SECTION V

STORM DRAINS, STORMWATER QUALITY, AND WATERSHED PROTECTION

V-1. GENERAL

It is the general purpose of these standards that stormwater be contained and treated on the area to be developed. Adjacent improvements, existing or planned, will be free from flood hazard and will not receive a greater volume and intensity of stormwater runoff than pre-existing conditions. Flood hazard is defined as potential damage by water having sufficient depth or velocity to damage improvements or to deposit or scour soil.

These specifications are intended to meet the requirements of the National Flood Insurance Program, the City's Floodplain Management Ordinance (Chapter 21.14 et al), and the City's Stormwater Management Program. These specifications also reflect numeric stormwater control criteria adopted by the Water Board on July 13, 2013 (including subsequent revisions) and modified as specifically applicable to the City of Paso Robles.

The lowest floor of any project that is located within a Special Flood Hazard Area or shown as an A, AO, A1-A30, AE, A99, or AHZone shall be elevated to a height equal to or exceeding the depth number specified in the City Floodplain Ordinance.

Upon completion of a structure in a Special Flood Hazard Area, the elevation of the lowest floor including basement shall be certified by a registered professional engineer or land surveyor on Flood Elevation Certificate and verified by the city building inspector to be properly elevated. Such certification or verification shall be provided to the City Engineer.

Modification of a floodplain shall be accomplished in accordance with Federal Management Emergency Management (FEMA) regulations and the City's Floodplain Management Ordinance. The Project Engineer shall provide all data necessary for a Conditional Letter of Map Amendment (CLOMA) and a final Letter of Map Amendment (LOMA) and receive approval from the City Engineer and FEMA.

These standards are intended to provide general design criteria. Most design details are left to the responsibility of the project owner and/or consultant. The design standards contained herein are minimal and alternates may be approved, provided such alternates are to a higher standard than those set forth. Exceptions to these standards may be allowed by the City Engineer when it can be determined that such exceptions are in the best interest of the City.

A. Post-Construction Requirements (PCRs) Stormwater Quality and Watershed Protection

Reference Attachment 1 of Resolution No. R3-2013-0032 of the California Regional Water Quality Control Board, Central Coast Region adopted July 12, 2013, for definitions associated with the requirements outlined below.

1. Applicability

Performance requirements (PR) apply to all projects that create or replace greater than 2,500 square feet (sf) of impervious surface including:

a. Removing and replacing a paved surface resulting in alteration of the original line and grade, hydraulic capacity, or overall footprint of the road.
b. Extending the paving edge or paving graveled shoulders.
c. Resurfacing by upgrading from dirt to asphalt, or concrete; upgrading from gravel to asphalt, or concrete; or upgrading from a bituminous surface treatment ("chip seal") to asphalt or concrete.
d. Linear Underground Projects.

Net Impervious Surface square feet	**Performance Requirements**			
	PR #1	PR #2	PR #3	PR #4
0 - 2,499	*EXEMPT*			
2,500 - 4,999	✔			
5,000 - 14,999	✔	✔ *		
15,000 – 22,499	✔	✔	✔	
≥ 22,500	✔	✔	✔	✔

** Not applicable for a single-family residence*

2. Exemptions - Performance requirements will not apply to:

a. Road surface repair including slurry sealing, fog sealing, pothole and square cut patching; overlay of existing asphalt or concrete pavement without expanding the area of coverage; shoulder grading; cleaning, repairing, maintaining, reshaping or regrading drainage systems; crack sealing; resurfacing with in-kind material without expanding the road or parking lot; practices to maintain the original line and grade, hydraulic capacity, and overall footprint of the road or parking lot; repair or reconstruction of the road because of slope failures, natural disasters, acts of God or other man-made disaster.
b. Sidewalk or bicycle path projects, where no other impervious surfaces are created or replaced, built to direct stormwater runoff to adjacent vegetated areas.
c. Trails and pathways, where no other impervious surfaces are replaced or created, and built to direct stormwater runoff to adjacent vegetated areas

d. Underground utility projects that replace the ground surface with in-kind material.
e. Curb and gutter improvement or replacement projects that are not part of any additional creation or replacement of impervious surface area.

B. Stormwater Control Plan (SWCP)

All projects subject to PCRs shall submit a SWCP Application (Form SW-001). The Application provides project information, impervious surface areas, site description, and PR checklists. PR1 projects will complete pages 1-4 only, while PR2 through PR4 projects will complete pages 1-4 as well as the checklists appropriate for each PR.

SWCPs for PR2 and PR3 projects must demonstrate that the project incorporates site design characteristics, landscape features, and engineered facilities that will:

- Minimize imperviousness.
- Detain and treat, and/or retain, the specified amounts of runoff.
- Slow runoff rates.
- Reduce pollutants in post-development runoff.

The SWCP shall show all runoff from impervious areas is either dispersed to pervious areas or is routed to a Stormwater Control Measure (SCM).

