough to allow for open excavation for repair and replacement and vehicular access for inspection and maintenance. The vehicular access strip shall be 10 feet wide along the entire drainage course offered for dedication to the County. County staff shall review for minimum width and configuration of drainage easements offered for dedication to the County prior to the project developer completing site design. In cases where drainage improvements that are to be County maintained are too far removed from easy points of access, the County may require a separate easement in order to gain and maintain vehicular access to the drainage improvements. The Director of Public Works may accept a narrower easement after a project applicant demonstrates that site specific soil conditions are such that a narrower easement will allow for open trench excavation and still meet the CCR requirements for slope protection systems.

No permanent structures of any kind shall be placed in County drainage easements without the written permission of the Director of Public Works. Any gates which must be constructed over such easements shall be a minimum of 3 m (10 ft) in width and be noted on applicable improvement plans. Such gates shall have locking mechanisms compatible with existing County padlocks. Any obstructions in County easements can be removed by the County without compensation of any kind to the owner.

If the County is unable to remove an obstruction in its easement placed there by others and the owner is unresponsive to requests by the County to remove the obstruction, the County shall move against the owner to recover the costs associated with any extra work or any damages attributable to the obstruction.

3. If the parcel being developed receives existing runoff from an adjacent drainage area, the recordation of a drainage easement, maintenance agreement, deed restriction, or other document recorded on the parcel deed may be required. The recorded document shall acknowledge that the parcel does and will continue to receive upstream runoff, that the property owner is responsible for maintenance of the drainage pathway (natural and/or man-made) through the parcel, and that the County and Flood Control District(s) are not responsible for the upstream runoff or for maintenance of the drainage pathway.

4. Drainage improvements that are to be maintained by a homeowners’ association or other private entity, including water quality treatment units, stormwater detention or retention facilities, and drainage facilities that serve more than one parcel, shall be located within common area parcels or private storm drain easements. Adequate access shall be provided to allow for maintenance or repairs.
Section H - On-Site Detention of Stormwater Runoff

1. General Plan Policies

Applicable General Plan policies are found in the chapter sections listed:

a) 7.23.1 New Development

b) 7.23.3 On-Site Stormwater Detention

NOTE: Use of a structural detention system for controlling stormwater runoff is subject to the discretion of the Director of Public Works. Designers shall contact the Department of Public Works for approval prior to the design of a structural detention system.

2. Method

a. The standard method for calculating the required detention volume is the modified rational method. Please see Figure SWM-16 for a design example. See reference, Section B. 1. d., “Practices in Detention of Urban Stormwater Runoff,” for further guidelines and practice description.

b. Other methods may be used with prior approval by the Director of Public Works; however, a 25% safety factor shall be added to the storage volume determined by any such approved alternate method.

c. Common methods of providing detention are shallow surface swales in landscaped areas, underground structures or pipes, dry and wet detention basins, and constructed wetlands.

d. Rock or sand-filled trenches and excavations may be used with the approval of the Director of Public Works.

e. Stormwater management plans shall incorporate methods of design that include both resource and flood control protections, effective for a broad range of storms. Detention systems are typically used to address flood impacts from larger storms. Resource impacts are typically addressed with retention systems as detailed in Section H, along with other best management practices (BMPs) found in the references shown in Section B. 1. h and i.

3. General Site Selection

a. When on-site detention is to be utilized, it is required that the engineer make provisions for the system in the preliminary planning of the site development and landscaping plans.

b. Detention facilities shall not produce hazardous conditions. Potential future legal liability shall be carefully considered by the designer.
c. Detention facilities serving any development in common shall be located within reserved common space, easily accessed for maintenance and inspection. All detention systems shall be located on private property.

d. Site selection and design shall give proper consideration to the path for excess flows downstream of the designated detention area.

e. Detention structures shall not be located where concentrated point-source industrial contaminants could enter the facility unless such contaminants are isolated, treated or removed prior to runoff entering the facility.

4. Design Storm and Calculation Procedures

a. If a detention system is required, the minimum criteria for providing on-site detention is that the maximum rate of runoff leaving the developed site shall not exceed the runoff rate from the pre-development site based on a 10-year storm, 15-minute time of concentration, including a 25% safety factor.

b. If a detention system is required to meet groundwater recharge or water supply watershed requirements, see Section I (On-Site Retention of Stormwater Runoff) for sizing requirements.

c. Higher levels of protection, provided by a lower allowable release rate and/or a larger storm to be detained, may be required if a substantial flooding hazard exists downstream.

d. The modified rational method, and therefore the standard calculations, are applicable in watersheds up to 20 acres in size.

e. Detention design curves for required storage volumes, Figures SWM-15-a,b,c,d are provided for use by design engineers. These curves are based on the modified rational method assuming a 15-minute pre-development time of concentration, and a 0.9 post-project coefficient of runoff. There is a 25% safety factor in the curves. These design curves can be used for projects that meet the assumed conditions, or when the assumed conditions are conservative relative to the project conditions.

f. The detention system shall be designed to provide the required volume and maximum release rate for the specified design storm requirements as well as safe release/overflow for the required design return period (see Section D.1).

g. Storage areas shall be completely drained by properly sized discharge structures or pipes that limit the discharge flow rate (Q) to pre-development rates. The discharge structure shall be designed such that the allowable release rate will not be exceeded for any potential hydraulic gradients occurring for the design storm. Discharge structures shall be designed on the basis of inlet or outlet control, whichever is applicable, reflecting the actual stage-discharge relationship, rather than assuming the structure is flowing under constant uniform flow as determined by Manning’s equation.
h. The use of pumps as the primary low flow bypass is not permitted.

i. Detention systems shall be designed so that the facility completely drains within 48 hours from the cessation of storm runoff.

j. Required detention volume determinations shall be based on all net new impervious area, both on-site and off-site, resulting from the proposed project. Pervious areas shall not be included in detention volume sizing (an exception may be made for incidental pervious areas less than 10% of the total area).

k. On-site drainage systems, other than the detention facility, shall be designed to carry any off-site drainage entering the site from adjacent parcels. This off-site drainage shall bypass the on-site detention facility so that the storage volume is used only for the runoff generated by the development. If off-site drainage must enter the on-site detention system, calculations shall be submitted that demonstrate appropriate storage volume and release structure design.

l. For underground structural detention systems, the pre-development runoff flow shall bypass the detention facility so that the storage volume is used only for the additional runoff generated by the development. Above ground detention systems may or may not allow bypass of pre-development runoff, depending on water quality treatment goals.

m. Where a redevelopment project results in an alteration of less than 50 percent of the impervious surface of a previously existing permitted development, only runoff from the new and/or replaced impervious surface of the project are required to be routed to and included in the detention design. Runoff from other areas shall bypass the detention system and discharge separately from the site, unless an alternative design is approved in advance by the Director of Public Works. Any runoff not bypassed shall be included in the design of the detention system storage volume in addition to the volume required due to the project.

n. Where both retention and detention requirements are made, a combined system may be designed. However, both requirements must be fully met, and 100% of the retention volume must be provided below the detention release elevation.

o. Ground percolation as a means of disposal shall be substantiated with adequate soils data and will normally be approved only if soils conditions are particularly well suited for percolation.

5. Contaminant Screening

a. Detention systems shall be designed to minimize clogging and future maintenance.

b. Leaves, twigs, gravel, sand, silt, and other debris with a potential to clog outlet facilities shall be prevented from entering the detention structure by screening or filtering, or shall be separated from the flow with a hydraulic trap.
c. Runoff from paved areas with concentrations of oils and other chemicals shall require water quality treatment upstream of the detention facility. Vegetative treatment measures can be used in place of structural devices. Such use is subject to approval by the Director of Public Works.

d. The end(s) of any runoff storage chamber shall be provided with a cleanout and inspection access riser reaching the ground surface. No cleanout riser shall be less than 150 mm (6 in) diameter.

6. Structural Components

a. Gravel packed detention chambers shall specify on the plans aggregate that is washed, angular, and uniformly graded (of single size), assuring void space not less than 35%. The uniform gravel size may be chosen from sieve #4 to 50 mm (2 in). Well-graded and rounded aggregates shall not be used.

b. Gravel packed chambers shall be screened from surrounding soils with the use of a geotextile fabric filter envelope providing high permittivity. A sand/gravel filter envelope (150 mm (6 in) min.) may be used in place of geotextile fabric, with supporting filter gradation design submitted.

c. Structural pipe/arch detention chambers shall specify on the plans the materials used and the means of structural end closure. Corrugated steel, wood and other toxic or deleterious materials shall not be used.

d. All structures shall be designed to bear the dead and live loads placed upon them without harm to the long-term function of the detention facility.

7. Drainage Plan Drawing and Calculation Submittal Requirements

a. Designate and dimension the area to be used for the detention facility installation with a perimeter line, hatching, and specific notation.

b. Show the location of any leach field within 15 m (50 ft) of the detention facility.

c. Note land slope gradient at and below the detention facility, and/or provide contours.

d. Describe soil profile layers and note permeability range(s), or provide site test results for facilities that incorporate ground percolation as a means of disposal.

e. Note surface vegetation type or mulch coverage for surface impoundments.

f. Draw and label pipe routings and related appurtenances.

g. Specify structural materials to be used.

h. Include drawn detail views and cross sections that assure adequate construction information for all components, including the inlet and outlet structures.
i. Provide a map showing boundaries of both impervious areas and actual drainage areas routed to the hydraulic control structure of the detention facility, clearly distinguishing between the two areas, and noting the square footage of each.

j. Provide calculations for detention volume sizing and the hydraulic control structures, based on the appropriate drainage areas.

8. Regulatory

The Environmental Protection Agency (EPA) defines a class V injection well as any bored, drilled, or driven shaft, or dug hole that is deeper than its widest surface dimension, or an improved sinkhole, or a subsurface fluid distribution system. Such stormwater drainage wells are “authorized by rule.” For more information on these rules, contact the EPA. A web site link is provided from the County DPW Stormwater Management web page. The County does not exclude the design and use of detention facilities that may fall under these EPA regulations.

9. Maintenance

a. The developer/property owner shall record a maintenance agreement (Fig. SWM-25A or SWM-25B) for the future maintenance and inspection of the detention system in compliance with Section C.3.h. A copy of the recorded agreement shall be provided to Public Works.

b. Drainage easements shall be provided, if required, to insure perpetuity of detention areas when constructed as permanent drainage facilities.

c. If special maintenance procedures are required to maintain the long-term functioning of the detention facility, these procedures shall appear on the final plans and shall be recorded with the maintenance agreement on the private property deed, or in the homeowners’ association covenants, conditions, and restrictions (CC&Rs).

d. It is the responsibility of the developer/owner to operate and maintain the detention system so that it meets the original design intent.

e. The detention system shall be inspected at least once annually, and maintained as needed by the owner. For all large projects, the owner shall forward a letter to the County Department of Public Works prior to October 15 of every year stating the date and type of services performed on the detention system.
Figure SWM-15a: Detention Storage Volume Graph

Detention Storage Volume (CF/Acre)

10-Year Pre-Development Allowable Release @ 15 Minute Tc
10-Year Post-Development Storage Volume to be Area Adjusted, $C_{POST} = 0.9$
Chart Based on the Modified Rational Method with 1.25 Safety Factor

10,000

0.2

0.3

0.4

0.5

0.6

0.7

0.8

$C_{PRE}$

1,000

100

1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2 2.1 2.2 2.3 2.4

Storage-CF/Acre Impervious

11-05 $P_{90}$ Value FIG. SWM-15a
Figure SWM-15b: Detention Storage Volume Graph

Detention Storage Volume (CF/Acre)

5-Year Pre-Development Allowable Release @ 15 Minute Tc
10-Year Post-Development Storage Volume to be Area Adjusted, $C_{POST} = 0.9$
Chart Based on the Modified Rational Method with 1.25 Safety Factor

Chart showing the relationship between detention storage volume (CF/Acre) and $P_{60}$ value.
Figure SWM-15c: Detention Storage Volume Graph

Detention Storage Volume (CF/Acre)
10-Year Pre-Development Allowable Release @ 15 Minutes Tc
25-Year Post-Development Storage Volume to be Area Adjusted, C_{post} = 0.9
Chart Based on the Modified Rational Method with 1.25 Safety Factor
Figure SWM-15d: Detention Storage Volume Graph

Detention Storage Volume (CF/Acre)
5-Year Pre-Development Allowable Release @ 15 Minute Tc
25-Year Post-Development Storage Volume to be Area Adjusted, $C_{PCST} = 0.9$
Chart Based on the Modified Rational Method with 1.25 Safety Factor
Figure SWM-16: Detention Volume Design Example

Detention Volume Design Example:

Data to Collect -

- Design Rainfall Frequency = 10 year
- Pre-developed Runoff Coefficient ($C_{p,d}$) = 0.25 (from Design Criteria)
- Post-developed Runoff Coefficient ($C_{p,p}$) = 0.90 (Fig. SWM-1 or from site estimate)
- Antecedent Moisture Factor ($C_{A}$) = 1.0 for 10 year return period
- P00 loopflow = 1.6 used to determine Intensity ($I$) (Fig. SWM-2 & SWM-3 of Design Criteria)
- Return Period Factor ($I_{r}$) = 1.0 for 10 year return period (Fig. SWM-3)
- Pre-developed Time of Concentration ($T_{c,d}$) = 16 minutes (Fig. SWM-4 or from site estimate)
- Post-developed Time of Concentration ($T_{c,p}$) = 5 minutes (Fig. SWM-4 or from design plans)
- Impervious Area ($A$) = 5000 ft$^2$ (from site plans)
- Safety Factor ($SF$) = 1.25 (from Design Criteria)

Calculations -

Step 1:

Using the Rational Equation develop a range of hydrographs for different storm durations representing the post-development condition.

Step 2:

Determine the allowable release rate (const.) representing the pre-development condition.

$$Q_{rel} = C_{s}C_{p,d}T_{d}T_{A}43200$$

where 43200 is the conversion of in/hr to ft/s

$$C_{s} = 1.025/1.96/6000/43200 = 0.004 	ext{ cfs}$$

Note: "In normal flood routing, the maximum release rate will always occur at the point where the cutout hydrograph crosses the receding limb of the inflow hydrograph. For this reason the design release rate is forced to coincide with that point on the falling limb of the hydrograph resulting from the storm of duration equal to the time of concentration for the basin." (Reference B.1.d, page 86)

Step 3:

Determine the detention volume required.

The detention volume required is found by determining the maximum area between the inflow and allowable release hydrographs. This area can be approximated with the following formula which takes the rising limb of the allowable release hydrograph into account:

$$\text{Required Storage Volume} = (Q_{rel} - Q_{in}) \times \text{Duration} \times 60$$

Results -

The detention basin shall be designed to store a volume of 209 ft$^3 \times 1.25 (SF) = 261$ ft$^3$

NOTE:

1) The detention basin hydraulic control structures shall be designed to account for the entire area routed to the system.

2) For more complete discussion of this method see reference B.1.d, pgs. 54-57, APWA, *Practice in Detention of Urban Stormwater Runoff*, special report No. 43, 1974.

FIG. SWM-16
**RUNOFF DETENTION BY THE MODIFIED RATIONAL METHOD**

**Design Procedure:** Press tab key & enter design values

<table>
<thead>
<tr>
<th>Site Location</th>
<th>P60 Isopleth:</th>
<th>1.60</th>
<th>Fig. SWM-2 In County Design Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rational Coefficient Cpre:</td>
<td>0.25</td>
<td>See note # 2</td>
<td></td>
</tr>
<tr>
<td>. Cpost:</td>
<td>0.90</td>
<td>See note # 2</td>
<td></td>
</tr>
<tr>
<td>Impervious Area:</td>
<td>5000 ft²</td>
<td>See note # 2 and # 4</td>
<td></td>
</tr>
</tbody>
</table>

**STRUCTURE DIMENSIONS FOR DETENTION**

| 260 | ft³ storage volume calculated |
| 100 | % void space assumed |
| . | 260 | ft³ excavated volume needed |

<table>
<thead>
<tr>
<th>Structure</th>
<th>Length</th>
<th>Width</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio</td>
<td>25.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

| Dimen. (ft) | 34.38 | 2.75 | 2.75 |

**10 YEAR STORM VALUES**

<table>
<thead>
<tr>
<th>Storm Duration (min)</th>
<th>10 Year Intensity (in/hr)</th>
<th>Cpre</th>
<th>Cpost</th>
<th>Detention Specified</th>
</tr>
</thead>
<tbody>
<tr>
<td>1440</td>
<td>0.28</td>
<td>0.006</td>
<td>0.029</td>
<td>-0.025</td>
</tr>
<tr>
<td>1200</td>
<td>0.30</td>
<td>0.007</td>
<td>0.032</td>
<td>-0.022</td>
</tr>
<tr>
<td>960</td>
<td>0.33</td>
<td>0.010</td>
<td>0.036</td>
<td>-0.025</td>
</tr>
<tr>
<td>720</td>
<td>0.38</td>
<td>0.012</td>
<td>0.040</td>
<td>-0.044</td>
</tr>
<tr>
<td>480</td>
<td>0.44</td>
<td>0.015</td>
<td>0.046</td>
<td>-0.067</td>
</tr>
<tr>
<td>360</td>
<td>0.50</td>
<td>0.017</td>
<td>0.052</td>
<td>-0.072</td>
</tr>
<tr>
<td>240</td>
<td>0.59</td>
<td>0.021</td>
<td>0.062</td>
<td>-0.098</td>
</tr>
<tr>
<td>180</td>
<td>0.68</td>
<td>0.025</td>
<td>0.069</td>
<td>-0.110</td>
</tr>
<tr>
<td>120</td>
<td>0.79</td>
<td>0.028</td>
<td>0.082</td>
<td>-0.123</td>
</tr>
<tr>
<td>90</td>
<td>0.89</td>
<td>0.032</td>
<td>0.092</td>
<td>-0.133</td>
</tr>
<tr>
<td>60</td>
<td>1.05</td>
<td>0.038</td>
<td>0.109</td>
<td>-0.145</td>
</tr>
<tr>
<td>45</td>
<td>1.18</td>
<td>0.043</td>
<td>0.123</td>
<td>-0.158</td>
</tr>
<tr>
<td>30</td>
<td>1.40</td>
<td>0.049</td>
<td>0.140</td>
<td>-0.172</td>
</tr>
<tr>
<td>20</td>
<td>1.65</td>
<td>0.056</td>
<td>0.172</td>
<td>-0.196</td>
</tr>
<tr>
<td><strong>15</strong></td>
<td><strong>1.86</strong></td>
<td><strong>0.054</strong></td>
<td><strong>0.194</strong></td>
<td><strong>-0.219</strong></td>
</tr>
<tr>
<td><strong>10</strong></td>
<td><strong>2.20</strong></td>
<td><strong>0.064</strong></td>
<td><strong>0.229</strong></td>
<td><strong>-0.243</strong></td>
</tr>
<tr>
<td><strong>5</strong></td>
<td><strong>2.93</strong></td>
<td><strong>0.085</strong></td>
<td><strong>0.305</strong></td>
<td><strong>-0.275</strong></td>
</tr>
</tbody>
</table>

**Notes & Limitations on Use:**

1) The modified rational method, and therefore the standard calculations are applicable in watersheds up to 20 acres in size.

2) Required detention volume determinations shall be based on all net new impervious areas, both on and off-site, resulting from the proposed project. Pervious areas shall not be included in detention volume sizing; an exception may be made for incidental pervious areas less than 10% of the total area.

3) Gravel packed detention chambers shall specify on the plans, aggregate that is washed, angular, and uniformly graded (of single size), assuring void space not less than 35%.

4) A map showing boundaries of both regulated impervious areas and actual drainage areas routed to the hydraulic control structure of the detention facility is to be provided, clearly distinguishing between the two areas, and noting the square footage.

5) The EPA defines a class V injection well as any bored, drilled, or driven shaft, or dug hole that is deeper than its widest surface dimension, or an improved sinkhole, or a subsurface fluid distribution system. Such storm water drainage wells are "authorized by rule". For more information on these rules, contact the EPA. A web site link is provided from the County DPW Stormwater Management web page.
Section I - On-Site Retention of Stormwater Runoff

1. General Plan Policies

Applicable General Plan policies are found in the chapter sections listed:

a. 5.5.12 Drainage Design in Water Supply Watersheds
b. 5.8.4 Drainage Design in Primary Groundwater Recharge Areas
c. 7.23.1 New Development

2. Standard Methods

a. Two standard methods are described in this section:

1) Runoff retention by the Slope Infiltration Method
2) Runoff retention by the Storage Percolation Method

Further conceptual description is provided for these methods within this section and in the design examples that follow (See Figures SWM-21 and SWM-23).

b. For related procedures used to develop the storage percolation method, refer to the design examples for both detention and retention, and the reference listed in Section B. 1. d., “Practices in Detention of Urban Stormwater Runoff.”

c. This section establishes minimum standards for retention of stormwater runoff. Use of another retention design method may be allowed with prior County approval, but must equal or exceed the recharge capabilities provided by the standard criteria to the satisfaction of the Director of Public Works.

d. Stormwater management plans shall incorporate methods of design that include both resource and flood control protections, effective for a broad range of storms. Retention systems are typically used to address resource impacts from smaller storms, along with other best management practices (BMPs) found in the references shown in Section B. 1. h and i. Flood impacts are typically addressed with structural detention systems detailed in Section H.

3. General Site Selection

a. Implementation of retention systems shall be provided for in the preliminary planning of the site development layout, grading, and landscape plans to assure that suitable land areas are available and use conflicts do not arise.

b. The selected area shall not be in conflict with other uses or conditions such as steep slopes, leach fields, parking areas, graded or compacted soils, or any use
or condition compromising the infiltration capabilities of the designated retention area or the stability of the local area.

c. Retention facilities shall not produce hazardous conditions. Potential future legal liability shall be carefully considered by the designer.

d. Retention facilities serving any development in common shall be located within reserved common space, easily accessed for maintenance and inspection. All retention systems shall be located on private property.

e. Site selection and design shall give proper consideration to the path for excess flows downstream of the designated retention area.

f. Retention structures shall not be located where concentrated point-source industrial contaminants could enter the facility unless such contaminants are isolated, treated or removed prior to runoff entering the facility.

g. Slope Method Site Selection

1) The selected area should have uniform planar to convex slopes, free of rills and channels that concentrate flow.

2) The slope should be biologically active and well vegetated with ground covering sod and plants, or heavy leaf, bark or pine needle mulches, or equivalent.

3) Perforated pipe shall be laid parallel to the slope contour, and preferably secured at the surface, or with minimal burial and protective cover.

h. Storage Method Site Selection

Retention facilities with concentrated storage shall be located at least three meters (10 ft) from any habitable or high value structure, and 6 meters (20 ft) from any septic leach field. The distance from leach fields may be reduced to three meters (10 ft) under favorable conditions and with the approval of the Environmental Health Department.

4. Slope Stability

a. Either method may be used on slopes up to 15% without special provisions.

b. For site locations on or in the near vicinity of prior landslides, consult a geotechnical engineer and provide a signed, stamped letter of feasibility.

c. Slope Method Slope Stability

Retention site location on or immediately above slopes of 15% to 25% will
require site-specific erosion analysis, and possibly additional improvement measures. (See Figures SWM-19a and 19b.) For slopes exceeding 25%, consult a geotechnical engineer and provide a signed, stamped letter of feasibility.

d. Storage Method Slope Stability

Retention site location on or immediately above slopes exceeding 15% will require consulting a geotechnical engineer to provide a signed, stamped letter of feasibility.

5. Site Soils

a. Saturated soil permeability and hydraulic conductivity values may be used conservatively from the published physical properties table within the USDA-NRCS soil survey, or use actual test values. Other soil information may be found within this survey, including engineering index properties, restrictive layers and high groundwater occurrence. A web site link to the soil survey is provided from the County DPW Stormwater Management web page.

b. Site-specific soil data from geotechnical or septic system investigations shall be used when available and appropriate.

c. Slope Method Site Soils

1) The slope infiltration method has limited applicability for fully effective infiltration on surface soils having less than 15mm/hr (0.6 in/hr) permeability (4.00 um/sec saturated hydraulic conductivity) in the upper 300mm (12 in) of the soil profile. However, the method may still be used as a best management practice to provide partial infiltration, runoff retardance (delay), filtration and erosion control.

2) For project sites with saturated soil permeability less than 120% of the design storm intensity, the design engineer should consider storage methods to percolate runoff.

d. Storage Method Site Soils

Below grade retention storage facilities shall not be located on soils having less than 15 mm/hr (0.6 in/hr) saturated permeability (4.00 um/sec saturated hydraulic conductivity). The maximum saturated permeability assumed shall be capped at 200 mm/hr (8.0 in/hr) due to eventual clogging of the soil interface with imported soil fines.
6. Design Storm and Calculation Procedures

a. A design storm of 2-year return interval and 2-hour duration shall be used for retention design.

b. When using the Modified Rational Method procedure for retention, the 2-hour pre-development “retention threshold rate” shall be held as a constant value released to the soil, similar to detention procedure usage of “allowable release rate.”

c. Required retention volume determinations shall be based on both on-site and off-site impervious areas, as described in Section C.1. Pervious areas shall not be included in retention volume sizing (an exception may be made for incidental pervious areas less than 10% of the total area).

d. All of the impervious area runoff, or equivalent volume, shall be routed to the retention facility. Initial bypass of pre-development design storm flows, or other smaller storms, is not allowed. Where more drainage area than the impervious surfaces is received, and for larger storms, appropriate overflow facilities shall be provided.

e. A safety factor for volume is not required for the retention storage method.

f. Where both retention and detention requirements are made, a combined system may be designed. However, both requirements must be fully met, and 100% of the retention volume must be provided below the detention release elevation.

7. Contaminant Screening

a. Retention systems shall be designed to minimize clogging and future maintenance.

b. Leaves, twigs, gravel, sand, silt, and other debris with a potential to clog perforated pipes, structural chambers, or gravel packing shall be prevented from entering the retention structure by screening or filtering, or shall be separated from the flow with a hydraulic trap.

c. Runoff from paved areas with concentrations of oils and other chemicals shall require water quality treatment upstream of any Storage Method retention facility. Vegetative treatment measures can be used in place of structural devices, and may be integral to the Slope Method retention facility. Such use is subject to approval by the Director of Public Works.

d. The end(s) of any perforated line or structural chamber shall be provided with a cleanout and inspection access riser reaching the ground surface. No cleanout riser shall be less than 150 mm (6 in) diameter.
8. Structural Components
   a. Gravel packed retention chambers shall specify on the plans aggregate that is washed, angular, and uniformly graded (of single size), assuring void space not less than 35%. The uniform gravel size may be chosen from sieve #4 to 50 mm (2 in). Well-graded and rounded aggregates shall not be used.

   b. Gravel packed chambers shall be screened from surrounding soils with the use of a geotextile fabric filter envelope providing high permittivity. A sand/gravel filter envelope (150 mm (6 in) min.) may be used in place of geotextile fabric, with supporting filter gradation design submitted.

   c. Structural pipe/arch retention chambers shall specify on the plans the materials used, perforation size and density, and the means of structure end closure. Corrugated steel, wood and other toxic or deleterious materials shall not be used.

   d. All structures shall be designed to bear the dead and live loads placed upon them without harm to the long-term function of the retention facility.

9. Sizing Limits
   a. Slope Method

   1) The maximum slope length for maintaining sheet flow shall not exceed 30 m (100 ft) and shall be less as conditions dictate, with 9 m (30 ft) typical. This requires site observation by the designer to determine.

   2) The minimum length of perforated pipe shall be 1.8 m (6 ft). The maximum length shall be 12 m (40 ft) or 18 m (60 ft) if teed, per outfall.

   3) For calculated pipe lengths less than 1.8 m (6 ft), disperse downspout runoff over a splash block or gravel pad.

   4) Perforations shall be spaced no more than 150 mm (6 in) apart, and be no smaller than 10 mm (3/8 in) diameter, or equivalent.

   5) The minimum perforated pipe diameter shall be 75 mm (3 in).

   6) A 75% surface distribution efficiency factor shall be applied to the determined infiltration surface area.
b. Storage Method

1) The maximum runoff area to be directed to a Storage Method facility is 20 acres. For larger areas please consult with the Stormwater Management section.

2) Storage Method retention systems shall be designed so that the facility completely drains within 48 hours from the cessation of storm runoff.

10. Drainage Plan Drawing and Calculation Submittal Requirements

a. Designate and dimension the area to be used for the retention facility installation with a perimeter line, hatching, and specific notation.

b. Show the location of any leach field within 15 m (50 ft) of the retention facility.

c. Note land slope gradient at and below the retention facility, and/or provide contours.

d. Describe soil profile layers and note permeability range(s), or provide site test results.

e. Note surface vegetation type or mulch coverage for surface impoundments and runoff distribution slopes.

f. Draw and label pipe routings and related appurtenances.

g. Specify structural materials to be used.

h. Include drawn detail views and cross sections that assure adequate construction information for all components.

i. Provide a map showing boundaries of both impervious areas and actual drainage areas routed to the retention facility, clearly distinguishing between the two areas, and noting the square footage of each.

j. Provide calculations for retention volume sizing and any hydraulic control structures, based on the appropriate drainage areas.

11. Exclusions and Non-Feasibility

a. Small and Medium Projects as described in Section C.1 are exempt from specific quantitative retention requirements. Qualitative measures, such as site best management practices to control and reduce runoff, shall still be employed as required.
b. For situations where zoned GIS mapping is found to be in question, requests for exclusion shall be submitted by letter to the County hydrologist in the Environmental Health Department. This may specifically apply to mismatches between interrelated groundwater recharge, soils data, and parcel map digitized boundaries.

c. Other claims of non-feasibility shall require a stamped and signed letter from an appropriate professional clearly stating the technical basis for the non-feasibility determination, including specific documentation of the conditions causing non-feasibility. Generalized opinions of non-feasibility will not be accepted.

d. Where retention is found to not be feasible lower priority on-site measures shall be employed to minimize stormwater pollutants of concern (see Section C.3.b).

12. Regulatory

The Environmental Protection Agency (EPA) defines a class V injection well as any bored, drilled, or driven shaft, or dug hole that is deeper than its widest surface dimension, or an improved sinkhole, or a subsurface fluid distribution system. Such stormwater drainage wells are “authorized by rule.” For more information on these rules, contact the EPA. A web site link is provided from the County DPW Stormwater Management web page. The County does not exclude the design and use of retention facilities that may fall under these EPA regulations.

13. Maintenance

a. The developer/property owner shall record a maintenance agreement (Fig. SWM-25A and SWM-25B) for the future maintenance and inspection of the retention system in compliance with Section C.3.h. A copy of the recorded agreement shall be provided to Public Works.

b. Drainage easements shall be provided, if required, to insure perpetuity of retention areas when constructed as permanent facilities.

c. If special maintenance procedures are required to maintain the long-term functioning of the retention facility, these procedures shall appear on the final plans and shall be recorded with the maintenance agreement on the private property deed, or in the homeowners’ association covenants, conditions, and restrictions (CC&Rs).

d. It is the responsibility of the developer/owner to operate and maintain the retention system so that it meets the original design intent.

e. The retention system shall be inspected at least once annually, and maintained as needed by the owner. For all large projects, the owner shall forward a letter to the County Department of Public Works prior to October 15 of every year stating the date and type of services performed on the retention system.
Figure SWM-18: Selection of Perforated Pipe Length
Figure SWM-19a: Estimated Velocity Attained for Overland Flows
Figure SWM-19b: Permissible Velocity for Bare Soils

PERMISSIBLE VELOCITY FOR BARE SOILS

<table>
<thead>
<tr>
<th>TYPE OF MATERIAL IN EXCAVATION SECTION</th>
<th>PERMISSIBLE VELOCITY (Meters per Second)</th>
<th>(Feet per Second)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine Sand (Noncolloidal)</td>
<td>0.8</td>
<td>(2.5)</td>
</tr>
<tr>
<td>Sandy Loam (Noncolloidal)</td>
<td>0.8</td>
<td>(2.5)</td>
</tr>
<tr>
<td>Silt Loam (Noncolloidal)</td>
<td>0.9</td>
<td>(3.0)</td>
</tr>
<tr>
<td>Firm Loam</td>
<td>1.1</td>
<td>(3.5)</td>
</tr>
<tr>
<td>Volcanic Ash</td>
<td>1.1</td>
<td>(3.5)</td>
</tr>
<tr>
<td>Fine Gravel</td>
<td>1.2</td>
<td>(4.0)</td>
</tr>
<tr>
<td>Stiff Clay (Colloidal)</td>
<td>1.4</td>
<td>(4.5)</td>
</tr>
<tr>
<td>Graded Material (Noncolloidal)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loam to Gravel</td>
<td>1.5</td>
<td>(5.0)</td>
</tr>
<tr>
<td>Silt to Gravel</td>
<td>1.7</td>
<td>(5.5)</td>
</tr>
<tr>
<td>Gravel</td>
<td>1.8</td>
<td>(6.0)</td>
</tr>
<tr>
<td>Coarse Gravel</td>
<td>2.0</td>
<td>(6.5)</td>
</tr>
<tr>
<td>Gravel to Cobbles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 150mm (6 in)</td>
<td>2.1</td>
<td>(7.0)</td>
</tr>
<tr>
<td>Over 200 mm (8 in)</td>
<td>2.4</td>
<td>(8.0)</td>
</tr>
</tbody>
</table>
Figure SWM-20: Water Supply Watershed Detention Storage Volume
Figure SWM-21: Retention by the Slope Infiltration Method

RUNOFF RETENTION BY THE SLOPE INFILTRATION METHOD

Practice Concept:

Many soils have saturated permeability rates that exceed design storm rainfall intensities. The excess intake capability may be used to infiltrate delivered runoff from developed areas concurrently with the storm event, and without provision for storage volume. This procedure estimates an area of ground surface of adequate size to infiltrate net increases in impervious area runoff. Collected water must be redistributed across the surface of the slope width by a gravel-protected, perforated pipe, and spread slowly down the slope length by gravitational sheet flow. The slope must be uniformly smooth, vegetated, or heavily mulched to assist in the spread of water, maintain a porous soil surface, provide flow retardance, and prevent surface erosion.