The SWCP shall be comprised of the following information:

- Project name, application submittal date, address and assessor parcel number
- Name of applicant, landowner, and engineer
- Project Type and Description
- Hydrologic Soils Group
- Soil Infiltration Rate
- Total project site area
- Total new impervious surface area
- Total replaced impervious surface area
- Total pre-project impervious surface area
- Total post-project impervious surface area
- Net impervious surface area (exhibit shall be provided to justify new impervious area results)
- Show an accounting of pre-project impervious areas and impervious areas created or replaced. Determine total new impervious surface area, total replaced impervious surface area, total new pervious area, and calculation of Net Impervious Area.
- Delineate and quantify the impervious area being drained to landscape and/or the extent of pervious pavement
- Divide the project area into discrete Drainage Management Areas

- Statement of water quality treatment performance requirements that apply to the project
- Summary of site design and runoff reduction measures (PR1) selected for the project
- Description of all post-construction structural SCMs
- Supporting calculations used to comply with the applicable water quality treatment performance requirements
- Documentation stating that the selection, sizing, and design of the stormwater control measures meet the water quality treatment requirement
- Water quality treatment calculations used to comply with water quality treatment performance requirement/s
- Operations and Maintenance Plan for all structural stormwater control measures

The SWCP shall document:

- All SCMs have been considered for the project and implemented where feasible.
- Document the planning process and the decisions that led to the selection of SCMs.
- Provide the calculations for design of SCMs to demonstrate that applicable performance standards are met by the SCM design.
- Identify O&M requirements of the SCMs; and identify the maintenance mechanism for long term O&M of each SCM.

C. <u>PR1 Site Design and Runoff Reduction</u>

Projects that create and/or replace greater than or equal to 2,500 sf of impervious surface must implement the following design strategies:

1. Limit disturbance of creeks and natural drainage features
2. Minimize compaction of highly permeable soils
3. Limit clearing and grading of native vegetation
4. Concentrate improvements on the least sensitive portions of the site
5. Implement one or more of the following site design measures:
6. Direct roof runoff into cisterns or rain barrels for reuse
7. Direct roof runoff into vegetated areas
8. Direct runoff from sidewalks, patios, driveways and uncovered parking areas to vegetated areas
9. Construct driveways, walkways and parking lots with permeable materials

D. PR2 Water Quality Treatment

Projects that create a Net Impervious Area (NIA) of 5,000 sf must treat stormwater runoff to reduce pollutant loads and concentrations using physical, biological and chemical removal (single family residences are exempted). See City of Paso Robles Stormwater Technical Guide.

Net Impervious Area is the total (new and replaced) post project impervious areas minus any reduction in total imperviousness from the pre-project to the post-project condition:

- NIA = New and Replace Impervious Area – Reduced Impervious Area Credit
- Reduced Impervious Area Credit is the total pre-project to post-project reduction in impervious area.
- Water quality treatment shall be applied in the order of preference listed below (highest to lowest). Water quality performance requirements shall apply to the runoff from existing, new and replaced impervious surfaces on sites where runoff from existing impervious surfaces cannot be separated from runoff from new and replaced impervious surfaces.

Low Impact Development (LID) Treatment Systems:
Implementing harvesting and use, infiltration, and evapotranspiration stormwater control measures that collectively achieve the following hydraulic sizing criteria for LID systems:

- Retain stormwater runoff equal to the volume of runoff generated by 85th percentile 24-hour storm event (0.90 inches).

Biofiltration Treatment Systems:
Implement biofiltration systems using facilities that must be demonstrated to be at least as effective as a biofiltration system with the following design parameters:

- Maximum surface loading rate appropriate to prevent erosion, scour and changeling within the biofiltration system itself and equal to five inches per hour, based on the flow of runoff produced from a rain event equal to 0.2 inches per hour intensity.
- Minimum surface reservoir volume equal to the biofiltration treatment system surface area times a depth of six inches.
- 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 ASTM C33 and compost (30%-40%) may be used. An alternative planting medium may be utilized if it is demonstrated to be equal or more effective at attenuating pollutants than the specified planting medium mixture.
- Proper plant selection as provided by the Central Coast LID Initiative.

- Subsurface drainage/storage (gravel) layer with an area equal to the biofiltration treatment system surface area and having a minimum depth of 12 inches.
- Underdrain with discharge elevation at top of gravel layer.
- No compaction of soils beneath the biofiltration facility.
- No liners or other barriers interfering with infiltration (excepting conditions where lateral infiltration is not feasible).

Non-Retention Based Treatment Systems:
Stormwater Control Measures that collectively achieve at least one of the following hydraulic sizing criteria for non-retention based treatment systems:

- Volume Design Basis: Treat stormwater runoff equal to the volume of runoff generated by the 85th percentile 24-hour storm event (0.90 inches).
- Flow Design Basis: Treat the flow of runoff produced by a rain event equal to at least 0.2 inches per hour intensity.

E. PR3: Runoff Retention

Projects that create and/or replace greater than or equal to 15,000 sf of impervious surface are required to meet runoff retention performance requirements using LID Standards. See City of Paso Robles Stormwater Technical Guide.