The equation used to construct the log-log graph (Fig. SWM-18) is developed as:

\[ W_P = \text{Width across slope contour to run perforated pipe (ft)} \]
\[ Q_{\text{NET}} = \text{Impervious runoff increase (cfs)} \]
\[ I_{\text{INF}} = \text{Permeability rate of saturated soil (in/hr)} \]
\[ i = \text{Intensity of rainfall directly on infiltrating slope (in/hr)} \]
\[ I_{\text{NET}} = \text{Net available infiltration rate} = I_{\text{INF}} - i \text{ (in/hr)} \]
\[ L_S = \text{Length of slope distance for assumed sheet flow (ft)} \]
\[ A = \text{Impervious surface area (ft}^2\text{)} \]
\[ C_{\text{NET}} = \text{Change in runoff coefficient} = C_{\text{POST}} - C_{\text{PRE}} \]
\[ 43200 = \text{Unit conversion of ft/sec to in/hr} \]

Where: \[ Q_{\text{NET}} = C_{\text{NET}} \cdot i \cdot A / 43200 \]

Design Example:

Data to Collect -

- Impervious Area (A) = 5000 ft\(^2\) (from design plans)
- 2 yr, 2 hr Rainfall Intensity (i) = 0.50 in/hr (Figs. SWM-2 and SWM-3)
- Pre-Developed Runoff Coefficient (C\(_{\text{PRE}}\)) = 0.25 (Fig. SWM-1 or from site estimate)
- Post-Developed Runoff Coefficient (C\(_{\text{POST}}\)) = 0.90 (Fig. SWM-1 or from design plans)
- Saturated Soil Permeability Rate (I\(_{\text{INF}}\)) = 2.0 in/hr (from NRCS soil survey or site test)
- Available Sheet Flow Slope Length (L\(_S\)) = 25 ft (from design plans and site inspection)

Find Pipe Length by Calculations -

\[ W_P = C_{\text{NET}} \cdot i \cdot A \cdot I_{\text{NET}} \cdot L_S = (0.9 - 0.25) \cdot 0.50 \text{ in/hr} \cdot 5000 \text{ ft}^2 / (2.0 \text{ in/hr} - 0.50 \text{ in/hr}) \cdot 25 \text{ ft} = (0.65) \cdot 2500 \text{ in/hr} \cdot \text{ft}^2 / 37.5 \text{ in/hr} \cdot \text{ft} = 43.3 \text{ feet} \]

A 75% slope distribution efficiency is applied to increase pipe length: = 58 feet

Find Pipe Length by Fig. SWM-18 -

First, find \( i \cdot A = 2500 \) on the right side of the x-axis, and project a vertical line upwards to intercept with \( C_{\text{NET}} = 0.65 \). Then turn left and project a horizontal line towards the y-axis. Next, find \( I_{\text{NET}} \cdot L_S = 37.5 \) on the left side of the x-axis and project a second line upwards to intercept with the horizontally projected line from the first step. The intersection point of these two projected lines indicates the length of perforated pipe, approximately 58 feet. This chart value has already been adjusted for slope distribution efficiency.
# RUNOFF RETENTION BY THE SLOPE INFILTRATION METHOD

**Notes & Limitations on Use:**

- Saturated soil permeability values may be used conservatively from the USDA-ARS soil survey, or use actual test values.
- Projects with unsaturated soil permeability less than 120% of the design storm intensity should consider storage methods to percolate runoff.
- Maximum sheet flow length is 100 ft, with 30 ft typical. This requires site observation by the designer to determine.
- Minimum length of perforated pipe is 6 ft, maximum length 40 ft, or 69 ft if tidal, per outlet.
- Minimum perforated pipe diameter is 3 inches.

Perforated pipe is to be laid parallel to the slope contour, preferably recessed at the surface, or with minimal buried and protective cover.

This method may be used on smooth and uniform vegetated or moistened slopes over 15%, without special provisions.

Slopes greater than 15%, or other irregular slopes require specific erosion consideration, and possibly surface improvements.

For any slopes greater than 25% occurring nearly at lower elevations, consult a geotechnical engineer.

A 75% efficiency factor is applied to the determined infiltration surface area.

Table is based on computations using the Rational Equation for 2 1/2 yr, 10 yr, and 20 yr duration storms.

Refer to the County Design Criteria, Storm Water Management - Section H, for complete method criteria and example calculations.

## Design Procedure:

<table>
<thead>
<tr>
<th>Design Storm Intensity (in/hr)</th>
<th>0.05</th>
<th>0.10</th>
<th>0.25</th>
<th>0.50</th>
<th>1.00</th>
<th>2.00</th>
<th>4.00</th>
<th>6.00</th>
<th>8.00</th>
<th>10.00</th>
<th>12.00</th>
<th>14.00</th>
<th>16.00</th>
<th>18.00</th>
<th>20.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impervious Area (ft²)</td>
<td>500</td>
<td>500</td>
<td>1000</td>
<td>1500</td>
<td>2000</td>
<td>2500</td>
<td>3000</td>
<td>3500</td>
<td>4000</td>
<td>4500</td>
<td>5000</td>
<td>5500</td>
<td>6000</td>
<td>6500</td>
<td>7000</td>
</tr>
<tr>
<td>0.05</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
</tr>
<tr>
<td>0.10</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
</tr>
<tr>
<td>0.50</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
</tr>
</tbody>
</table>

**Table Value to Interpolate**

Design Storm Intensity: 0.50 in/hr

---

This method is available from the County Public Works website in a computerized Excel spreadsheet format to simplify usage. [Link](http://www.dow.co.santa-ruz.ca.us/drainage.aml)
RUNOFF RETENTION BY THE STORAGE PERCOLATION METHOD

Practice Concept:
Many soils have saturated permeability rates that exceed storm rainfall intensities. The excess intake capability may be used to infiltrate delivered runoff from developed areas. Additionally, storage volumes may be provided that hold runoff in a confined percolation area, commonly referred to as a retention facility. Such a storage structure allows lower permeability soils to be effectively used, or allows the facility size to be compressed into a smaller land area on soils of typical permeability, with the infiltration achieved over a longer time period than the storm event. This procedure estimates a volume of storage space required, balanced with the related size of permeable surface area created within this volume, such that it is of adequate size to percolate net increases in impervious area runoff. The retention facility may be located below grade as a chamber or trench, or at the surface as a shallow basin. The chamber or trench area may be held open with perforated pipe or arch support, or may be gravel-filled with void space providing the storage volume. In all cases, retained water must have extensive contact with permeable soils.

Method Adaptation:
This method’s retention design procedure is based on the Modified Rational Method as used for detention structures, but with adaptations to account for soil infiltration and application to water resource protection.

First, the practice of assigning an allowable release rate, normally assumed in detention design, is still performed the same way, but is defined differently. “Allowable release rate” can be thought of as a “retention threshold rate,” with the focus being on-site recharge into the soil profile that is desired of more frequent, longer duration, low intensity storms. This is in contrast to infrequent, short duration, higher intensity storms, and the resulting peak discharges and off-site releases to downstream drainage systems that are controlled with traditional detention design. The Storage Percolation Method requires a 2-year design storm with a 2-hour duration pre-development “retention threshold rate,” which is intended to represent the upper range of storm events responsible for providing the bulk of natural recharge. Use of this upper range provides a structure size that is less prone to overflow when subject to brief but very intense storms, and also provides for adequate long-term function despite some performance loss over time.

The second adaptation is an extension to the Modified Rational Method procedure that accounts for the addition of direct rainfall occurring over the footprint of the facility, and the on-going subtraction of percolated water out of the storage volume and into the soil.

Finally, the adapted procedure necessitates an iterative calculation process that accounts for, and balances, the inter-relationship between retention structure volume and the internal surface area provided by the structure.

This adapted method is available from the County Public Works web site in a computerized Excel spreadsheet format to simplify usage. http://www.dpw.co.santa-cruz.ca.us/drainage.htm
Design Example:

Data to Collect -

- P60 Isopleth = 1.6 (Fig. SWM-2)
- 2 yr, 2 hr Rainfall Intensity (i) = 0.50 in/hr (Fig. SWM-3)
- Pre-developed Runoff Coefficient (C_{PRE}) = 0.25 (Fig. SWM-1 or from site estimate)
- Post-developed Runoff Coefficient (C_{POST}) = 0.90 (Fig. SWM-1 or from design plans)
- Impervious Area (A) = 5000 ft² (from design plans)
- Saturated Soil Permeability Rate (P_{SAT}) = 2 in/hr (from NRCS soil survey or site test)
- Soil Horizon/Layer Composition (from NRCS soil survey or site test)
- Structure Dimension Ratios = 25:2:2 (L:W:D) (choose approx. dimensions that fit site)
- Structure Internal Voids = 100% (structural pipe is planned)

Calculations -

**Step 1:**
Make an estimate of the required retention storage volume. To provide a reasonable first estimate, try using the 2-yr return, 1-hour duration detention requirement chart (Fig. SWM-20), remembering to adjust for acreage.

At P60 of 1.6, read 2,600 ft³/ac, multiply by 5,000 ft²/43,560 ft²/ac = 298 ft³

**Step 2:**
Adjust volume up if void space is less than 100%. Ex. for 35% void space: 298 ft³/0.35 = 851 ft³

For this problem: 298 ft³/1.00 = 298 ft³

**Step 3:**
Choose a set of ratios to represent the proportions for length, width, and depth of the design structure volume, and calculate the product of these three numbers.

Ratios of 25:2:2 (Length:Width:Depth), Ratio Product = 25*2*2 = 100

**Step 4:**
Calculate the structure dimensions for each ratio value using the estimated design storage volume and the ratio product. As necessary, return to Step 3 and select new ratios if structure dimensions are significantly off from those desired. Note that all dimensions will change as iterations progress.

Length = 25 * (298 ft³/100)₁⁄₃ = 35.98 ft
Width = 2 * (298 ft³/100)₁⁄₃ = 2.88 ft
Depth = 2 * (298 ft³/100)₁⁄₃ = 2.88 ft

**Step 5:**
Calculate the structure footprint area exposed to rainfall: L*W = 35.98 ft * 2.88 ft = 103.6 ft²
Step 6:
Calculate the structure internal surface area from the determined length, width, and depth, and adjust to effective surface area. Note that the 70% effectiveness value adjusts for variability within the soil profile layers and bottom sedimentation, as well as a correction for the structure not filling or draining instantaneously.

\[
\text{Internal Surface Area} = \text{Sides} + \text{Ends} + \text{Bottom} = (L \times D \times 2) + (W \times D \times 2) + (L \times W)
\]

\[
\text{Internal S.A.} = (35.98 \text{ ft} \times 2.88 \text{ ft} \times 2) + (2.88 \text{ ft} \times 2.88 \text{ ft} \times 2) + (35.98 \text{ ft} \times 2.88 \text{ ft}) = 327.5 \text{ ft}^2
\]

Assume 70% Effective Surface Area: \(327.5 \text{ ft}^2 \times 0.70 = 229.2 \text{ ft}^2\)

Step 7:
Calculate the design Storage Volume (SV) by the Modified Rational Method for a full range of storm durations.

\[
\text{SV} = (\text{Req. Retention Rate} + \text{Direct Rainfall Rate} – \text{Soil Infiltration Rate}) \times \text{Storm Duration} \times 60
\]

Where:

- Required Retention Rate = \(Q_{\text{POST}} - Q_{\text{PRE}}\), with \(Q = C \times i \times A\) by the Rational Equation
  \[Q_{\text{PRE}} = C_{\text{PRE}} \times i \times A = 0.25 \times 0.50 \text{ in/hr} \times 5,000 \text{ ft}^2/43,200 = 0.0145 \text{ CFS} \quad \text{(held constant)}\]
  \[Q_{\text{POST}} = C_{\text{POST}} \times i \times A = 0.90 \times (i) \text{ in/hr} \times 5,000 \text{ ft}^2/43,200 = 0.1042 \times (i) \text{ CFS} \quad \text{(i varies w/duration)}\]

- Direct Rainfall Rate = Storm intensity \times Structure Footprint Area
  \[= (i) \text{ in/hr} \times 103.6 \text{ ft}^2/43,200 = 0.0024 \times (i) \text{ CFS} \quad \text{(i varies w/duration)}\]

- Soil Infiltration Rate = Saturated Soil Permeability Rate \times Structure Effective Surface Area
  \[= 2 \text{ in/hr} \times 229.2 \text{ ft}^2/43,200 = 0.0106 \text{ CFS} \quad \text{(held constant each iteration)}\]

Per the table below, after the 1\(^{st}\) iteration the storage volume peak adjusts from 298 \text{ ft}^3 to 218 \text{ ft}^3

<table>
<thead>
<tr>
<th>Required Retention Rate (cfs)</th>
<th>Direct Rainfall Rate (cfs)</th>
<th>Soil Infiltration Rate (cfs)</th>
<th>Storm Duration (min)</th>
<th>Storage Volume (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.004</td>
<td>0.0004</td>
<td>0.0106</td>
<td>1440</td>
<td>-517</td>
</tr>
<tr>
<td>0.006</td>
<td>0.0005</td>
<td>0.0106</td>
<td>1200</td>
<td>-323</td>
</tr>
<tr>
<td>0.008</td>
<td>0.0005</td>
<td>0.0106</td>
<td>960</td>
<td>-143</td>
</tr>
<tr>
<td>0.010</td>
<td>0.0006</td>
<td>0.0106</td>
<td>720</td>
<td>17</td>
</tr>
<tr>
<td>0.015</td>
<td>0.0007</td>
<td>0.0106</td>
<td>480</td>
<td>146</td>
</tr>
<tr>
<td>0.019</td>
<td>0.0008</td>
<td>0.0106</td>
<td>360</td>
<td>192</td>
</tr>
<tr>
<td>0.025</td>
<td>0.0009</td>
<td>0.0106</td>
<td>240</td>
<td>Peak = 218</td>
</tr>
<tr>
<td>0.038</td>
<td>0.0012</td>
<td>0.0106</td>
<td>120</td>
<td>205</td>
</tr>
<tr>
<td>0.055</td>
<td>0.0016</td>
<td>0.0106</td>
<td>60</td>
<td>167</td>
</tr>
<tr>
<td>0.079</td>
<td>0.0021</td>
<td>0.0106</td>
<td>30</td>
<td>126</td>
</tr>
<tr>
<td>0.096</td>
<td>0.0025</td>
<td>0.0106</td>
<td>20</td>
<td>105</td>
</tr>
<tr>
<td>0.110</td>
<td>0.0029</td>
<td>0.0106</td>
<td>15</td>
<td>92</td>
</tr>
<tr>
<td>0.132</td>
<td>0.0034</td>
<td>0.0106</td>
<td>10</td>
<td>75</td>
</tr>
<tr>
<td>0.181</td>
<td>0.0045</td>
<td>0.0106</td>
<td>5</td>
<td>52</td>
</tr>
</tbody>
</table>
Step 8:

Return to Step 4 with the new peak storage volume and repeat through Step 7 until there is no longer variation in the answers for storage volume peak and effective surface area from the most recent iteration. The calculation process should close in about 6 to 8 iterations. These calculations are most efficiently performed on a computerized spreadsheet. If performed by hand, narrow the range of storm durations calculated in successive iterations of Step 7 to those clustered around the peak from the first iteration.

Results from each iteration of calculations showing closure

<table>
<thead>
<tr>
<th>Iteration #</th>
<th>Structure Dimensions</th>
<th>Effective Surface Area</th>
<th>Storage Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length</td>
<td>Width</td>
<td>Depth</td>
</tr>
<tr>
<td>1</td>
<td>35.98</td>
<td>2.88</td>
<td>2.88</td>
</tr>
<tr>
<td>2</td>
<td>32.27</td>
<td>2.58</td>
<td>2.58</td>
</tr>
<tr>
<td>3</td>
<td>33.76</td>
<td>2.70</td>
<td>2.70</td>
</tr>
<tr>
<td>4</td>
<td>33.18</td>
<td>2.65</td>
<td>2.65</td>
</tr>
<tr>
<td>5</td>
<td>33.41</td>
<td>2.67</td>
<td>2.67</td>
</tr>
<tr>
<td>6</td>
<td>33.31</td>
<td>2.67</td>
<td>2.67</td>
</tr>
<tr>
<td>7</td>
<td>33.38</td>
<td>2.67</td>
<td>2.67</td>
</tr>
<tr>
<td>8</td>
<td>33.34</td>
<td>2.67</td>
<td>2.67</td>
</tr>
<tr>
<td>9</td>
<td>33.34</td>
<td>2.67</td>
<td>2.67</td>
</tr>
</tbody>
</table>

The structure dimensions for width and depth equate to a cross-sectional pipe area equivalent to 36” diameter.

\[
2.67 \text{ ft} \times 2.67 \text{ ft} = 7.13 \text{ ft}^2 \quad \text{so} \quad \left((7.13 \text{ ft}^2/3.14)^{1/2}\right) \times 2 \text{ in/ft} = 36.2” \text{ diameter}
\]

This pipe structure would need to be provided with substantial perforations and set in a surrounding gravel pack envelope that assures extensive distributed contact with permeable soils. The additional void volume in this gravel pack is not included in the calculation example above.
Figure SWM-24: Sample Retention Calculation Form on County Website
Recording requested by:

Upon recording return to:

County of Santa Cruz, DPW
Stormwater Management
Section 701 Ocean Street, Room
410 Santa Cruz, CA 95060

AGREEMENT regarding private stormwater management maintenance.

APN: ________________________________

Application No. ____________________

__________________________________________________________________________

being the owner of the real property located at ________________________________________, California, consents and agrees to inspect and maintain annually “prior to the rainy season” and to maintain as necessary for ensuring proper performance of the ____________________________________________________ (stormwater management facility) on the subject property as shown on the plans prepared by ___________________________ dated ________________ per County Code 7.79 and to release, defend and indemnify the County from any and all claims or liability relating to my failure to perform this obligation. I understand that County staff may conduct inspections of the facility, and that as the property owner I may be assessed an annual service charge and/or re-inspection fee to cover the costs of inspection and oversight.

I have read the above agreement and understand it.

This agreement shall be binding on and shall inure to the benefit of the successors, heirs, executors, administrators, and assigns of owner.

Owner ____________________________________________

Dated this ______ day of ____________, ______

PRIVATE STORMWATER MANAGEMENT MAINTENANCE AGREEMENT

(Note: The signature on this form must be notarized.)
AGREEMENT regarding private stormwater management maintenance.

APN: __________________________

Application No. __________________

______________________________, being the owner of the real property located at ________________________, California, consents and agrees to inspect and maintain annually “prior to the rainy season” and to maintain as necessary for ensuring proper performance of the __________________________ (stormwater management facility) on the subject property as shown on the plans prepared by __________________________ dated ________________ per County Code 7.79, and to release, defend and indemnify the County from any and all claims or liability relating to my failure to perform this obligation. I understand that expected maintenance may include __________________________ and that proper performance requires the following restrictions on system or property use __________________________. I understand that County staff may conduct inspections of the facility and that as the property owner, I may be assessed an annual service charge and/or re-inspection fee to cover the costs of inspection and oversight. I agree to forward a letter to the County Public Works Department, prior to October 15 of every year, stating the date and type of service performed on these facilities.

I have read the above agreement and understand it. This agreement shall be binding on and shall inure to the benefit of the successors, heirs, executors, administrators, and assigns of owner.

Owner __________________________

Dated this _______ day of __________, ________

PRIVATE STORMWATER MANAGEMENT MAINTENANCE AGREEMENT

(Note: The signature on this form must be notarized.)

REV 02/17 FIG. SWM-25B
Section J - Stormwater Runoff from Individual Parcels

1. Site planning for new development on individual parcels shall incorporate appropriate best management practices to provide reasonable mitigation of likely drainage problems, stormwater runoff pollution, and stream erosion and sedimentation impacts resulting from new impervious surfaces. In addition, site plans shall specify required maintenance procedures to assure the proper functioning of the proposed drainage systems.

2. Stormwater runoff from individual parcels, both existing parcels being developed as such and new parcels created by a subdivision, shall be intercepted at the property line and channeled into adequate drainage facilities or to a logical safe point of release. These facilities shall be designed to prevent erosion and to convey storm flows as described herein. This interception and channeling on-site shall in no way be construed to permit illegal diversion of surface runoff. If off-site or downstream drainage facilities are not adequate to receive and convey such additional runoff and to convey storm flows as described herein, the developer shall be required to make off-site drainage improvements to the extent required by the Director of Public Works.
PART 4. SANITARY SEWER DESIGN
PART 4. SANITARY SEWER DESIGN

Section A - Submittal Requirements

1. Sewer design, containing the elements described below, will be reviewed by the Sanitation District Engineer’s office for adequacy and completeness.

2. Design calculations and manufacturer’s pump curves shall be required for all lift stations. When requested, design calculations shall also be submitted for other facets of projects.

Section B - Reference Manuals

1. The design and construction of sanitary sewers and pump stations shall conform to the practices and methods set forth in the following manuals:
   a. American Society of Civil Engineers’ Manual of Engineering No. 37
   b. Wastewater Engineering, Medcalf & Eddy
   c. Uniform Plumbing Code, current approved edition

2. Requirements set forth in this Design Criteria shall prevail over practices set forth in the above manuals.

3. Refer to the County of Santa Cruz Sanitation District’s Master Specifications for additional requirements relating to sewer construction procedures, class of pipe, pipe deformation, laterals, manholes, cleanouts, trench backfill, paving, line cleaning, testing and videotaping and other design criteria.

Section C - Design Flow Rates

1. Design flow rate shall be the peak flow rate, including infiltration and stormwater inflow, of the total ultimate tributary area.

2. Design flow rates in general shall be as given in Figure SS-1, or as approved or otherwise directed by the District Engineer.

3. Design flow rate for lift stations serving the equivalent of 29 homes or less shall be based on shower usage or a minimum of 19 m³/day (3.5 gpm) times the number of equivalent dwelling units.
Section D - Design of Sewer Systems

1. All sanitary sewer systems shall be designed as looped systems where topographically practical, with bypass connections at all intersecting streets, and shall be capable of serving all properties within the sewage basin, based on projected General Plan densities within the District’s sphere of influence. Sewers shall be installed on the centerline of the roadway. Curved sewers shall not be allowed. New sewer pipe shall be located no closer than 1.5 m (5 ft) from existing pipe systems except where approved by the District Engineer.

2. Diameter of gravity sewers shall be determined by Manning’s pipe friction formula, using a roughness coefficient, “n” of 0.013, or the pipe manufacturer’s recommendation, whichever is greater.

3. Sanitary sewers shall be designed and sized for the following depths of flow: pipes 300 mm (12 in) in diameter and less at 1/2 full and pipes greater than 300 mm (12 in) in diameter at 3/4 full.

4. The minimum pipe diameter shall be 200 mm (8 in) for public collector lines.

5. Velocity shall be restricted to 4.6 m/s (15 fps) maximum, unless special pipe or controls have been approved. Design depth of flow shall not exceed those standards established in paragraph 3 above. The use of pipe slopes less than 1.0% for any new construction must have variance approval by the District Engineer and will only be allowed where a greater slope is not physically possible.

6. Minimum pipe cover:

   Public sewer .........................1.5 m (5 ft)
   Laterals ............................1.0 m (3 ft)

   Cover less than above shall meet requirements of Figure SS-11.

   Prior to initiating any grading in the vicinity of any existing public sewers where the above required minimum depths of cover cannot be assured, the contractor shall be required to assume any costs in determining the existing condition of the sanitary sewers in the affected area. In the case of locating laterals, this would require video taping the sewer main, pursuant to District specifications, if an existing tape is not already on record with the District.

7. Manholes shall be provided at intervals not greater than 120 m (400 ft) for 200 mm (8 in) lines, 150 m (500 ft) for 250 mm (10 in) and larger lines, at all
changes in horizontal or vertical alignment, and at the end of all public sewer mains. Horizontal interior angles between incoming and outgoing lines shall not be less than 90 degrees. Manhole depth shall not exceed 6 m (20 ft) without written approval of the District Engineer. Water-tight covers shall be installed at all manhole and cleanout locations where storm inflow could otherwise enter the sewer. Manholes and cleanouts shall not be located within any drainage, valley, channel or gutter line.

8. Sewer mains shall conform to current State Of California Department of Health Services criteria regarding separation between sewer and water mains.

9. Drop manhole connections will be allowed only with prior District approval. Refer to Figures SS-6A and 6B for details.

10. Cul-de-sac manholes (see Figure SS-7) may be installed at the end of all lines where more than one building connection could be made, and where it would not be feasible to extend the line any further.

11. Any development containing 30 or more equivalent dwelling units shall deliver to the District Engineer flow metering or odor control equipment. Equipment shall be specified at time of development review. At the District Engineer’s option, a payment equivalent to the installed required equipment cost may instead be collected for future use.

12. For new commercial developments, an industrial waste sampling manhole shall be constructed, either on- or off-site, as part of the sewer system if any building or its dischargers will be used for industrial purposes. Details and specifications for each industrial waste sampling manhole shall be approved by the District Engineer during development review.

13. Anti-backflow check and/or sewer relief valves (see Fig. SS-14) shall be provided in all service connections in which the finished floor elevation is less than 300 mm (12 in) above the next upstream manhole or cleanout cover. The valves shall be located in such a way as to prevent damage to adjacent property as a result of sewage released through the device. Sewer relief-type overflow valves shall not be placed in any structure that would hamper the free discharge of sewage.

Section E - Sewer Easement Requirements

1. Easements shall be provided for all District maintained sewers, except in rights-of-way currently maintained by the County. Easements shall also be required wherever necessary to facilitate connections to any future lines or line extensions, to serve adjacent parcels, or to provide access to existing sewers within or adjacent to the proposal.

2. The easements shall be shown on either the final map or the parcel map and shall
be offered for dedication to the Sanitation District as part of the Owner’s Certificate. Easements shall be for public use for sanitary sewers and necessary appurtenances on or under the land so designated.

3. All easements shall be improved to a width of at least 4 m (12 ft), shall be fully accessible to all District maintenance vehicles, and shall be no less than 6 m (20 ft) in width. No fences, decks, landscaping, or other obstructions shall be placed over or in such easements. (The C.C. and R.’s for the development shall specifically prohibit any such encroachments.) Any gates that must be constructed over such easements shall be noted on the improvement plans as at least 3 m (10 ft) wide, with standard locking mechanisms compatible with existing District padlocks.

Section F - Sewer Plan Layout

1. Design drawings shall show the following:
   a. Location of manholes and cleanouts
   b. Location of laterals and stubouts
   c. Existing manhole numbers (available from District Engineer’s office) and distance between new structures and existing manholes
   d. Manhole rim and invert elevations (based on County Datum)
   e. Size of sewer and class of pipe
   f. Slope of pipe
   g. Special details
   h. Location of existing sewers and laterals that are to be abandoned
   i. Easements (existing and proposed)
   j. Finished floor elevations
   k. Grading and paving details for driveway construction (for access to easement sewers)
   l. Portions of lines to be publicly or privately maintained
   m. Datum from which elevations are established
   n. Sanitation District’s “Standard Notes for Development.”

2. Standard details and material specifications will be provided by the District Engineer.

3. Condominium, townhouse and cluster development sewer systems shall be designed according to these District criteria, and as noted on Figure SS-3, although such systems shall be operated and maintained by their homeowners’ association. Specific reference to sanitary sewer maintenance and operation shall be included in the C.C. & R.’s for all such developments.
Section G - Lift Stations

1. Refer to Section C regarding design flow rates for District maintained lift stations and private stations serving multiple units.

2. Refer to Figures SS-8 and SS-9 for minimum design standards for all such lift stations. The design and location of all lift stations shall be subject to the approval of the District Engineer. Where necessary, additional right-of-way shall be set aside within the development for such stations.

3. Lift stations shall be designed to provide for the following minimum force main diameters and flow velocities unless otherwise specified by the District Engineer:

   **District-Maintained Station**
   
   100 mm (4 in) F.M. @ 1.2 m/s (4 fps)

   **Private Multi-Residential Station**
   
   75 mm (3 in) F.M. @ 900 mm/s (3 fps)

4. Private residential pump stations shall conform to the provisions of Fig. SS-13 and to the Uniform Plumbing Code. Their locations shall be included on the plot plan of the building permit application, together with a complete list of all equipment (including pump curves) and accessories that are to be installed.

5. A permanently installed standby engine-generator set, capable of automatically running both pump motors simultaneously at maximum load during power outages, shall be provided to the District Engineer for each new public lift station. The District shall specify criteria.

6. Shop drawings (3 sets) of all lift station equipment shall be submitted to the District Engineer for review and approval prior to accepting the delivery of any such equipment.
Section H - Construction Standards

1. Reference is made to the County of Santa Cruz Sanitation District’s *Master Specifications*, which are hereby incorporated into the *Design Criteria*, and which set forth the required special provisions for sanitary sewer work on all projects covered by the *Design Criteria*.

2. In order to allow for more reliable future location of existing sewer lines and laterals, insulated 10-gauge copper wire shall be attached to the top of new sewers and over those new sewer laterals that are constructed in the public right-of-way or sewer easements, (See Figures SS-2A, SS-2B and SS-12). Wire shall be brought up from outside of manhole, under manhole cover frame and shall make an easily accessible loop within manhole.

3. County survey crews will prepare “as-built” plans of all publicly-maintained sewers that are constructed as part of any land division. The developer shall be responsible for all staff charges and preparation costs involved therein. All other sewers which are to be dedicated to the District shall be built through standard sewer extension agreement proceedings, with appropriate cash deposits required for all plan checking, inspection (including videotaping), and “as-built” survey costs.

Criteria for “as-built” plans shall include:
manhole and cleanout rim and invert elevations; reference to appropriate County datum; length of sewers; distances between new manholes and both upstream and downstream existing structures; pipeline materials; offset distances to easements and other right-of-way references; and any horizontal alignment changes.

4. Following cleaning (balling, flushing, and screening of the debris) and testing of the new sewers, the developer shall be responsible for all costs to have the District-maintained sewer system (and private laterals at the discretion of the District Engineer) video recorded by a qualified firm. The video recording shall be submitted to the District Engineer on DVD in a Microsoft Windows Media Player compatible format. The video recording shall be performed after the introduction of clean water to the new pipeline(s), but prior to the introduction of any sewage into said line(s). The accompanying report shall indicate the name of the development or name of construction project, the contractor, both line and DVD footage references to all structures and junction points, and observed deficiencies.

The video picture shall be of such clarity that it shall afford the viewer a clear perspective of any defects, sags, or debris left in the pipeline, and shall indicate orientation of the camera with respect to the invert of the pipe. The depth of any standing water shall be indicated on the video by a measurement device, approved by the District, mounted ahead of the camera. If any sags are detected that are not within allowable tolerances, the contractor shall be required to re-lay said line by appropriate means, so as not to damage or otherwise dislodge said
pipeline. Sags shall be considered out of tolerance if the depth of the sag exceeds 10 percent of the pipe diameter. Additional defects that may cause non-acceptance and are subject to video review shall include, but not be limited to: mud and debris; slipped joints; an excessive number of sags in any particular segment; any improperly installed laterals, wyes, tees, or manholes; and any noticeable horizontal offsets. The District Engineer shall review all videos within 5 working days.

Once all defects have been corrected, the contractor shall then be required to revideo record the entire affected segment(s). No permanent paving or other feature shall be constructed over a sewer line until all videos have been reviewed and approved by the District Engineer.

5. Approval of final occupancy of any dwellings constructed in conjunction with new sewer lines shall be further conditioned upon the completion and acceptance of all public or private downstream sewers. In cases where public sewers are involved, this will also require video recording said lines per the above criteria.
Figure SS-1: Design Flow Graph
Figure SS-2A: Sanitary Sewer Standard Longitudinal Trench Backfill Section

1. Cut A.C. as shown to produce a straight face against which to butt trench pavement.

2. **PAVED ROADS** – Minimum 75mm (3") Type B A.C. over 240mm (9") class 2 A.B. 95% R.C. or replace in kind if more than minimum.

3. **NON-PAVED ROADS** – Single seal coat over 150mm (6") class 2 A.B. in trench area, then single seal coat entire road section.

4. Locating Wire: #10 Insulated copper wire shall be tied to all sewer lines and run up into all connecting structures for locating access. For manholes, place wire under manhole cover frame and make an easily accessible loop within manhole.

5. Select drainrock and approved filter fabric is required as "extra work" where soil or ground water conditions are encountered during construction or where it has been specified on the project plans.

6. Backfill, min. 95% compaction [maximum 600mm (24") lifts], where sewer line has 1.5m (5") or more of cover.

7. One-sack cement/sand slurry backfill.

8. Refer to Fig. SS-11 for concrete encasement.

NOTES:

1. All publicly—maintained sewers or private lines shall be laid with approved controls. Following cleaning and testing, public sewers (or private sewers at the discretion of the Public Works Inspector) shall be video recorded on DVD in a Microsoft Windows Media Player compatible format after slurry encasement in the pipe zone prior to final slurry and acceptance by District.

2. In non-paved, non-County maintained sewer right-of-way area, minimum 90% R.C. for top 1.5m (5") of backfill.

3. In paved, County or non-County maintained right-of-way, minimum 95% R.C. for top 1.5m (5") of backfill.

4. In non-paved, County maintained right-of-way area, minimum 95% R.C. for top 1.5m (5") of backfill.

5. New sanitation improvements ( mains, laterals, cleanouts manholes or other structures) constructed as a part of road improvement projects or divisions of land below the new structural section may use structural backfill compacted to 95%.

SANITARY SEWER STANDARD LONGITUDINAL TRENCH BACKFILL

FIG. SS-2A
Figure SS-2B: Sanitary Sewer Standard Cross Trench Backfill for Laterals or Sewer Structures

1. Cut A.C. as shown to produce a straight face against which to butt trench pavement.

2. **PAYED ROADS** - Minimum 75mm (3") Type B A.C. or replace in kind if more than minimum.

3. **TRENCHES SKewed** over 15° from perpendicular to public roads shall have 200mm (8") of four-sack concrete under 75mm (3") of Type B A.C.

4. Locating Wire: #10 insulated copper wire shall be tied to all sewer lines and run up into all connecting structures for locating access. For manholes, place wire under manhole cover frame and make an easily accessible loop within manhole.

5. Structural backfill, minimum 95% R.C. (maximum 600mm (24") lifts) or sand/cement slurry as directed by the Engineer.

6. Select drainrock and approved filter fabric is required as “extra work” where soil or ground water conditions are encountered during construction or where it has been specified on the project plans.

7. 900mm (3’) of one-sack cement/sand slurry backfill required on any cross trenching for new sewer lateral connections or repairs, or excavations for manholes, cleanouts, or other structures on sanitary sewer mains within the County—maintained road right-of-way.

NOTES:
1. All publicly—maintained sewers or private lines shall be laid with approved controls. Following cleaning and testing, public sewers (or private sewers at the discretion of the Public Works Inspector) shall be video recorded on DVD in a Microsoft Windows Media Player compatible format offer slurry encasement in the pike zone prior to final slurry backfill paving and acceptance by District.

2. In non—paved, non—County maintained sewer right—of—way area, minimum 90% R.C. for backfill.

3. In paved, non—County maintained right—of—way, minimum 95% R.C. for top 1.5m (5’) of backfill, or slurry backfill.

4. In non—paved, County maintained right—of—way, minimum 95% R.C. for top 1.5m (5’) of backfill.

5. New sanitation Improvements (mains, laterals, cleanouts, manholes or other structures) constructed as a part of road Improvement projects or divisions of land below the new structural section may use structural backfill compacted to 95%.