Prevent off-site discharge from events up to the 95th percentile 24-hour rainfall event (1.45 inches). Retention is to be achieved by optimizing infiltration. Project design shall be founded in LID principles. Site opportunities and constraints shall be identified, and a site assessment shall include:

1. Topography, structures, utilities, easements
2. Hydrologic features including natural areas, wetlands, watercourses, seeps, or springs.
3. Depth to seasonal high groundwater
4. Locations of wells
5. Depth to impervious bedrock
6. Presence of unique geology
7. Geotechnical hazards
8. Soil and/or groundwater contamination
9. Soil types and hydrologic soil groups
10. Vegetative cover/trees
11. Run-on characteristics (estimate off-site runoff discharging to the project area)
12. Existing drainage infrastructure
13. Zoning, setbacks and open space requirements
14. Define the development envelope and protected areas, identifying areas that are most suitable for development and areas to be left undisturbed.
15. Conserve natural areas including existing trees, vegetation and soils

16. Limit the overall impervious footprint of the project
17. Set back development from creeks, wetlands and riparian habitats
18. When runoff reduction measures and natural landscape areas have been maximized to the extent feasible stormwater control measures shall be used to comply with performance requirements. Stormwater control measures associated with small-scale, decentralized facilities designed to infiltrate, evapotranspirate, filter, or capture stormwater shall be optimized. Refer to the City of Paso Robles Stormwater Technical Guide for sizing of stormwater retention facilities.

F. Retention Compliance by 10% of EISA

Where technical infeasibility prevents full on-site compliance with the Runoff Retention Performance Requirement, on-site retention of the full Retention Volume is not required, and the Regulated Project is required to dedicate no less than ten percent of the Regulated Project's Equivalent Impervious Surface Area (EISA) to retention-based Stormwater Control Measures. Refer to the RWQCB Post Construction Standards for definitions of Technical Infeasibility, EISA, and retention-based Stormwater Control Measures. When compliance by 10% of EISA is implemented. On-site retention to the extent practicable is still required. Documentation shall be in compliance with Attachment E of the Post construction Standards.

To propose the Ten Percent Adjustment, first prepare a complete Stormwater Control Plan as described in this chapter. Prepare your LID design. The Stormwater Control Plan should show a complete and thorough implementation of opportunities for implementing LID, including delineation of DMAs and sizing of LID facilities. Show clearly in the plan the extent to which LID can and will be implemented on-site.

Potential causes of infeasibility include:

1. High seasonal groundwater limits infiltration and/or prevents construction of subgrade stormwater control measures.
2. Near-surface bedrock or other impermeable conditions limit infiltration
3. Soil types significantly limit infiltration.
4. Pollutant mobilization in soil or groundwater is a documented concern
5. Space constraints imposed by infill projects, some redevelopment, and high-density development, etc.
6. Geotechnical hazards.
7. Proximity to drinking water wells (within 100' if private; 200' setback to public wells).
8. Incompatibility with connections to the municipal storm drain system (for example, a project drains to an existing stormwater collection system, the elevation of which precludes connections to a properly functioning treatment or flow control facility).

Ten Percent Adjustment. Compliance with the criterion to fully retain onsite the discharge from events up to the 95th percentile rainfall event can be waived if stormwater control measures occupy an area equivalent to no less than 10% of the project's "Equivalent Impervious Surface Area."

Tabulate "Equivalent Impervious Surface Area" and the area of retention-based stormwater control measures and show totals for each; then divide the area of stormwater control measures by the Equivalent Impervious Surface Area to show the 10% criterion is met or exceeded.

G. Alternative Compliance (Off-site Compliance)

Off-site compliance is available to those projects located in the City's Approved Watershed Plan(s). In order to determine if your project is in the City's Watershed Plan(s), or if there is interest in developing a new Watershed Plan meet with the City Engineer.

H. PR4: Peak Management

All projects that create and/or replace greater than or equal to 22,500 sf of impervious surface in Watershed Management Zone (WMZ) 1 shall manage peak stormwater runoff as required below as well as meeting Water Quality and Runoff Retention requirements. This requirement is not applicable in WMZ 4 (west side of Paso Robles) and is assumed to be met if PR3 requirements are implemented. Paso Robles WMZs

Post-development peak flows, discharged from the site, shall not exceed pre-project peak flows for the 2 through 10-year storm events.

A SWCP shall be provided in conformance with the Stormwater Technical Guide on File with the Stormwater Manager.

I. Operation and Maintenance (O&M) for Structural SCMs

SCMs designed for Water Quality Treatment, Runoff Retention and/or Peak Management must be maintained to ensure proper performance. Regulated Projects with structural SCMs (i.e., meeting PR2, PR3, and/or PR4 requirements) are required to have an O&M Plan and Maintenance Agreement that clearly establishes responsibility for all structural SCMs. Form SW-002

The O&M Plan must include:

- Short-term maintenance requirements
- Long-term maintenance requirements

- Recommended frequency of maintenance
- Estimated cost of maintenance
- A copy of the Exhibit B Site map
- Operational procedures (attach copies of vendor manuals/instructions, as applicable) AND
- Contact information for vendors who can provide replacement parts/materials (as applicable)

Where a property owner is responsible for maintenance, the property owner will be required to provide assurance of long-term maintenance. The maintenance agreement must be transferred to the new owner if the property is sold. For residential properties where the SCMs are located within a common area that will be maintained by a homeowner's association, language regarding the responsibility for maintenance must be included in the project's conditions, covenants, and restrictions (CC&Rs).

J. Recording Agreement Procedures

Developments that install structural post construction Stormwater Control Measures (SCMs) shall record an approved operation and maintenance plan.

An Operations and Maintenance Plan must be recorded, prior to issuance of Certificate of Occupancy (COO) and/or Final Permit Signoff.

A Stormwater Control Measure (SCM) tracking number will be assigned for the long-term tracking of the stormwater system. The SCM tracking number will be used to track the annual inspections and long-term maintenance of the project with the stormwater requirements of building/grading permits.

K. Single Owner: - Reference Form SW-003

Small stormwater systems owned and operated by a single owner shall guarantee long-term operation and maintenance through a recorded Agreement. (The text template for Agreements is provided as Form SW-006). The owner or agent shall provide information to sufficiently document the system for the Agreement. The applicant shall submit the system description forms (SW-002) for review by the Stormwater Department prior to notarization.

The City will review the Agreement for completeness and will return to the system owner to review, sign, and notarize. The City will countersign and notarize the Agreement following notarization by the System Owner. The System Owner will then record the Agreement with the County Clerk- Recorder. The Agreement shall be recorded prior to issuance of the Certificate of Occupancy (COO).

After completion of construction, the Owner shall complete annual self-inspections of all SCMs and submit them to the Stormwater Department by June 15 of each year. These self-inspections will be tracked as part of the long-term SCM tracking.

L. Covenants, Codes, and Restrictions (CC&Rs): - Reference Form SW-004

Systems that treat stormwater drainage from multiple private parcels may guarantee long-term operation and maintenance through language in the recorded Covenants, Codes, and Restrictions (CC&Rs). Existing CC&Rs may be amended to include appropriate provisions for operation, maintenance, and inspection of stormwater infrastructure.

After completion of construction, the Homeowners Association (HOA) shall complete annual self-inspections and submit to the Stormwater Department by June 15 of each year. These self-inspections will be tracked as part of the long-term SCM tracking.

M. Form Summary

Single Owner – refer Form SW-003 (Recording Procedure for Single Owner)
CC&Rs – refer Form SW-004 (Recording Procedure for CC&Rs)

For both Single Owners and CC&Rs:

- Complete Form SW-005 (Owner, Designer and Agent Information)
- Complete Form SW-006 (Agreement)
- Complete Form SW-007 (Exhibit B)

Annual Inspections:

Projects are required to perform annual inspections of each SCM as described in Form SW-007.

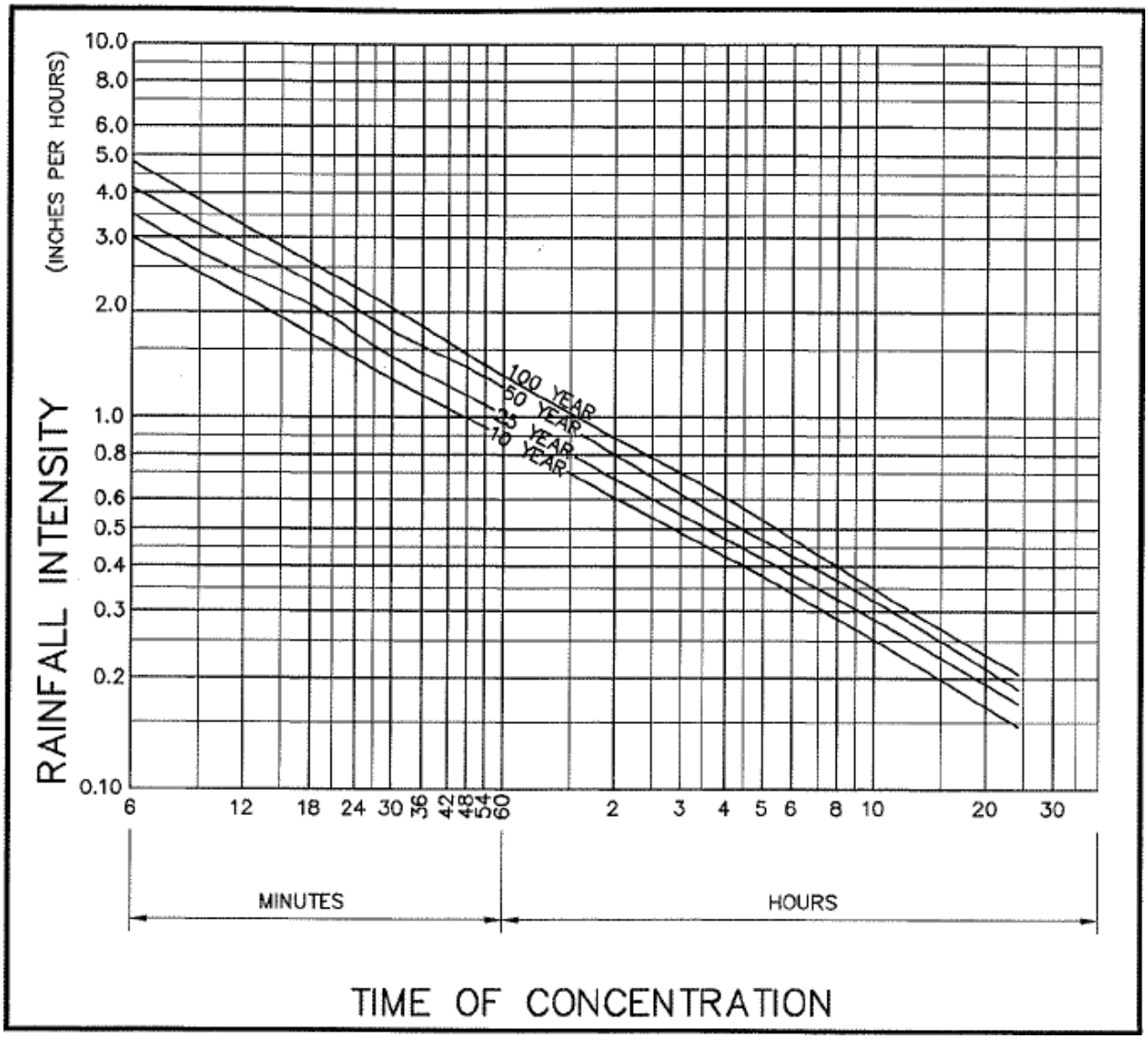
N. Off-Site Hydrology, Cross-Culverts, Open Channels