**SANITARY SEWER STANDARD CROSS TRENCH BACKFILL FOR LATERALS OR SEWER STRUCTURES**

**FIG. SS-2B**

REV. 11—07
Figure SS-3: County Criteria for Sewer Layouts

SEWER LAYOUT CRITERIA FOR DEVELOPMENTS

I. Single Ownership of More than Two Dwelling Units on the Same Parcel
   
A. A multiple unit private collector line shall be 150 mm (6") diameter minimum.

B. A cleanout (see figure SS-10) is required at the end of every collector line. A cleanout (or backflow prevention device, if required, see Figure SS-14) is required between the building and the collector line.

C. A wye connection to the public main may be allowed with District approval when 4 or less units are connected to an 200 mm (8") diameter or larger main. A cleanout is required every 300 m (100 feet). The minimum collector line slope would be 2.0 percent.

D. A manhole is required when 5 or more units are connected to the main, or the main is 150 mm (6") diameter. The minimum collector slope shall be 2.0% unless a District variance is given.

E. A cleanout is required at every change in direction or slope of the collector.

F. A 4" sewer lateral may be used for a proposed development of two dwelling units (duplex or detached) with a "Y" configuration. The inspector may require additional cleanouts where field conditions such as slope, distance between cleanouts or vertical or horizontal angles of pipe warrant their installation.

II. Multiple Ownership

A. Townhouse or Condominium


2. The minimum collector slope shall be 2.0% unless a District variance is given.

3. Private collector lines shall be located in private easements or common areas.

4. Maintenance of private collector lines shall be noted in the CC&R's, a copy of which shall be approved by the District prior to Public Works approval.

5. A manhole is required at the connection to the public main.

6. A manhole is required at every change in direction or slope of the collector.

B. Single Family Dwellings

1. Each unit shall be separately connected to a public main.

2. Existing laterals shall be located and shown on the plans.

3. A minimum 1.5m (5') wide private easement for laterals, where necessary, shall be shown on the recorded map.

SEWER LAYOUT CRITERIA

5/04 (DOC: SS-3 2004)
Figure SS-4: Standard Main Manhole
Figure SS-5: Standard Trunk Manhole

Pour concrete to within 75mm (3") of top of cover casting. Round block.

Concrete block 1.37m (4'-6") dia. or 1.37m (4'-6") square.
Square sides parallel to or at right angles to edge of pavement.

Cast iron frame & cover (see note 3) Top elevation to be determined in field.

Precast grade rings (1ea. min.) 450mm (18") max.

Clean and install flexible sealing gasket to all barrel, cone and grade ring sections. Grout inside and outside.

Class A concrete base cast in place. 250mm (10") min.

225mm (9") coarse bedding material.

2.08m (6'-0")

Manchole section

600mm (24") max.

Slope shelf to channel 60mm (2") or as directed by engineer.

NOTES:

Pour concrete around casting cover. Lay pipe through M.I. when possible. Otherwise form U-shaped channel to maintain pipe section for full diameter.

At specified locations, water-tight covers with bottom mounted gaskets shall be required to prevent storm water inflow.

M.I. coupling device (rubber ring gasket) shall be installed on all M.I.s. Inside and outside of all M.I.s shall be water-proofed by the application of standard drywall products, Inc. "Thoroseal" or approved equal if inflow or infiltration is anticipated.

Precast sections shall conform to A.S.T.M. C473.

See Fig. SS-9A and SS-9B for backfill requirements.

Standard Trunk Manhole
For 450mm (18") or larger lines

Fig. SS-5

REV 8-94
Figure SS-6A: Outside Drop Manhole Connection

NOTES:
1. ALL PIPE CONNECTIONS, WATERPROOFING, BASE, PIPE RISERS, AND UPPER SECTION OF DROP MANHOLE SHALL CONFORM TO DETAILS SHOWN FOR STANDARD MANHOLE OF APPROPRIATE SIZE.
2. CUT PIPE FLUSH AT INTERIOR BARREL SECTION.
3. DISTRICT MAY REQUIRE T-LOCK LINER.

OUTSIDE DROP MANHOLE CONNECTION
REV. 4/03
FIG. SS-6A
Figure SS-6B: Inside Drop Manhole Connection

NOTES:
1. DROP MANHOLE CONNECTION WILL ONLY BE ALLOWED WITH PRIOR DISTRICT APPROVAL.
2. ALL INSIDE DROP CONNECTIONS FOR SERVICES AND COLLECTOR SEwers SHALL USE THE DROP BOWL AS PRODUCED BY:
RELINER-DURAN, INC.
53 MT. ARCHER RD.
LYNE, CT 063371
PHONE: (860)34-0277 FAX: (860)34-3185 OR APPROVED EQUAL.
3. DROP BOWL MODEL "A-4" SHALL BE USED FOR ALL LINES UP THROUGH FULL 6" INLETS. DROP BOWL MODEL "A-6" SHALL BE USED FOR ALL 8" INLETS. DROP BOWL MODELS "B-8" SHALL BE USED FOR ALL 10" INLETS. LINES LARGER THAN 10" SHALL BE AS DIRECTED BY THE DIRECTOR.
4. THE FORCE LINE HOOD SHALL BE ATTACHED ON MODELS "A-4" & "A-6" WHEN THE INCLINING LINE IS FROM A FORCE MAN OR THE SLOPE IS S=0.03 OR GREATER, OR EXCESSIVE VELOCITY RESULTS IN SPILLING OUT OF BOWL.
5. SECURE DROP PIPE TO MANHOLE WALL WITH RELINER-DURAN, INC STAINLESS STEEL ADJUSTABLE CLAMPING BRACKETS OR APPROVED EQUAL.
6. ATTACH THE DROP BOWL & EACH CLAMPING BRACKET TO THE MANHOLE WALL WITH 3/8" X 3 3/4" BANSET/RED HEAD BOLTS HELD IN PLACE WITH 2 STAGE EPOXY PASTE. EPOXY SHALL MEET THE FOLLOWING REQUIREMENTS:
A. EPOXY PASTE SHALL BE A TWO COMPONENT, 100% SOLID EPON HYDROCELL 14-1 MOD D OL (BY DMA CORPORATION)
PH (582)/961-0231) OR APPROVED EQUAL.
B. THE EPOXY PASTE SHALL DEVELOP A MINIMUM COMpressive STRENGTH OF 5,000 PSI IN 28 DAYS WHEN TESTED IN ACCORDANCE WITH ASTM D695 AT 73 DEGREES.
C. THE EPOXY PASTE SHALL DEVELOP A MINIMUM TENsile STRENGTH OF 3,000 PSI IN 14 DAYS WHEN TESTED IN ACCORDANCE WITH ASTM D633.
D. THE EPOXY PASTE SHALL DEVELOP A MINIMUM BOND STRENGTH OF 2,000 PSI IN 2 DAYS WHEN TESTED IN ACCORDANCE WITH ASTM C882 (HARDENED CONCRETE TO HARNdENED CONCRETE).
E. MANUFACTURER'S INSTRUCTIONS SHALL BE PRINTED ON EACH CONTAINER IN WHICH THE MATERIALS ARE PACKAGED.

INSIDE DROP - PLAN

INSIDE DROP MANHOLE CONNECTION
FIG. SS-6B

REV. 4-03
Figure SS-7: Cul-de-sac Manhole

NOTE:
NO LATERAL CONNECTIONS
TO BE MADE IN DOWN-
STREAM HALF OF MANHOLE

NOTE:
MAXIMUM NUMBER OF SIDE
SEWERS ALLOWED = 5

NOTE:
TOP OF SIDE SEWERS SHALL
MATCH TOP OF OUTLET PIPE.
REFER TO NOTES ON STD.
MANHOLE FIG. SS-4 FOR
REMAINING NOTES AND
REQUIREMENTS.

SECTION A--A

CUL-DE-SAC MANHOLE

FIG. SS-7
Figure SS-8: Lift Station
Figure SS-9: Lift Station

NOTES:

1. Pump sizing shall depend on flows. Typical large pumps shall be open impeller sewage pumps capable of passing a minimum 3" solid. Typical small pumps shall be minimum 3 hp grinder pumps. All pumps to be 3 phase, 230 volt. Plan submittals shall include hydraulic design calculations and all pertinent pump data, curves and shop drawings for review. The Contractor shall provide 3 copies of the lift station operation manuals to the District.

2. The lift station shall be located within the sidewalk or approved low traffic area, out of any driveways, and accessible by maintenance vehicles and personnel. The control panel shall be located within the immediate vicinity of the station.

3. Provide explosion-proof unions with water-tight cable connectors.

4. Minimum 50mm (2") conduit for motor wiring, one per pump, plus one spare.

5. All liquid level sensor conduit within the wet well shall be Schedule 80, 25mm (1" PVC) pipe.

6. The Contractor shall contact Water and Wastewater Operations at (831) 464-5462 to coordinate connection and testing of the auto communicator.

7. The contractor shall coordinate the location, installation and design of the standby generator with Sanitation Engineering. Auxiliary power shall be tied directly into the Control Panel.

8. Provide MCP style motor starters for each pump, and surge protectors for the panel.

9. Provide approved ground rod connection and wire per current code.

10. Engineer's submittals shall include flow meter. Type to be specified by District. Install receiver on rear of panel.

11. Engineer's submittals shall include simple roof structure over panel, similar to typical bus stop structure.

Rev. 3/99
Figure SS-10: Standard Cleanout

CAST IRON FRAME & COVER
WATERTIGHT WHERE SPECIFIED
OR REQUIRED

150mm
(6")
MIN.

380mm
(15") MAX.

80mm
(3")

CLASS 2 (CLASS 'A') CONCRETE

PACK WITH OAKUM
ALL AROUND SO THAT
BARREL DOES NOT TOUCH
CAST IRON FRAME

RISER MUST NOT BE RIGID WITH
CASTING OR CONCRETE BLOCK

RISER IS SAME
DIAMETER AS MAIN

CLEANOUT STATIONING
45° BEND -
LONG RADIUS

UNDISTURBED
GROUND

CLASS 2 (CLASS 'A') -
CONCRETE CRADLE
FULL WIDTH OF TRENCH
(Do NOT ENCASE JOINTS)

UNDISTURBED
GROUND

TYPICAL FOR C.O. NOT
IN SURFACED ROADS

100mm
(4")

150 mm
(6")
TRENCH WIDTH
150 mm
(6")

1.05m
(3' - 6" MIN.)

IN UNPAVED AREAS THE TOP
OF COVER SHALL BE PLACED A
MINIMUM OF 100mm (4") ABOVE
GROUND WITH PROTECTION FROM
STORM WATER INTRUSION.
SEE FIG. SS-4 FOR LOCATION
OF MARKER POST.

STANDARD CLEANOUT
FIG. SS-10

REV' 4-03
Figure SS-11: Concrete Encasement - Slurry Cap

1. Single wrap approved non-bonding layer between pipe and concrete.
2. All reinforcing 10 (#4) bars, 80mm (3") clear, as shown.
3. Stirrups at 600mm (24").
4. Class 2 or 3 (Class A or B) concrete.
5. One or two sack cement/sand slurry backfill. See Fig. SS-2A and SS-2B for slurry and other backfill requirements.

<table>
<thead>
<tr>
<th>COVER</th>
<th>CONDITION</th>
<th>SEWER MAINS</th>
<th>PRIVATE LATERALS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>DUCTILE IRON</td>
<td>ALL OTHER APPVD. PIPE</td>
</tr>
<tr>
<td>0.20–0.45m (0.7–1.5 FT)</td>
<td>TRAFFIC AREA</td>
<td>NOT ALLOWED</td>
<td>NOT ALLOWED</td>
</tr>
<tr>
<td></td>
<td>NON–TRAFFIC AREA</td>
<td>NOT ALLOWED</td>
<td>NOT ALLOWED</td>
</tr>
<tr>
<td>0.45–0.90m (1.5–3.0 FT)</td>
<td>TRAFFIC AREA</td>
<td>SLURRY CAP</td>
<td>NOT ALLOWED</td>
</tr>
<tr>
<td></td>
<td>NON–TRAFFIC AREA</td>
<td>SLURRY CAP</td>
<td>SLURRY CAP</td>
</tr>
<tr>
<td>0.90–1.5m (3.0–5.0 FT)</td>
<td>TRAFFIC AREA</td>
<td>NO ADDED REQUIREMENTS</td>
<td>SLURRY CAP</td>
</tr>
<tr>
<td></td>
<td>NON–TRAFFIC AREA</td>
<td>NO ADDED REQUIREMENTS</td>
<td>SLURRY CAP</td>
</tr>
</tbody>
</table>

**NOTES:**
1. PRECAUTIONS SHALL BE TAKEN TO PREVENT FLOATING PIPE.
2. CONCRETE SHALL BE CAST AGAINST UNDISTURBED EARTH.
3. SEE MASTER SPECIFICATIONS FOR DUCTILE IRON REQUIREMENTS.

REV. 4–93
Figure SS-12: Sewer Lateral Connection Details

NOTES:

1. Saddles to be "ROMAC" type or approved equal. "TAP-TITE" type connections shall require concrete to be poured around fitting and sewer main to form a secure saddle.

2. All laterals within the County–maintained right-of-way or sewer easement shall be 100mm (4") diameter. All laterals shall have a minimum 2.0% slope.

3. L Laterals shall be installed with a straight grade and alignment from sewer main to property line unless otherwise directed by Engineer.

4. Laterals not immediately connected to the structure are to extend a minimum of 1.5m (5') beyond the public utility easement or public right-of-way, whichever is greater.

5. No private sewer lateral shall be connected to a public sewer manhole or cleanout, except for a cut-de-sce manhole, unless the District has granted prior written approval or as directed by the District Engineer.

6. Minimum 0.9m (3') separation between saddle or tap connection on all pipe with the exception of V.C.P. For V.C.P. maintain 1.5m (5') separation (or one connection per pipe segment if V.C.P. is standard length).

7. Refer to Figure SS–2A and SS–2B for backfill requirements in County maintained right-of-way. Refer to Figure SS–11 for additional requirements.

8. Sewer lateral connection at sewer main shall utilize 22.5° bend or elbow.

9. Septic tank shall be pumped at time of connection. Proof of pumping and filling of abandoned tank shall be provided to District. If District gives prior approval for use as wet wall, tank shall be pumped and may require testing by a method approved by the District. The District shall have final determination for use of the tank (see Fig. SS–13 for residential pump station requirements).

10. The District's "Sanitary Sewer Lateral Repair Criteria and Procedure" shall be enforced. Inspection of break/repair by District Inspector is required.

REV. 4–03
Figure SS-13: Residential Sewage Pump Station

REINFORCED CONCRETE BASE
WITH #4 BARS @ 250mm (10")

MIN. 50mm (2") FORCEMAIN

MIN. 75mm (3") BUILDING SEWER (GRAVITY)

SEWER M.H. COVER

100mm (4") CLEANOUT TO BE BROUGHT TO SURFACE (INSTALL IN BOX AS RED. BY INSPECTOR)

PRESSURE GRAVITY DISCHARGE LINE

THUST BLOCK FOR ALL PIPE ANGLES UNDER GROUND. ALL ABOVE GROUND ANGLES SHALL BE STRAPPED PER UPC REQUIREMENTS.

TYPICAL CONNECTION TO MAIN SEWER

NOTES:

GENERAL — THE MINIMUM REQUIREMENTS FOR A RESIDENTIAL SEWAGE PUMPING SYSTEM CONNECTING A SINGLE RESIDENCE OR EQUIVALENT TO THE DISTRICT'S SYSTEM ARE SPECIFIED IN THE FOLLOWING PARAGRAPHS. THE DISTRICT ACCEPTS NO RESPONSIBILITY FOR THE DESIGN, OPERATION, OR MAINTENANCE OF SUCH PRIVATELY-OWNED AND OPERATED SYSTEMS.

ALL EQUIPMENT AND ACCESSORIES SHALL BE STANDARD MANUFACTURED ITEMS AND THOSE COMING IN DIRECT CONTACT WITH SEWAGE SHALL BE SPECIFICALLY MANUFACTURED FOR SEWAGE USE.

THE MOTOR AND CONTROLS SHALL BE SHELTERED AND PROTECTED BY A WEATHER-PROOF, WELL-VENTILATED ENCLOSURE WHEN INSTALLED OUTSIDE OF BUILDING.

A PRESSURE RELIEF STRUCTURE WILL BE REQURED WHEN SURCHARGE HEAD IS EXCESSIVE.

THE PUMP SUMP COVER SHALL BE SECURELY ANCHORED TO THE PUMP SUMP BY BOLTS AND ALL JOINTS BETWEEN THE COMPONENT PARTS SHALL BE SEALED WITH A WATERPROOF MASTIC.

ALL ELECTRICAL WORK AND CONTROLS SHALL CONFORM TO THE REQUIREMENTS OF THE CITY, COUNTY, AND/OR THE SANITARY DISTRICT, WHICHEREVER, IN THE OPINION OF THE DISTRICT ENGINEER, IS THE GREATER. THE ELECTRICAL CONTROLS SHALL PROVIDE ADEQUATE PROTECTION FOR MOTOR AND EQUIPMENT.

THE HIGH WATER ALARM SHALL BE CONNECTED TO A LIGHT OR BELL TESTED TO THE INSPECTOR'S SATISFACTION.