1. Hydrology Calculations

The Rational Method shall be used to compute the peak rate of runoff from a development with an area less than 200 acres. For drainage areas in excess of 200 acres, or where the Project Engineer determines that the Rational Method is not practical or appropriate, the Project Engineer shall provide all documents necessary to confirm computations.

All calculations shall be prepared by a registered professional engineer with a current license to practice in the State of California. The rainfall intensity curve is available for use as part of the hydrology calculations. Engineers may also use the

NOAA Atlas 14 Point Precipitation Data. In computing runoff in a partial development, adequate provisions must be made for the drainage of the overall improvements and/or drainage tributary. Hydrology calculations shall be based upon ultimate land use designations in accordance with the adopted General Plan.



2. Closed Conduits

Design considerations for closed conduits are as follows:

- Pipe friction losses are determined by Manning's equation.
- Entrance and exit losses.
- Tail-water impacts.
- Entrance control headwater.

For each length of pipe, the hydraulic grade line (hgl) at the pipe entrance and exit shall be determined assuming both inlet control and outlet control. The more restrictive shall control. The storm drain system shall be designed to meet the following conditions:

- The hydraulic grade line shall be a minimum of 0.50 feet below the elevation of inlet grates and manhole covers of all structures for a design storm of 25 years. Said gradient shall be shown on the profile for storm drain systems.
- Minimum pipe diameter allowable on any public storm drain shall be 18 inches.
- Storm drain systems shall be designed for the 25-year storm. In a sump condition a secondary overland flow path shall be documented such that during the 100-year storm, all buildings or first floor elevations shall be at least one foot (1') above the 100-year storm (in non-FEMA flood zone areas). Secondary overland flow paths are subject to approval by the City Engineer.
- Street capacity shall be defined as the 10-year storm allowed to spread between the crown of the street and the top of curb for single lane roads, between the number curb and number two lane on multi-lane roads and from the edge of traveled way (etw) to crown or number two lane. Where the street capacity is exceeded at either the etw, curb, crown, or number two lane a storm drain, or other approved facility shall be provided to convey the excess flows. In all cases, the 100-year storm shall be contained within the right-of-way.

Cross culvert design shall be determined on the basis of a twenty-five year storm with no head. The hydraulic entrance condition shall be such that the 25-year discharge will have the specified freeboard in the upstream channel or waterway and that the 100-year discharge will be contained within the banks of the upstream waterway or drainage easement. The entrance to the closed conduit minor waterway may be submerged provided that the above criteria are satisfied. The invert elevation of the closed conduit entrance shall not be set lower than the natural flowline of the waterway or open channel flowing into it.

3. Open Channels

   Open channels shall be designed based on Manning's equation. The impacts of culverts, bridges or other structures affecting the hydraulic performance of the channel shall be considered as appropriate.

   The City Engineer may require more complete analysis if he/she determines conditions merit a more thorough study. This additional analysis may include determination of the water surface profile, analysis of critical sections, and analysis of erosion and/or sedimentation.

   Maximum velocity for channels flowing full shall be limited to preclude erosion. Freeboard of at least one foot based on 25-year flow-rate shall be provided for all channels. Lining treatments shall extend to the full height of freeboard. The 100-year discharge shall be contained within the banks or within the easement established for the channel. For natural waterways, the design flow may be allowed in the natural overflow area.

4. Drainage Structures

   a. Manholes. Standard precast concrete manholes shall be used wherever feasible. When cases arise where special manholes or junction boxes are required, the design shall be approved by the Department. All manholes shall conform to the following requirements:

      1). Any pipes placed at a grade of 1-percent or flatter, shall have manholes provided every 200-feet. Pipes at a grade of greater than 1-percent shall follow the criteria in #2 and #3 below.
      2). Manholes shall be located at junction points, changes in gradient and changes in pipe size. On curved pipes with radii of 200-feet to 400-feet, manholes shall be placed at the BC or EC of the curve and on 300-foot maximum intervals along the curve for pipes of 24-inches and less in diameter, and 500-feet maximum intervals along the curve for pipes greater than 24-inches in diameter. Curves with radii less than 200-feet will be handled on an individual basis.
      3). Spacing of manholes or inlets, of such size as to be enterable for maintenance, shall not exceed 500-feet along a tangent alignment for pipes 24-inches or less in diameter and 600-feet along a tangent alignment for pipes greater than 24-inches in diameter, except under special approved conditions. The spacing of manholes shall be nearly equal wherever possible.
      4). All manholes shall have standard 24-inch diameter manhole covers. No manholes shall be allowed in roadway gutter or flowlines. Maintenance access points in roadway gutter or flowlines shall be standard drainage inlets with bicycle-proof grates.

b. Catch Basin. Catch basins shall be in accordance with the types shown on **D series Standard Drawings**, or approved equivalent "precast" products, or other approved special inlets. Catch basins without a curb opening inlet shall not be used in urban areas. Curb face only drainage inlets are required when the inlet is located next to a bike lane. Curb face inlet openings shall be appropriately sized to handle design flows. Refer to the State Standard Specifications for extended curb opening inlets. All inlets shall conform to the following requirements:

1). The capacity and spacing of drainage inlets shall be such that the spread of water in a Primary Design Storm does not inundate the traveled way (which includes all through lanes and center turning lanes but does not include bike lanes or right-turn-only lanes) as follows:

   a) For roads with design speeds less than 45 mph, the spread encroachment on the traveled way shall not be greater than 1/2 the outside through lane width.
   b) For roads with design speeds greater than or equal to 45 mph, the spread shall not encroach on the traveled way at all. Any inundation shall be limited to the area outside the traveled way as defined above.
   c) Where there is a potential for ponding at sag vertical curves (or other locations), pavement drainage shall be checked for a Secondary Design Storm. The spread encroachment shall comply with the requirements above.

2). Sufficient drainage capacity shall be provided within the road Right-of-Way and other drainage facilities to convey a 100-year storm without damage to any structures.

3). No more than 1.0 cubic feet per second (cfs) shall be allowed to "bypass" a midblock inlet. No more than 0.3 cfs shall be allowed to go around a curb return at an intersection.

4). Sheet flow across a road shall not exceed 0.1 cfs.

5). All "at-grade" grates shall be adequate for State of California HS-20 traffic loading and shall be "bicycle-proof".

6). Storm Drain Markers. All catch basins or inlets that have been installed, replaced, or modified and that convey storm water to a basin, creek, waterway or ocean shall have a storm drain marker installed per Standard Drawing M-6. Markers can be purchased from the Department.

c. Junction Boxes. Junction boxes shall be constructed of reinforced Portland cement concrete which complies with the compressive strength requirements provided in Appendix C or fabricated from reinforced concrete pipe sections where size limitations permit. All junction boxes shall conform to the following requirements:

1). Minimum wall thickness for poured-in-place reinforced concrete junction boxes shall be 6-inches, 8-inches when invert is in excess of 6-feet.
2). The inside dimensions of junction boxes shall be such as to provide a minimum of 3-inches clearance on the outside diameter of the largest outfall pipe.
3). All manholes shall have the standard 24-inch manhole cover (Phoenix P1090, Pinkerton A640, or approved equal).

d. Other Structures. The following requirements shall apply to other drainage structures, as noted:

1). All headwalls, wingwalls, and end walls shall be of reinforced Portland cement concrete which complies with the compressive strength requirements found in the State Standard Specifications.
2). All headwalls, wingwalls, and end walls shall be considered individually and shall be designed in accordance with the State Standard Specifications unless approved otherwise by the City Engineer.
3). Trash racks shall be provided where, in the opinion of the City Engineer, they are necessary to prevent clogging of culverts and storm drains or to provide safety to the general public.
4). Guardrail or pedestrian/worker railings are required at culverts, headwalls, box culverts, and on steep side-slopes (3:1) or when the drop exceeds 18 inches. When so required, the railing shall be installed in accordance with State Standard Specifications and CBC.
5). For reinforced concrete box culverts and structural plate arch culverts, all materials, designs, and construction shall conform to the provisions of the State Standard Specifications unless approved otherwise by the Department.

5. Flood Control Basins

Surface and Subsurface flood control basins designed for retention or detention are permitted in the City. The City Engineer must approve the type of basin used based on the downstream hydrology for each development site, physical site and historic conditions, and City policies. In all cases, the Engineer of Record shall provide evidence that the basin will completely drain within seven (7) days. Infiltration testing results used to show compliance must only include the vertical component of the infiltration unless otherwise approved by the City Engineer.

If a basin is determined to be required to serve a particular subdivision or land development project which was not evaluated during the application phase of the project, then the Developer shall consult with the City Engineer to determine if a grading permit or land use permit is required for the construction of the basin. If a permit is required, a copy must be submitted prior to approval of the plans.

a. Retention Basin. Any flood control basin which is used as a terminal disposal facility shall be classified as a retention basin.
   1). Basin Capacity. Storm water retention for flood control purposes shall be applied as determined by the Project Engineer; typically, where downstream conditions are constrained, and properties are threatened or have been flooded in conditions existing prior to upstream development. Criteria for the design of retention basins may be reviewed on a case-by-case basis. Typically, the volume of storage for flood control purposes is based upon the post-development 100-year, 24-hour storm event.
   2). Inlet Structure. The inlet structure shall be designed to meet the requirements of Catch Basins Section 4B
   3). Infiltration Test Required. A minimum of three (3) infiltration tests per basin shall be submitted for approval prior to construction to determine that the basin will be able to drain within the 7-day standard noted above

b. Detention Basin. Any flood control basin which has a downstream outlet designed to meter the outflow shall be classified as a detention basin. Basin capacity shall be based on receiving the runoff from a 100-year storm with the watershed in its fully-developed condition and releasing the flow by matching the historical hydrograph of flows leaving the previously undeveloped land under consideration.

c. Surface Basins. Surface basins, which are typically earthen, may be used for either retention or detention of site runoff, and are classified as either deep or shallow.