A VENT 50mm (2") OR LARGER SHALL BE PROVIDED AS REQUIRED BY THE INSPECTOR, WHERE THE SYSTEM IS LOCATED WITHIN THE DWELLING. A 50mm (2") OR LARGER VENT SHALL BE EXTENDED TO A POINT 300mm (1") ABOVE THE PUMP COVER, OTHERWISE REQUIRED BY THE UPC, WHERE SYSTEM IS LOCATED OUTSIDE THE DWELLING.

DISCHARGE LINE: THE PRESSURE PORTION OF THE DISCHARGE LINE, INCLUDING THE CHECK VALVE, GATE VALVE, AND FLEXIBLE COUPLINGS, SHALL BE EQUAL IN SIZE TO THE PUMP DISCHARGE. THE PIPE SHALL BE CAST IRON CLASS 160 CONFORMING TO A.S.A. STANDARD A21. PVC SCHEDULE 40 OR ABS SCHEDULE 40, OR APPROVED EQUAL.

DATA REQUIRED FOR DISTRICT APPROVAL: THE OWNER OR CONTRACTOR SHALL SUBMIT TO THE DISTRICT FOR APPROVAL A PLOT PLAN AND A COMPLETE LIST OF EQUIPMENT AND ACCESSORIES TO BE INSTALLED, INCLUDING PUMP CURVES.

RESIDENTIAL = ONE SINGLE FAMILY DWELLING.

TANK AND INSTALLATION METHODS SHALL BE IN ACCORDANCE WITH SECTION 710 OF U.P.C. THE SIZE AND TYPE OF TANK SHALL BE APPROVED BY THE DISTRICT PRIOR TO INSTALLATION. OPERATIONAL TESTING OF THE PUMP AND TANK IS REQUIRED.

REV. 9-98

RESIDENTIAL SEWAGE PUMP STATION

FIG. SS-15
Figure SS-14: Backflow Preventive Devices

**BACKFLOW OVERFLOW DEVICES**
Optional for existing systems only

**BACKWATER CHECK VALVE AND GIANNI SYSTEM**
Required for new installations preferred but optional for existing installations

**NOTES:**

1. An overflow system is required and shall be installed per sanitation district ordinance where the finished floor elevation of the building to be connected is less than 0.3m (1') above the rim of the nearest upstream manhole, or rim flushing inlet, or where sewer lateral has not been constructed per design criteria requirements.

2. Inspection of the backwater device shall be made after the final grading around the building is completed. The backwater device shall be as detailed, or an approved equal.

3. Consideration must be given to the damage potential to adjacent property by sewage released through the backwater device.

4. Kelly or Gianni type valves shall not be installed inside a box in any way.

**BACKFLOW PREVENTIVE DEVICES**

---

**REV. 4-03**

---

**FIG. SS-14**

---
WHEN A HOUSE IS TO BE MOVED OR DEMOLISHED: THE CONNECTING SANITARY SEWER LATERAL SHALL BE CUT, PLUGGED WITH A TIGHT-FITTING CAP, AND A REDWOOD STAKE MARKER PLACED TO 300mm (12") ABOVE THE GROUND, PRIOR TO EITHER MOVING OR DEMOLISHING THE STRUCTURE.

THE END OF THE SANITARY SEWER LATERAL TO BE ABANDONED SHALL BE PLUGGED WITH A GLUE OR SCREW TYPE CAP, OR CONCRETE.

TO OBTAIN THE NECESSARY INSPECTION OF THE PROPOSED ABANDONMENT AND CAPPING OF THE SEWER LATERAL, PLEASE CALL THE SANITATION DIVISION OF THE PUBLIC WORKS DEPARTMENT, COUNTY OF SANTA CRUZ, AT (831) 454-2895, BETWEEN 10 A.M. AND 3 P.M., OR (831) 454-2160 FROM 8-10 A.M. OR 3-5 P.M.


CAPPING OF ABANDONED SEWER LATERAL

PROVIDE 50mm x 100mm x 1.5m (2"x4"x5") TYPICAL REDWOOD SURVEY STAKE MARKER TO 300mm (12") ABOVE GROUND AT PLUGGED END.

PROPERTY LINE

GROUND

TO

SEWER MAIN

CUT LATERAL AND PLUG END AS SPECIFIED BELOW

(1 C.FT.) 0.03 CUBIC METERS CONC.

EXIST. LAT.

150mm 150mm

(6") (6")

CONCRETE CAP

CAP

EXIST. LAT.

EXIST. LAT.

LATERAL ABANDONMENT DETAILS

REV. 4/99

FIG. SS-15
Figure SS-16: Exterior Grease Interceptor Specifications

SIZING SPECIFICATIONS FOR
EXTERIOR GREASE INTERCEPTOR

Exterior Concrete Grease Interceptors shall be sized according to the following formula:

For Restaurants:  
Interceptor size in gallons = Seating capacity x 4.5 gallons x 2.5 hours x hour factor  
Interceptor size in liters = Seating capacity x 17 liters x 2.5 hours x hour factor

(4.5 = gallons used per seat per hour)  
(17 = liters used per seat per hour)

(2.5 = hours of retention required for grease separation.)

Example:  
120 seats x 4.5 gallons x 2.5 hours x 2.0 hour factor = 2700 gallons  
120 seats x 17 liters x 2.5 hours x 2.0 hour factor = 10,200 liters

The next larger standard size interceptor shall be used when the above calculation yields an intermediate size.

<table>
<thead>
<tr>
<th>HOUR FACTOR = increase in size to compensate of hours of operation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 hour = 1.02</td>
</tr>
<tr>
<td>2 hours = 1.04</td>
</tr>
<tr>
<td>3 hours = 1.06</td>
</tr>
<tr>
<td>4 hours = 1.08</td>
</tr>
<tr>
<td>5 hours = 1.11</td>
</tr>
<tr>
<td>6 hours = 1.14</td>
</tr>
<tr>
<td>7 hours = 1.18</td>
</tr>
<tr>
<td>8 hours = 1.23</td>
</tr>
</tbody>
</table>

For Hospitals:  
Interceptor size in gallons = No. Beds x 4.5 gallons x 2.5 hours x hour factor  
Interceptor size in liters = No. Beds x 17 liters x 2.5 hours x hour factor

For Bed & Breakfast Inns:

Pretreatment devices (grease interceptors or grease traps) shall be required for Bed and Breakfast Inns with six (6) or more rooms.

Exterior grease interceptors are required for any size Bed and Breakfast Inns offering full menu service.

The minimum size exterior concrete interceptor allowed is 1325 liters (350 gallons) for all applications.
Figure SS-17: Exterior Grease Interceptor (Plan & Section)

**PLANT**
- Cleanout and vent as required by plumbing code
- 100mm (4") pipe and fittings
- 150mm x 150mm (6" x 6")/610x610 wire mesh at each wall and base
- All walls minimum 75mm (3") thick

**SECTION**
- 50mm (2") static water level
- 50mm (2") retention tank
- 450mm (18") 3 rebars @ 80mm (3 1/4") c/c both ways
- Sample box
- Cleanout (as req'd.)

**NOTES**
1. Size and details of the grease interceptor shall be approved by the District Engineer prior to installation.
2. Secure necessary permits from the Building Department and check location and structural requirements before beginning installation of the grease interceptor.
3. All covers shall be tight-fitting, removable, easily-accessible, and supplied with a gasket type seal.
4. The interceptor shall be located and installed outside of the building and shall be constructed in such a manner as to exclude the entrance of surface water, and storm or rain water. Tanks must be set level.
5. Grease interceptor or forming for grease interceptor shall be installed prior to the time of rough plumbing inspection. For inspection of grease interceptor call (831) 464–5462, 24 hours prior to installation or concrete pour.
6. Precast structures of equivalent capacity may be installed.
7. Toilet facilities are prohibited from flowing through the interceptor.
8. A running trap and cleanout may be required if odors from venting become excessive.
9. If water is present at excavated depth, then a minimum of 75mm (3 inches) of drain rock shall be laid in the bottom of the trench prior to setting the tank.
10. Garbage grinders are not permitted for commercial or restaurant operations.

**EXTERIOR GREASE INTERCEPTOR**

REV. 5–03

FIG. SS-17
Figure SS-18: Interior Grease Trap

![Typical Grease Trap Detail](image)

**Specifications for Interior Type Grease Traps**

<table>
<thead>
<tr>
<th>Type Food Service</th>
<th>Serving</th>
<th>Min. Rating Required</th>
<th>Fixtures to Trap*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy Stand &amp; Food Stand</td>
<td>Dairy products, hamburgers, fries</td>
<td>45kg (100 LB.)</td>
<td>Pot Sink(s) &amp; Janitorial Sink(s)</td>
</tr>
<tr>
<td>Hamburger Stand</td>
<td>Hamburger, fries, sandwiches</td>
<td>45kg (100 LB.)</td>
<td>&quot;</td>
</tr>
<tr>
<td>Fish &amp; Chips</td>
<td>Take out</td>
<td>32kg (70 LB.)</td>
<td>&quot;</td>
</tr>
<tr>
<td>Pizzeria</td>
<td>Pizza &amp; drinks</td>
<td>32kg (70 LB.)</td>
<td>&quot;</td>
</tr>
<tr>
<td>Hot Dog Stand</td>
<td>Hot dog, kraut</td>
<td>32kg (70 LB.)</td>
<td>&quot;</td>
</tr>
<tr>
<td>Donut Shop &amp; Bakery</td>
<td>Donuts, coffee, milk, tea</td>
<td>45kg (100 LB.)</td>
<td>&quot;</td>
</tr>
<tr>
<td>Delicatessens</td>
<td>Meats, cheeses, sandwiches, salads</td>
<td>32kg (70 LB.)</td>
<td>&quot;</td>
</tr>
<tr>
<td>Sandwich Shops</td>
<td>Sandwiches, salads, soups</td>
<td>32kg (70 LB.)</td>
<td>&quot;</td>
</tr>
<tr>
<td>Ice Cream Services</td>
<td>Ice cream</td>
<td>32kg (70 LB.)</td>
<td>&quot;</td>
</tr>
<tr>
<td>Espresso Bars</td>
<td>Coffee &amp; steamed milk</td>
<td>32kg (70 LB.)</td>
<td>&quot;</td>
</tr>
<tr>
<td>Frozen Yogurt (Low Fat Included)</td>
<td>Yogurt</td>
<td>32kg (70 LB.)</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

**NOTES:**

1. Toilet facilities are prohibited from flowing through grease trap.
2. Installation pursuant to District requirements, manufacturer's recommendations, and U.P.C.
3. A plumbing permit must be obtained from the Building Department.
4. *Under no circumstances shall an automatic dishwasher ever be connected to a trap (interior).
5. Garbage grinders are prohibited from all commercial uses.

**INTERIOR GREASE TRAP**

**Fig. SS-18**
## SPECIFICATIONS FOR CLARIFIERS

1. Toilet facilities are prohibited from flowing through the clarifier.
2. Standard - 3-unit, 5700 L (1500 gallons) with 450 mm X 600 mm (18" x 24") sample box.
3. All are minimum 3-unit plus sample box unless otherwise specified.

<table>
<thead>
<tr>
<th>TYPE OPERATION</th>
<th>EQUIPMENT</th>
<th>SIZE</th>
<th>LOCATION</th>
<th>DRAINS TO CLARIFIER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Station</td>
<td>2 or 3 bay, lube equipment</td>
<td>5700 L (1500 gallons)</td>
<td>Outside</td>
<td>Lube area, wash rack and storage area</td>
</tr>
<tr>
<td>Service station</td>
<td>Same as above, w/steam cleaner</td>
<td>5700 L (1500 gallons)</td>
<td>Outside</td>
<td>Same as above, drains from steam clean area</td>
</tr>
</tbody>
</table>

### Garages:

<table>
<thead>
<tr>
<th>(1) General</th>
<th>w/steam cleaning facilities w/o steam cleaning facilities</th>
<th>5700 L (1500 gallons) w/steam cleaning facilities</th>
<th>Outside</th>
<th>All drains from work area. Same as above</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2) Transmission</td>
<td>w/steam cleaning facilities w/o steam cleaning facilities</td>
<td>5700 L (1500 gallons) w/steam cleaning facilities</td>
<td>Outside</td>
<td>All drains from work area. Same as above</td>
</tr>
<tr>
<td>(3) Body Shop</td>
<td>w/drain from work area w/o drain from work area None</td>
<td>5700 L (1500 gallons) None</td>
<td>Outside</td>
<td>All drains from work area. Same as above</td>
</tr>
<tr>
<td>(4) Paint Shop</td>
<td>Spray booth w/drain and/or water wash vent</td>
<td>5700 L (1500 gallons)</td>
<td>Outside</td>
<td>All drains from work area and water wash vent</td>
</tr>
<tr>
<td>Steam Cleaners</td>
<td>1 or more cleaning booth</td>
<td>5700 L (1500 gallons) w/9m x 9m x 9m (3' x 3' x 3') primary</td>
<td>Outside</td>
<td>All drains from work area. Same as above</td>
</tr>
<tr>
<td>Car Wash (Automatic)</td>
<td>Fully automatic</td>
<td>2-5700 L (1500 gallons) 11400 L (3000 gallons) total</td>
<td>Optional</td>
<td>All drains from work area. Same as above</td>
</tr>
<tr>
<td>Car Wash (Self-service)</td>
<td>To 4 bays w/o steam cleaner</td>
<td>5700 L (1500 gallons)</td>
<td>Optional</td>
<td>All drains from work area. Same as above</td>
</tr>
<tr>
<td></td>
<td>To 4 bays w/steam cleaner &amp; 5 bays &amp; above w/o steam cleaner</td>
<td>5700 L (1500 gallons)</td>
<td>Optional</td>
<td>All drains from work area. Same as above</td>
</tr>
<tr>
<td></td>
<td>5 bays w/steam cleaner</td>
<td>5700 L (1500 gallons) 11400 L (3000 gallons) total</td>
<td>Optional</td>
<td>All drains from work area. Same as above</td>
</tr>
</tbody>
</table>

STANDARD CLARIFIER SPECIFICATIONS FIG. SS-19

REV. 5-03
Figure SS-20: Standard Clarifiers

NOTES

1. Secure necessary permits from the Building Department and/or the Sanitation District and check location and structural requirements before beginning installation of clarifiers.

2. Size and details of clarifiers shall be approved by the District Engineer. Refer to Figure SS-19.

3. Clarifier or forming for clarifier shall be installed prior to the time of the rough plumbing inspection. Call 464-5462 for inspection of clarifier 24 hours prior to installation or concrete pour.

4. Inlet box shall be covered with a removable iron plate or grill as specified. The other compartments and the sample box shall be covered with a removable, tight fitting, solid metal plate.

5. Waterways of compartments can be made using a 75mm (3") by 100mm (4") slot or by installing pipe fittings of equal diameter to that of the outlet pipe. Keep waterways below bottom of "Elbow E."

6. Allow no surface, storm or rain water to enter the clarifier at any time.

7. Clarifier may be constructed in two separate parts providing that waste flows through all boxes.

8. Outlet from clarifier shall be properly vented per U.P.C. standards.

9. All lines shown shall be 100mm (4") minimum.

STANDARD CLARIFIER

FIG. SS-20

REV. 5-03
Figure SS-21: Sewer Lateral or Main Repair

NOTES:
1. The District’s "Sanitary Sewer Lateral Criteria and Procedure" shall be enforced. Inspection of break/repair by District Inspector is required.
2. Property owner or owner’s agent shall obtain a lateral repair permit prior to excavation of lateral. Inspection of break/repair by District Inspector is required. Call (631) 454-2180 for information.
3. Concrete shall set at least 1 hour prior to backfill.
4. Rubber bushings, of appropriate thickness, shall be used when different types of pipe are connected.

REV. 4-03
Figure SS-22: Industrial Waste Sampling Manhole

**SECTION**

**SAMPLING MANHOLE POLICY**

A SAMPLING MANHOLE WILL BE REQUIRED UNDER THE FOLLOWING CIRCUMSTANCES. BOTH INSTALLATION AND OPERATING COSTS OF THE SAMPLING MANHOLE WILL BE AT THE SOLE EXPENSE OF THE CUSTOMER.

1. ANY NEW BUILDING AND/OR LAND DIVISION INTENDED FOR INDUSTRIAL OR COMMERCIAL USE WILL REQUIRE INSTALLATION OF SAMPLING STRUCTURES.

2. ANY EXISTING BUILDING WHERE THE WASTEWATER DISCHARGE IS SUSPECTED TO HAVE AN ADVERSE IMPACT ON TREATMENT AND COLLECTION SYSTEM FACILITIES IF NOT MONITORED, OR DOES NOT MAINTAIN UNIFORM CHARACTERISTICS.

3. ANY EXISTING BUILDING WHERE THE OPERATION INVOLVES USE OF CHEMICALS LISTED AS PRIORITY POLLUTANTS BY ENVIRONMENTAL PROTECTION AGENCY (EPA), OR CHEMICALS LISTED AS HAZARDOUS BY FEDERAL, STATE OR COUNTY HAZARDOUS WASTE REGULATIONS.

4. ANY EXISTING BUILDING UNDERGOING PLUMBING MODIFICATION OR EXPANSION, AND/OR LAND DIVISION WILL BE FLAGGED FOR THE INDUSTRIAL WASTE INSPECTOR TO DETERMINE WHETHER A SAMPLING MANHOLE IS NECESSARY. THE NATURE OF THE BUSINESS ACTIVITY AND THE EXPENSE OF INSTALLING THE SAMPLING MANHOLE WILL BE EVALUATED.