   1). Deep Basins. The depth to the overflow point is greater than 2-feet. Max side slope of 3:1.
   2). Shallow Basins. The depth to the overflow point is 2-feet or less. Max side slope of 3:1 without fencing.
   3). Bioretention Basins. The depth to the overflow point is 6-inches or less. Bioretention basins shall be designed according to “Stormwater Requirements for New Construction” (see City website). A minimum of three (3) infiltration tests per basin shall be submitted to the City Engineer for approval prior to construction.

d. Subsurface Basins. Subsurface basins may be used for either retention or detention of site runoff, where their application is suitable for project conditions. Subsurface systems include dry wells, bored wells, and any subsurface infiltration system (manufactured chambers) used to enhance infiltration capabilities or used to comply with City ordinances, standards, or policy.

Subsurface drainages systems must comply with the following:

1). May need to be registered with US EPA's Region 9 Office as a Class V injection well. Designs that meet the definition must submit proof of registration with US EPA.
2). Be designed, constructed, and maintained in a manner that will not endanger Underground Sources of Drinking Water (USDW).
3). Design Criteria. The City Engineer will review all development plans proposing subsurface stormwater systems based on the following criteria:

a) Not permitted on project sites having an elevated risk of releasing contaminants (spills), such as vehicle repair, or fueling stations; facilities that store, transfer, or generate hazardous materials; auto part recycling facilities; and sites with a history of spills or illegal dumping.
b) Must incorporate pre-treatment devices to isolate and contain trash, solids, TSS, oil, and grease.
c) Must incorporate appropriately labeled inspection and maintenance access ports, labeled "STORM".
d) Must include an operation and maintenance manual and schedule.
e) Must include additional storage volume equal to 20-percent of the maximum storage depth.
f) Must submit a soils report that substantiates:

i. Soil infiltration rate. Percolation rate testing may be performed; however, results shall be converted to soil infiltration rates. Soil percolation rate:

Percolation rate (minutes/inch)	Minimum distance to groundwater (feet)
<1	50
1-4	20
5-29	8
30 up	5

ii. Soil Type – Not suitable in soils with >30% clay or >40% silt content.
iii. Depth to seasonally high-water table.
iv. Must conform to the following minimum setback requirements:

Item	Setback (min.)
Buildings, structures, property lines, and domestic water service lines	10 feet[2]
Seasonally high-water table	10 feet
Tree canopy	10 feet
Water distribution lines (mains)	25 feet[3]
Water supply wells, streams, springs, ponds	100 feet
Natural ground slopes	15 percent max.
Proximity to cut or natural slope	Per soils engineer

[2] Additional setback requirements per Section 1804 of the CBC

[3] State of CA Waterworks Standards, Title 22, Chapter 16, Section 64572.

v. dd

vi. Must address other design considerations including:

- Surface (vehicle) loading characteristics.
- Distance to building foundations and basements.
- Maintenance practicality considering access, access ports, and landscaping.
- Lateral clearances to wells and septic
- Dry well separation between wells (center to center): 100 feet recommended.
- Dry well penetration: 10-feet minimum into permeable porous soils recommended.
- Dry well surface inlet: 3-inch minimum above bottom of retention basin recommended if located within basin.

4). Materials.

a) Storage Chambers. Must be fully perforated (by the manufacturer) HDPE or HP storm pipe with a minimum diameter of 18-inches and a maximum diameter of 60-inches. Larger diameter pipes or infiltration chamber systems may be used with approval from the City Engineer. Storage chambers shall meet the requirements of this Section and AASHTO Section 12 (including Load and Resistance Factor Design - LRFD - requirements).

b) Drain Rock. Drain rock shall be Class 2 permeable material conforming to the State Standard Special Provisions and consist of hard durable clean gravel or crushed stone free from organic material, clay, or other deleterious substances. In the absence of laboratory tests, the Project Engineer may assume a "void ratio" not to exceed 40-percent of the volume of the drain rock backfill in the computation of the storage volume of the subsurface basin.

c) Geotextiles. Filter fabric shall comply with the requirements of AASHTO M288, Class 2 non-woven, or as specified by the manufacturer.