**NOTES:**

MANNHOLE SHALL BE AT LEAST 600MM (24") DIAMETER TO ACCOMMODATE SAMPLING EQUIPMENT

**INDUSTRIAL WASTE SAMPLING MANHOLE**

FIG. SS-22
Figure SS-23: Standard Manhole Cover
Figure SS-24: Standard Manhole Frame
Section A - Purpose of Water Standards

1. The standards set forth in this article are minimum requirements for safe practice in the production and delivery of water for domestic use. They are to be interpreted as meeting only the minimum requirement of design, construction, maintenance, and operation of water utility systems. It is the intent of these standards to safeguard domestic water consumers from injury resulting from sanitary hazards, or structural hazards, or both, which may arise from inadequacies in the design, construction, maintenance, and operation of water utility systems. It is the purpose of these minimum requirements to utilize standards of design, construction, maintenance, and operation of domestic water systems that will provide protection of the public health and welfare.

Section B - Domestic Water System

1. Every lot shall be supplied water for domestic purposes from a domestic water system approved by the Santa Cruz County Environmental Health Service, and when required by California Health and Safety Code, Division 5, Part 1, Chapter 7, under a valid permit issued by the State Department of Health or the Santa Cruz County Health Officer. An approved domestic water system shall meet the requirements of this Design Criteria and the “Standards for Domestic Water Supply Wells,” State of California Department of Water Resources Bulletin No. 74-81 (December 1981).

Section C - Use of Existing Domestic Water Systems - Availability and Capability

1. When the water supply is to be from an existing domestic water system not under the ownership or control of the developer, the developer shall furnish evidence of agreements showing availability of the public water system to serve the improvement. When required by the Santa Cruz County Environmental Health Service, evidence shall be provided demonstrating the capability of the existing domestic water purveyor to extend service in conformance with Section G.

Section D - Use of Existing Domestic Water Systems - Quality Standards

1. The quality of water supplied for human consumption shall conform to the standards contained in the California Administrative Code, Title 22, the California Health and Safety Code, and the California Water Code.

2. In order to use an existing domestic water supply system as the water supply for the proposed improvement, it must have met the standards contained in the California Administrative Code, Title 22, the California Health and Safety Code, and the California Water Code during the preceding twelve months. If the system has been in existence for less than one year, it shall have met such standards during the period of existence.
Section E - Use of Individual Springs or Wells

1. When a developer proposes that each lot in the improvement will be supplied by means of individual springs or wells, each spring or well shall be developed by the developer in conformance with the Santa Cruz County Code Chapter 11.40, Individual Water Systems, prior to the filing of the final map or parcel map.

Section F - Water System Improvement Plans

1. The developer shall prepare a detailed engineering report complete with plans and specifications showing compliance with all requirements of this Design Criteria when the water system for the improvement is not from an existing public domestic water system operating under a valid permit.

Section G - Quantity of Water for Domestic Service

1. The quantity of water from all the water sources and distribution reservoirs shall be sufficient to supply adequately, dependably, and safely the total requirements of all consumers under maximum demand conditions. The following minimum sources and storage requirements together with the pipe sizes specified in Section J are considered adequate to meet maximum domestic demand conditions.
   a. Minimum source requirements shall be determined from Figure W-1 or W-2.
   b. Minimum storage requirements shall be determined from Figure W-3 or W-4.

2. In lieu of the quantity requirements specified in Figures W-1 through W-4, minimum consumer domestic water requirements may be determined from adequately supported and documented system records.

3. A master water supply meter or other suitable measuring device shall be provided for each source of water supply.

Section H - Continuity of Service

1. Water systems with more than 15 connections shall have more than one source of supply and standby power generator or other means to assure that adequate water at minimum pressure is supplied to the distribution system under all conditions and circumstances.

Section I - System Pressure and Facilities Requirements

1. System Pressure
a. Normal operating pressure at the service connection shall not be less than 0.21 megapascals gauge (MPag) (30 pounds per square inch gauge (psig)) nor more than 0.86 MPag (125 psig), except that during periods of hourly maximum demand at the time of peak seasonal loads the pressure may be not less than 0.14 MPag (20 psig) and that during periods of hourly minimum demand, the pressure may be not more than 1.03 MPag (150 psig). Variations in pressure under normal operation shall not exceed 50 percent of the average operating pressure. The average operating pressure shall be determined by computing the arithmetical average of at least 24 consecutive hourly pressure readings.

b. In a water system supplying customers at widely varying elevations, the utility may furnish a service which does not comply with the foregoing pressure specifications, if the customer is fully advised of the conditions under which average service may be expected, and the customer’s agreement is secured in writing.

c. New water systems, or new pressure zones in existing water systems, supplying customers at substantially constant elevation shall be designed to maintain an operating pressure at the service connection of not less that 0.14 MPag (20 psig) nor greater than 0.69 MPag (100 psig).

2. Wells

For systems with approved well sources, additional wells shall be constructed in accordance with all local and State regulations. Proposed well sites shall be investigated to determine the distance from sewage collection and disposal facilities, and any hazards therefrom shall be eliminated prior to well construction. If wells are a new source of supply, application shall be made to the County Environmental Health Service for a new or amended water system permit.

3. Storage Reservoirs

Reservoirs and tanks from which water is delivered directly into the mains of a distribution system shall be adequately protected against pollution and shall be covered with waterproof covering. Drains and overflows shall not be directly connected to sewers or storm drains without gradient breaks guaranteeing that no back flow can occur.

4. Pumping Plants

Booster pumping plants shall be designed by a registered civil engineer.

5. Security

All operating facilities shall be protected against unauthorized entry and vandalism.
Section J - Distribution System Requirements

1. Water Main Materials
   
a. Water main materials shall meet the applicable standards listed in Table I.
   
b. Cast iron and ductile iron pipe shall be cement mortar lined in accordance with AWWA Standard C104-74.
   
c. Steel pipe shall be protected from internal and external corrosion. Table II lists various acceptable protective coatings and linings with appropriate standards.

<table>
<thead>
<tr>
<th>Type of Coating or Lining</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement Mortar Coating or Lining</td>
<td>AWWA C205-71 or Federal Specification SS-P-385a</td>
</tr>
<tr>
<td>Coal Tar Coating, Lining or Wrapping</td>
<td>AWWA C203-73</td>
</tr>
<tr>
<td>Asphalt Mastic Coating</td>
<td>Asphalt Institute M-2 CS-96</td>
</tr>
<tr>
<td>Extruded Plastic Coating</td>
<td>Federal Specification L-C-530B 1.03 MPag (1972)</td>
</tr>
<tr>
<td>Rubber-Alkyd Paint Coating</td>
<td>AWWA C204-75</td>
</tr>
<tr>
<td>Cold Applied Tape Coating</td>
<td>AWWA C209-76</td>
</tr>
<tr>
<td>Coal Tar-Epoxy Coating</td>
<td>AWWA C210-78</td>
</tr>
<tr>
<td>Asphalt Coating and Wrapping</td>
<td>Standard Specifications for Public Works (1973), Section 207-10.4.4</td>
</tr>
<tr>
<td>Construction</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pipe Material</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cast Iron</td>
<td>AWWA C106-75</td>
</tr>
<tr>
<td>Ductile Iron</td>
<td>AWWA C151-76</td>
</tr>
<tr>
<td>Steel</td>
<td>AWWA C200-75</td>
</tr>
<tr>
<td>Copper</td>
<td>AWWA C800-66</td>
</tr>
<tr>
<td>Concrete</td>
<td>AWWA C300-74, C301-72, C302-74 or C303-70</td>
</tr>
<tr>
<td>Polybutylene</td>
<td>AWWA C902-78</td>
</tr>
<tr>
<td>Polyethylene</td>
<td>AWWA C901-78</td>
</tr>
<tr>
<td>Polyvinylchloride</td>
<td>AWWA C900-75</td>
</tr>
</tbody>
</table>
2. Water Main Selection and Installation

   a. Steel pipe shall be selected and installed in accordance with American Water Works Association (AWWA) Manual M-11 (1964), “Steel Pipe Design and Installation.” The design shall comply with Sections 6.1 and 6.2 of the manual, except that the minimum design pressure shall be at least the maximum anticipated system pressure, but in no case less than 1.03 MPa (150 psig).

   b. Cast iron and ductile iron pipe shall be selected and installed in accordance with the standards listed in Table III.

   c. Polyvinyl chloride pipe shall be selected and installed in accordance with Appendix A of AWWA Standard C900-75 as published in the American Water Works Association Journal, 67 (12): 701-704 (December 1975).

   d. Polyethylene pipe shall be selected and installed in accordance with Appendix A of AWWA Standard C902-78 as published by the American Water Works Association (Denver, Colorado, 1978).


   f. Plastic pipe shall not be used in areas subject to contamination by petroleum distillates.

   **TABLE III**

<table>
<thead>
<tr>
<th>Type of Pipe</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cast Iron</td>
<td>AWWA C101-67 and C600-77</td>
</tr>
<tr>
<td>Ductile Iron</td>
<td>AWWA C150-76 and C600-77</td>
</tr>
</tbody>
</table>

3. Layout of Water Mains

   a. Water mains should be laid out only in segmented grids and loops and should be located within streets. Dead-end water mains shall be installed only if:

      1) Looping or gridding is impractical due to topography, geology, pressure zone boundaries, unavailability of easements or locations of users; or

      2) The main is to be extended in the near future and the planned extension will eliminate the dead-end conditions.
4. **Minimum Water Main Diameter and Length of Run**
   
a. Water mains shall have a nominal inside diameter of at least 100 mm (4 in).

b. Dead-end water mains exceeding 300 meters (1,000 ft) in length shall be constructed of pipe with a nominal inside diameter of at least 150 mm (6 in).

c. Dead-end water mains exceeding 600 meters (2,000 ft) in length shall be constructed of pipe with a nominal inside diameter of at least 200 mm (8 in).

d. The requirements of a, b, and c shall not apply to water main installations meeting one of the following criteria:

   1) The installation is designed under the direction of a qualified registered engineer to meet the requirements of Section 64566.

   2) The installation is approved by the District prior to construction.

      A) If District approval is sought, the water supplier shall submit information needed by the District to evaluate the proposed installation.

      B) Within ten working days after receiving the needed information, the District shall, in writing, either approve or reject the proposed installation.

      C) If the District does not respond within ten working days, the proposed installation shall be deemed acceptable.

5. **Water Main Installation**
   
a. Water mains shall be installed below the frost line or shall otherwise be protected to prevent freezing.

b. Water mains shall not have less than 750 mm (30 in) of cover over the top of the pipe except where necessary to avoid underground obstructions or rocky conditions.

c. Water mains shall be installed at least:

   1) Three meters (10 ft) horizontally from and 600 mm (2 ft) higher than sanitary sewers crossing the main.

   2) 600 mm (2 ft) higher than sanitary sewers crossing the main.

   3) Three meters (10 ft), and preferably 7.5 meters (25 ft), horizontally from sewage leachfields, cesspools, seepage pits and septic tanks.
d. Separation distances specified in c. shall be measured from the nearest edges of the facilities.

e. Where the requirements of c. and d. cannot be met due to topography, inadequate right-of-way, or easements or conflicts with other provisions of these regulations, lesser separation is permissible if:

1) The water main and the sewer are located as far apart as feasible within the conditions listed above.

2) The water main and the sewer are not installed within the same trench.

3) The water main is appropriately constructed to prevent contamination of the water in the main by sewer leakage.

f. Water mains shall be disinfected according to AWWA Standard C601-68 before being placed in service.

g. Installation of water mains near the following sources of potential contamination shall require written approval by the District on a case-by-case basis.

1) Storage ponds or land disposal sites for waste water or industrial process water containing toxic materials or pathogenic organisms.

2) Solid waste disposal sites.

3) Facilities such as storage tanks and pipelines where malfunction of the facility would subject the water in the main to toxic or pathogenic contamination.

6. Water Main Valve Locations

Sufficient valves shall be provided on water mains to minimize inconvenience and sanitary hazards during repairs. In general, valves on water mains of 300 mm (12 in) and smaller diameter should be located such that water main lengths of not more than 300 meters (1,000 ft) can be isolated by valve closures.

7. Water Main Valve Construction Standards

a. Water main valves shall conform to the standards shown in Table IV.

b. A valve box shall be installed over each valve stem to aid in locating and operating the valve.
8. Air and Vacuum Relief and Air Release Valves
   a. Vent openings for air and vacuum relief and air release valves shall be:
      1) Extended at least 300 mm (12 in) above grade and above maximum recorded high water.
      2) Provided with a screened, downward-facing vent opening.
   b. Where the requirements of 8.a.1) cannot be practicably met, vent openings may be located in a subsurface chamber or pit under the following conditions:
      1) The pit is adequately drained.
      2) The pit drain is not connected by pipe or other closed conduit to a sewer or storm drain without an air gap separation.

9. Water Main Joints

   Joints and appurtenances shall safely withstand the same working pressures for which the water main is designed. Jute shall not be used as a backup gasket material.

10. Fire Hydrants

   Fire hydrant laterals shall be provided with shutoff valves.

11. Flushing Valves and Blowoffs
   a. A flushing valve or blowoff shall be installed at the end of each dead-end water main where stagnant conditions are likely to develop.
   b. Flushing valves and blowoffs shall be capable of establishing the minimum continuous flushing flow in the main, indicated by Table V.
   c. Flushing valves and blowoffs shall not discharge to a sewer without an air gap separation.

<table>
<thead>
<tr>
<th>Type of Valve</th>
<th>Construction Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate Valve</td>
<td>AWWA C550-71</td>
</tr>
<tr>
<td>Butterfly Valve</td>
<td>AWWA C504-74</td>
</tr>
<tr>
<td>Ball Valve</td>
<td>AWWA C507-73</td>
</tr>
<tr>
<td>Swing Check Valve</td>
<td>AWWA C508-76</td>
</tr>
</tbody>
</table>
### TABLE V
Minimum Water Main Flushing Flow

<table>
<thead>
<tr>
<th>Nominal Inside Diameter</th>
<th>Minimum Flushing Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches</td>
<td>Millimeters</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>75</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
</tr>
<tr>
<td>8</td>
<td>200</td>
</tr>
<tr>
<td>10</td>
<td>250</td>
</tr>
</tbody>
</table>

12. **Service Connection Pipe**

Service connection pipe and fittings shall be designed for cold water working pressures of not less than 1.03 MPag (150 psig). Copper tubing shall be commercial designation type K or L. Plastic tubing and fittings shall be products tested and certified as suitable for use in potable water piping systems by the national Sanitation Foundation Testing Laboratory, the Canadian Standards Association Testing Laboratory or another testing agency acceptable to the District.

**Section K - Water Treatment**

Water treatment shall be required when source facilities lack appurtenances or structures to satisfactorily guard against entry of foreign material into the water system. Minimum treatment requirements shall be in accordance with the following:

1. **Wells or Springs**
   a. When a well or spring meets construction standards and the water quality requirements, it will be approved without treatment.
   
   b. When either well or spring construction or water quality fails to meet standards, the minimum treatment considered for approval will be continuous automatic chlorination.
   
   c. When a well or spring is known or suspected to be contaminated with domestic sewage, approval will not be granted.

2. **Streams or Lakes**
   a. If a lake and/or stream and watershed is adequately protected, the minimum treatment for approval will be filtration and continuous automatic chlorination.
   
   b. Where it is impractical to provide adequate watershed protection, complete treatment of the water may be necessary for approval. The treatment required may include aeration, coagulation and settling, filtration, chlorination, and measures for odor and taste control.
Section L - Abandoned Wells

1. All abandoned wells shall be destroyed or sealed in accordance with Part II of Chapter V of the California Department of Water Resources Bulletin No. 74-81 Water Well Standards, December 1981. This shall be done under permit from the Santa Cruz County Division of Environmental Health.
Figure W-1: Maximum Demand Graphs
Figure W-2: Maximum Demand Graphs

![Maximum Demand Graphs](image-url)
Figure W-3: Storage Capacity Graphs
Figure W-4: Storage Capacity Graphs

[Diagram showing storage capacity graphs with various temperature and volume scales.]
Figure W-5A: Standard Water Service Connection

<table>
<thead>
<tr>
<th>PIPE TYPE</th>
<th>JONES</th>
<th>FORD</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC</td>
<td>J-995</td>
<td>101BS/202BS</td>
</tr>
<tr>
<td>C-900</td>
<td>J-996</td>
<td>101BS/202BS</td>
</tr>
<tr>
<td>AC, CI, DI</td>
<td>J-975</td>
<td>101B/202BS</td>
</tr>
</tbody>
</table>

NOTES:

1. DETAIL TO BE USED FOR 15mm (5/8") AND 20mm (3/4") METERS ONLY.
2. WHEN INSTALLING A NEW SERVICE AT AN EXISTING LOCATION, THE CONTRACTOR MUST REPLUMB THE CUSTOMER SIDE SO THE NEW INSTALLATION MEETS THIS PLAN AND REMOVE ALL ABANDONED PIPE.
3. IRRIGATION METERS WILL REQUIRE A BACKFLOW PREVENTOR PER DETAIL W-5B.
4. NEW INSTALLATIONS AT EXISTING LOCATIONS MUST BE RELOCATED INTO THE RIGHT-OF-WAY.

STANDARD WATER SERVICE CONNECTION
FIG. W-5A
Figure W-5B: Backflow Prevention Assembly

**NOTES:**

1. REDUCED PRESSURE BACKFLOW PREVENTION ASSEMBLY SHALL BE FEBCO 825Y OR 825YA.
2. ASSEMBLY SHALL BE READILY ACCESSIBLE FOR REPAIR AND INSPECTION.
3. PIPE SHALL BE STANDARD GALVANIZED SCHEDULE 40 STEEL.
4. FITTINGS SHALL BE STANDARD GALVANIZED MALLEABLE IRON.
5. ALL PIPE AND FITTINGS BELOW GROUND OR IN CONCRETE TO BE PRIMED AND WRAPPED WITH PROTECTIVE TAPE.
6. PIPING ABOVE GROUND TO BE PAINTED WITH TWO COATS OF ENAMEL AVOCADO GREEN, RUSTOLEUM # 7734.
7. ASSEMBLY TO BE SET LEVEL AND STANDPIPES PLUMB.

**BACKFLOW PREVENTION ASSEMBLY**

**FIG. W-5B**
Figure W-6: Standard 3" and Larger Fire Service Installation

NOTES:
1. TEST COCKS AND RELIEF VALVE SHALL BE Set BACK 450 mm (18") MIN. AND FACING AWAY FROM WALL.
2. ASSEMBLIES REQUIRE PIPE SUPPORTS UNDER EACH GATE VALVE.
3. INSTALLATION SHALL BE LOCATED ON THE PROPERTY SUCH THAT THE DETECTOR METER SHALL BE ACCESSIBLE AT ALL TIMES FOR READING AND MAINTENANCE PURPOSES. LOCATION MUST BE APPROVED BY WATER DISTRICT PRIOR TO INSTALLATION.
4. BACKFLOW ASSEMBLY GATE VALVES SHALL BE O.S. & Y. TYPE AND SHALL BE CHAINED IN THE OPEN POSITION.
5. DRAWING SHOWS REDUCED PRESSURE PRINCIPLE DETECTOR. CLASS I AND II INSTALLATIONS REQUIRING DOUBLE CHECK DETECTOR ASSEMBLY (DCDA) INSTALLATION SHALL BE IDENTICAL WITH THE EXCEPTION OF THE ASSEMBLY.

75mm (3") AND LARGER FIRE SERVICE OR BACK FLOW PREVENTION ASSEMBLY

FIG. W-6
Figure W-7: Standard Fire Hydrant Installation

NOTES:

1. FIRE HYDRANT SHALL BE COVERED WITH BURLAP SACK UNTIL PUT INTO SERVICE.

2. SEE DRAWING ON PLANS FOR VALVE BOX DETAIL.

3. HYDRANT OUTLET CAP CHAINS SHALL BE REMOVED.

4. STANDARD CONCRETE THRUST BLOCKS SHALL BE POURED AGAINST UNDISTURBED SOIL.

FIRE HYDRANT (SEE MATERIAL SPECIFICATIONS)

INSTALL 'BREAK-AWAY' EXTENSION FOR HEIGHT ADJUSTMENT (NUTS TO BE ON TOP)

FACE OF CURB

150 mm (6") FLG. INLET GATE VALVE

150 mm (6") FLG. OUTLET TEE

150 mm (8") PIPE

CONCRETE THRUST BLOCK (TYP.)

CONCRETE THRUST, BLOCK (TYP.)

STANDARD FIRE HYDRANT INSTALLATION

FIG. W-7
PART 6.  DRIVEWAYS AND ENCROACHMENTS
PART 6 - DRIVEWAYS AND ENCROACHMENTS

Section A - Driveway Regulations

Driveways shall be constructed or modified in accordance with Figures DW-1 through DW-7 and as described in this section.

1. Driveways shall not interfere with legal encroachments nor create hazards or nuisances, and shall be spaced to maximize available street parking.

2. A plan and profile drawn to scale showing the following must be submitted for approval prior to the issuance of a driveway permit:
   a. Existing right-of-way line and property lines
   b. Existing roadside features and topography (e.g., swales, ditches, culverts, utilities, curb and gutter, sidewalk, etc.)
   c. Edge of pavement of road
   d. Existing and proposed ground profiles with elevations and grades
   e. Typical cross section indicating type and thickness of proposed surface and base material, cross slopes, and drainage facilities.
   f. Method of handling driveway runoff

3. A common driveway will be allowed only if rights-of-way over all properties are granted to each property owner.

4. Adequate sight distance shall be provided based on the design speed of the road. The minimum sight distance shall be 75 m (250 ft) for minor local streets, or as required by a traffic engineering report.

5. When more than one driveway serves a given property, the total width of all driveways shall not exceed 70 percent of the frontage for commercial parcels or 50 percent of the frontage for residential parcels. There shall be a minimum of 6 m (20 ft) of full height curb between driveways on the same parcel.

6. The sideline of any driveway shall not be closer than 3 m (10 ft) to the intersection curb return.

7. Driveway alignment of less than 60 degrees from the intersected road is not allowed.

8. Trees may only be removed to provide vehicular access if no suitable alternative exists. The applicant shall obtain all necessary permits for tree removal work.
9. Engineered plans for a driveway must be submitted upon request by the Director of Public Works.

10. Subdivision plans shall show a driveway design conforming to these specifications for each lot.

11. The applicant is responsible for the accuracy of all information submitted for the permit.

12. Base rock shall be Class 2 aggregate base, asphalt concrete shall be hot mix Type B, and concrete shall be Class 3 (Class B) (5 sack) minimum.

13. The minimum inside turning radius along a driveway shall be 4.5 m (15 ft).

14. Inspections are required prior to placing concrete or asphalt concrete. A final inspection is required upon completion of the permitted work.

15. Forty-eight hour advance notice is required prior to inspections.

16. Concrete grass pavers, installed to manufacturers’ specifications, and as shown on plans approved by the Director of Public Works may be used as an alternate driveway surface type, outside of County maintained road rights-of-way, subject to the following:

a. Concrete grass pavers may be used for fire access, emergency roads or turnarounds.

b. Concrete grass pavers may be used when warranted by significant environmental conditions.

c. Concrete grass pavers may be used on driveways that slope away from the street.

d. The Director of Public Works may disapprove the use of concrete grass pavers on driveways that slope towards the street, if the Department determines that their use could result in the deposit of sediment on the street, or could otherwise cause significant problems within a County maintained right-of-way.

e. If appropriate, the Director of Public Works may require that provisions be made to accommodate pedestrian traffic, with a minimum 1.2 m (4 ft) wide asphalt or concrete walkway.

f. The Director of Public Works may require that compaction test results of the subgrade soil be submitted for review and that adequate compaction be demonstrated to the satisfaction of the Department.
17. To encourage stormwater retention and infiltration, base rock or gravel may be used as an alternate surfacing type for driveways outside the County maintained road right-of-way, subject to the following:

a. The driveway shall be designed to minimize runoff to the adjoining access road.

b. The driveway shall be a minimum of 150 mm (6 in) thick or as required by the appropriate fire agency.

c. The driveway shall be cross-sloped to promote sheet flow to a non-erosive vegetated area prior to the runoff being released beyond the property line.

d. Driveway runoff shall not cause the deposition of sediment onto the access road or into downstream drainage conveyances.

e. An asphalt or concrete driveway apron shall be constructed adjacent to the paved right-of-way for a minimum distance of 4.6 m (15 ft) to conform to existing roadside improvements.

Section B - Trench Backfill

1. Longitudinal trenches may use sand backfill or native material compacted to 95% for the top 1.5 m (5 ft) of cover, and 90% for depths over 1.5 m (5 ft) (see Figure EP-1). A qualified inspector, approved by the Director of Public Works, shall be on site during all compaction work to observe uniform compaction methods and materials. If a full-time inspector is not provided by the utility company or the County, trench backfill shall be cement/sand slurry (see Figure EP-2).

2. All service connections, cross trenches, manholes, clean outs, valves, utility boxes, vaults or other structures within paved areas shall be backfilled with cement/sand slurry (see Figure EP-2).

3. Trenches constructed as part of road improvement projects or land divisions that involve construction of new roads in their entirety may use sand backfill or native material below the new structural section (see Figure EP-1). This standard also applies to service connections, cross trenches, manholes, clean outs, valves, utility boxes, vaults and other structures within the improvement project. A full-time inspector, approved by the Director of Public Works, shall be on site during all compaction work to observe uniform compaction methods and materials. If an inspector is not provided by the utility company or the County, trench backfill shall be cement/sand slurry. Trenches constructed as part of road improvement projects or land divisions that involve work on existing roads, shall be subject to the requirements of Paragraphs 1 and 2 above.

4. Minimum cover over all underground utilities shall be 750 mm (30 in). With authorization from the Director of Public Works, the cover may be reduced to avoid interfering with existing utilities.
5. If the edge of the trench cap is within 600 mm (2 ft) of the existing edge of pavement or lip of gutter, the remaining pavement within this area shall be removed and the trench cap paving shall be extended to the existing edge of pavement or lip of gutter.

**Section C - Encroachment Regulations**

1. All work within County right-of-way requires an approved encroachment permit. Improvement plan submittals for encroachment permits shall conform the requirements of Part I, General, of this *Design Criteria*. The County Encroachment Inspector shall be contacted at (831) 454-2160 at least 24 hours prior to commencement of any approved work.

2. Whenever any work for which an encroachment permit is required by the Encroachment Ordinance has been commenced without first obtaining said permit, a special investigation shall be made before a permit may be issued for such work. An investigation fee, separate from the permit fee, shall be collected whether or not a permit is subsequently issued. The investigation fee shall be equal to the amount of the permit fee required by the Encroachment Ordinance. The payment of such investigation fee shall not exempt any person from compliance with all other provisions of the Encroachment Ordinance nor from any other penalty prescribed by law.

3. The standard terms and references that pertain to encroachments within the County maintained road right-of-way system are set forth in the Santa Cruz County Code, Chapter 9.70, “Streets and Roads.”

**Section D - Underground Utility Conduit Trench Backfill Requirements**

1. The backfill requirements above the conduit bedding for all underground utility conduits within County rights-of-way and easements shall be identical to those shown on Figures EP-1 and EP-2.
Figure DW-1: Driveways with Type A Curb and Gutter
Figure DW-2: Driveways with A.C. Dike
Figure DW-3: Driveways with Type B Curb and Gutter
Figure DW-4: Driveways with Rolled Asphalt Berm

NOTES:
1. SHOW EXISTING GROUND ON PROFILES SUBMITTED FOR APPROVAL.
2. SEE SECTION 6, PART A, FOR INFORMATION REGARDING CONTROL OF RUNOFF.

CENTERLINE PROFILE

ROADWAY

ROLLED BERM

4.1m (15") MIN

OPTIONAL CLASS 2 BASE ROCK SURFACE

ROADWAY AT 2% TYP.

ASSUMED ELEV = 0.00

DISTANCE VARIES

3.2m (10.5") MIN

10% MAX

FINISH GRADE AT DRIVEWAY CENTERLINE

provide FOR DRAINAGE

5.5m (19") VERTICAL CURVE

VARES

3.2m (10.5") MIN

10% MAX

1.0m (3") AT 22'

2.3m (7.5") MIN

10% MAX

2% MAX

NOTES:

100mm (4") CONCRETE ON 100mm (4") SAND OR 50mm (2") ASPHALT ON 150mm (6") CLASS 2 BASE OR FOR SLOPES LESS THAN 10% AWAY FROM ROAD 150mm (6") CLASS 2 BASE

PLAN VIEW

REQUIREMENT FOR DRIVEWAYS WITH ROLLED ASPHALT BERM
Figure DW-5: Driveways with Valley Gutters
Figure DW-6: Driveways with Culverts
Figure DW-7: Driveways Downhill Without Roadside Drainage
Figure EP-1: Longitudinal Trench Detail

1. PAVEMENT SHALL BE REPLACED IN KIND. HOWEVER, MINIMUM STANDARDS ARE AS FOLLOWS:
   A. PAVED ROADS — 75mm (3") A.C. TYPE B OVER 225mm (9") PRIME COATED A.B. CLASS 2.
   B. NON-PAVED ROADS — SINGLE SEAL COAT OVER 150mm (6") A.B. CLASS 2 IN TRENCH AREA,
      THEN SINGLE SEAL COAT ENTIRE ROAD SECTION.

2. CUT EXISTING PAVEMENT TO PRODUCE A STRAIGHT VERTICAL FACE AGAINST WHICH TO
   BUTT THE TRENCH PAVEMENT.

3. LONGITUDINAL TRENCHES WITHIN A PAVED AREA OR A ROAD RIGHT-OF-WAY SHALL
   BE BACKFILLED AS SHOWN ABOVE.

4. TRENCHES OUTSIDE A PAVED AREA OR A ROAD RIGHT-OF-WAY SHALL HAVE BACKFILL
   COMPACTED TO NOT LESS THAN 90% RELATIVE COMPACTION.

5. AN INSPECTOR, APPROVED BY THE DIRECTOR OF PUBLIC WORKS, SHALL BE ON SITE
   DURING ALL COMPACTION WORK TO OBSERVE UNIFORM COMPACTION METHODS AND MATERIALS.

6. IF THE EDGE OF THE ASPHALT TRENCH CAP IS WITHIN 600mm (2 FEET) OF THE EXISTING EDGE OF
   PAVEMENT OR LIP OF GUTTER, THE REMAINING PAVEMENT SHALL BE REMOVED AND THE TRENCH PAVING
   SHALL BE EXTENDED TO THE EDGE OF PAVEMENT OR LIP OF GUTTER.

LONGITUDINAL TRENCH DETAIL

REV 12/05
Figure EP-2: Trench Cut Details

1. **Minimum Standards are as follows:**
   A. Paved Roads — 4" A.C. Type B, 1/2" max, placed in 2" lifts
   B. Non-paved Roads — Single seal coat over 6" A.B. Class 2 in trench area, then single seal coat entire road section.

2. Cut existing pavement to produce a straight vertical face against which to butt the trench pavement.

3. Cement/sand slurry shall be mixed in a transit mixer (certification tags required), shall consist of 188 lbs of cement for each cubic yard of material.

4. Trenches outside a paved area or a road right-of-way shall have backfill compacted to not less than 90% relative compaction.

5. If the edge of the asphalt trench cap is within 2' of the existing edge of pavement or lip of gutter, the remaining pavement shall be removed and the trench paving shall be extended to the edge of pavement or lip of gutter.

6. Any exceptions to this detail must be approved by the Director of Public Works.

7. Clean sand compacted to 95% relative compaction may be used for pipe bedding below bottom of pipe. For water main lines the sand bedding may extend up to 12" above top of pipe. Cement sand slurry shall be used above sand zone.

8. Where no painted centerline exists, a full road width Type II slurry seal coat is required after trench paving.

**Longitudinal Trench Detail**

REV 9/14

**Fig. EP-1**
1. Minimum Standards are as follows:
   A. Paved Roads — 4" A.C. Type B, 1/2" Max, Placed in 2" Lifts
   B. Non-Paved Roads — Single Seal Coat Over 6" A.B. Class 2 in Trench Area, Then Single Seal Coat Entire Road Section.

2. Cut existing pavement to produce a straight vertical face against which to butt the trench pavement.

3. Cement/Sand Slurry shall be mixed in a transit mixer (certification tags required), shall consist of 188 lbs of cement for each cubic yard of material.

4. Trenches outside a paved area or a road right-of-way shall have backfill compacted to not less than 90% relative compaction.

5. Any exceptions to this detail must be approved by the Director of Public Works.

6. Clean sand compacted to 95% relative compaction may be used for pipe bedding below bottom of pipe. For water main lines the sand bedding may extend up to 12" above top of pipe. Cement sand slurry shall be used above sand zone.

CROSS TRENCH DETAIL

REV 9/14

FIG. EP-2
(E) AC ROAD SURFACE

PROPERLY CLEAN EDGES OF (E) SIDES OF AC W/ WIRE BRUSH & COMPLETELY COAT (E) CUT EDGE OF PAVEMENT WITH RS-1 TACK COAT PRIOR TO PAVING.

TWO 2" LIFT OF HMA,

SAND SLURRY CEMENT BACKFILL TO 4" BELOW EXISTING ASPHALT ROAD SURFACE.

NOTES:

1. 8" ø OR SMALLER HOLES

2. SAND SLURRY CEMENT BACKFILL MUST BE 1 TO 2 SACK AND CURED PRIOR TO PLACEMENT OF AC LIFTS.

3. HOT MIX ASPHALT SHALL BE 3/8" MEDIUM MAX. AND COMPACTED WITH POWDER PUFF TYPE COMPACTOR IF WIDTH CANNOT ACCOMMODATE CONVENTIONAL METHODS OF COMPACTION.

3. NO COLD PATCH ALLOWED.

4. MAY USE "PLUG-R" TYPE PLUS OR APPROVED EQUAL ON HOLES BELOW 2" ø.

GEOTECHNICAL & ENVIRONMENTAL BORINGS THROUGH ASPHALT ROAD SURFACE (SMALL)
NOTES:

1. 8" Ø OR GREATER HOLES

2. SAND SLURRY CEMENT BACKFILL MUST BE 1 TO 2 SACK AND CURED PRIOR TO PLACEMENT OF AC LIFTS.

3. HOT MIX ASPHALT SHALL BE ² INCH MEDIUM MAX, AND COMPACTED WITH POWDER PUFF TYPE COMPACTOR IF WIDTH CANNOT ACCOMMODATE CONVENTIONAL METHODS OF COMPACTION.

3. NO COLD PATCH ALLOWED.

GEOTECHNICAL & ENVIRONMENTAL BORINGS THROUGH ASPHALT ROAD SURFACE (LARGE)