5). Operational Requirements.
Include provisions and maintenance schedule for pretreatment facility, including:

a) Maintenance plan, including provisions for vehicular access and confined-space entry safety requirements, where applicable.
b) Overflow path (see 5.f), including easements as required.
c) Freeboard (see 5.h) – may be included in parking areas per the requirements of 5.k.

e. Easement Requirements. Drainage facilities must be located in a public street right-of-way or within a public drainage easement. Easements for closed conduits shall be a minimum width of twenty feet (20). Easements for open channels shall have sufficient width to contain the channel with a minimum ten-foot (10) setback to side slopes and a fifteen (15) foot wide service road on at least one side. Drainage easements shall be reviewed and approved by the engineering department to ensure that public dedicated easements are always accessible.

f. Overflow Path Required. The design of all drainage basins shall identify the designated route for overflow. The Project Engineer shall design the overflow path so that the flow in a 100-year storm is non-erosive and will not damage downstream improvements, including other basins. Easements will be required for concentrated flows onto private properties.

g. Fencing Requirements. Shallow Basins, bioretention basins, and subsurface basins are not required to be fenced if side slopes are less than 3:1. All deep basins must be fenced according to the specifications found in the Materials section below.

h. Surface Basin Freeboard Requirements. All basins shall be designed to provide “freeboard,” measured from the design water surface to the lowest-elevation (the “overflow point”) at which the basin would overflow during a greater-than-design storm. This overflow point may be a location on the basin perimeter, a point outside the basin perimeter if the location is a natural sump, or the flowline of the inlet structure for gutter flow entering the basin. An overflow path shall be identified as required in 5F. The amount of freeboard to be provided under design-storm conditions is as follows:

1) Deep basins require 1-foot of freeboard above the design-storm water surface elevation.
2) Shallow basins require freeboard equal to 15-percent of their design depth.
3) Bioretention basins freeboard to comply with Stormwater Technical Guide.

i. Bench Requirements. All drainage basins shall provide a bench around the perimeter to provide for maintenance, as follows:

1) Deep basins shall provide a bench 5-feet wide between the fence and the top of the basin side slope.
2) Shallow basins shall provide a bench 5-feet wide between the easement line and the top of the basin side slope.

j. Maintenance Requirements. Perpetual maintenance of all drainage basins shall be the responsibility of the Developer and subsequent owner(s) unless the maintenance responsibility is accepted by a public entity or a property owners' association.

k. Parking Areas. Parking areas may be used to store part, or all of the volume required to be retained or detained, subject to the following criteria:

1) The maximum depth of inundation in the design storm shall be 6-inches.
2) No more than 75-percent of the parking area shall be inundated in the Primary Design Storm. ADA parking shall not be inundated in the Primary Design Storm.

6. Design Criteria for Porous Pavements

The following minimum design criteria must be followed where porous pavements are used as a site design measure for PR1 projects, or a self-retaining area for PR2 and PR3 projects.

- No erodible areas drain on to permeable pavement.
- Subgrade compaction is minimal.
- Reservoir base course is of open-graded crushed stone. Base depth (3" or more) is adequate to retain rainfall and support design loads (more depth may be required).
- No subdrain is included or, if a subdrain is included, outlet elevation is a minimum of 3 inches above bottom of base course.
- Subgrade is level and slopes are not so steep that subgrade is prone to erosion.
- Rigid edge is provided to retain granular pavements and unit pavers.
- Solid unit pavers, if used, are set in sand or gravel with minimum 3/8-inch gaps between the pavers. Joints are filled with an open-graded aggregate free of fines.
- Permeable concrete or porous asphalt, if used, are installed by industry-certified professionals according to the vendor's recommendations.
- Selection and location of pavements incorporates Americans with Disabilities Act requirements (if applicable), site aesthetics, and uses.

7. Storm Drain Alignment Criteria

   Storm drain lines shall be parallel with street centerlines to the best extent practical and typically twelve feet southerly or easterly of the centerline **(Standard Detail U-1)**. Storm drain lines that encounter circumstances that don't allow parallel installation need to be reviewed and approved by the engineering department.

   Maximum spacing for manholes shall be 500 feet. Manholes shall be located at junction points, changes in gradient and changes in conduit size. The alignment between any two manholes may consist of one curve and one tangent section. A manhole must be placed at the beginning or end of any curve. Reverse curves are not acceptable between manholes. Curve radii shall conform to pipe manufactures recommendations. All manholes must be located in areas accessible for maintenance.

V-2. MATERIALS

Closed Conduits shall be high density polyethylene (HDPE) with watertight couplings or reinforced concrete pipe (RCP). Other pipe materials such as hot-dipped galvanized Corrugated Metal Pipe (CMP) can only be used with approval of the City Engineer.

Standard pre-cast concrete manholes shall be typical **(Standard Detail D-2)**. Special designs of manholes or junction boxes shall be approved by the City Engineer.

Open conduits may be natural watercourses, earthen channels, or channels lined with materials such as:

- Native grass which forms a thick, dense sod without irrigation;
- Turf reinforcement mats, erosion control blankets, or geotextile materials. Such material may be interplanted with vegetation;
- Rock slope protection in accordance with Caltrans specifications;
- Bioengineering methods recommended in Natural Resource Conservation Service's *Streambank Soil Bioengineering Field Guide for Low Precipitation Areas*;

Drain inlets shall conform to **Standard Detail D-1**. Grates shall be adequate for AASHTO's HS-20 traffic loading and shall be double dipped hot galvanized or approved equal.

All headwalls, wing-walls, and end-walls shall be constructed of Class "A" reinforced Portland cement concrete. Trash racks shall be provided where necessary to prevent clogging of culverts and storm drains.

V-3. CONSTRUCTION STANDARDS

A. General

Excavation, pipeline placement and backfill shall conform to **Section VI-3** of these specifications for sanitary sewers.

Concrete structures shall be placed in accordance with these Standards and Specifications and shall conform to the requirements of Section 51 of Caltrans Standard Specifications.