

**PLACER COUNTY LAND DEVELOPMENT MANUAL
SECTION 5**

DRAINAGE

SEC. 5.01 BASIC OBJECTIVE

This section is intended to supplement the current edition of the Placer County Stormwater Management Manual (SMM). In case of conflict, the most stringent requirements shall apply.

In order to provide a uniform drainage system in the County, the following objectives and standards will be followed, unless modified by request with approval confirmed in writing by the Engineer.

Improvements shall be protected from inundation, flood hazard, street overflow, ponding of local storm water, springs and surface waters. The drainage design shall provide for the control of drainage flows to be carried through and also collected within the improved area without injury to adjacent property. Natural drainage ways and water courses shall be retained and used to convey surface water through the improvement unless otherwise approved by the Engineer.

Surface waters must be retained within the drainage way in which they collect. It is each property owner's duty to leave the natural flow of surface water undisturbed unless prior written approval for improvements, clearing, or grading has been obtained from the Engineer except as exempted in this Manual. It is incumbent upon the owner to avoid injury to adjacent property due to the flow of surface waters.

SEC. 5.03 DRAINAGE DESIGN CONSIDERATIONS

Drainage design is a combination of legal and physical factors and shall reflect, at a minimum, the following items:

- (1) Drainage shall not be diverted.
- (2) Acceleration of drainage flows shall not cause property damage.
- (3) Drainage and appurtenant structures shall be properly designed to take into account drainage flow, bedload, and debris at all stages of flow. Overland release drainage shall be designed to convey stormwater runoff without loss of life and/or damage to any building structure assuming 50% of capacity of major underground systems and 100% blockage of local drainage structures.

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(4) No detrimental change in drainage flow pattern shall result above and below the drainage structure. This consideration shall be carefully studied in relation to erosion and pollution. Controls shall be required to provide prevention, control, and abatement of erosion and water pollution.

(5) Provision for required drainage capacity for future upstream development. Only existing detention facilities that are to remain shall be included in the design calculations. All other facilities must be based on ultimate flows without detention.

(6) Shall not cause stagnant pools, unless required as part of an approved Best Management Practice (BMP).

(7) Shall avoid excessive ponding at entrances to drainage structures which may cause property damage, accumulation of drift, clogging or deposits of debris.

(8) Outlet design of drainage structures shall be effective in re-establishing nonerosive channel flow, and resist undermining.

(9) Drainage structures shall be simple, easy to build, reasonably self-cleaning, and easy to maintain.

(10) Safety of pedestrians and vehicular traffic.

(11) Shall not hinder the passage of fish as may be required by permits from the California Department of Fish and Game and/or other applicable agencies.

(12) Drainage system design shall include the application of "Best Management Practices" (BMP's) wherever practical and feasible for water quality protection. BMP measures shall address such concerns as erosion and sediment control, prevention of illicit or illegal discharges, protection from the discharge of petroleum products, chemicals, heavy metals, organics, hydrocarbons, and other pollutants into surface or ground waters.

(13) Compliance with the Federal "Clean Water Act", including acquisition of any necessary stormwater discharge permits pursuant to Federal or State law.

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(14) Provision for required drainage capacity assuming any existing open irrigation ditches/canals upstream are encased and all upstream flows go through the design site. Additionally, any spill rights of the canal owner must be included in the design.

(15) Grading and drainage design for lots less than 1 acre shall be consistent with requirements outlined in Section 2 of this manual and the Stormwater Management Manual (SMM).

(16) For non-graded lots, storm runoff shall not cross more than one adjacent lot before entering a drainage easement or an approved stormwater drainage facility.

(17) For all critical release points for road drainage, such as low points of sags and cul-de-sacs, adequate drainage conveyance systems and associated grading shall be shown on the grading plans. Applicable easements shall be provided.

SEC. 5.05 HYDROLOGY AND RUNOFF

(1) The Placer County Flood Control and Water Conservation District "Stormwater Management Manual" shall be used for determining hydrology, runoff and for design storm frequencies of drainage facilities.

(2) It is the responsibility of the private engineer to verify all design assumptions and design discharges by a review of field conditions. This review should cover but not be limited to:

- (a) Historical high water marks and/or recorded stream flow data.
- (b) Seasonal variation in channel condition.
- (c) Soil type.
- (d) Ground cover.
- (e) Adjacent manmade drainage works.

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SEC. 5.06 DRAINAGE REPORTS

Drainage reports shall be prepared by a registered civil engineer, shall include the seal and original signature of the private engineer and shall include:

(1) A title sheet with the project name, design engineer's name, address and telephone number and date of report.

(2) A vicinity map showing the location of the project area in relationship to well-known features.

(3) A written text addressing existing conditions; a description of the proposed improvements, both on- and off-site; the effect of the improvements; the goals and all assumptions of the design; an explanation of all special designs; design concepts used in the design including a description of the hydrologic method used; any increase of flows downstream with a description of any proposed mitigation; description of easements required, drainage during construction (any special requirements outlined); proposed BMP's; description of any existing irrigation ditches/canals on the project site, and upstream or downstream of the site with any applicable "spill rights" that the canal may have which would impact the design.

(4) Watershed maps as outlined in Sec. 5.07 and the Stormwater Management Manual.

(5) Table(s) indexed to the watershed maps indicating drainage areas in acres; soil and cover types; existing and/or future land use; pervious infiltration rates; impervious areas; flows for both pre- and post-development conditions for both the 10 year and 100 year storm run-off.

(6) Summary tables of the pre-development and post-development design indexed to the watershed map(s) including the following as applicable:

(a) Identification of all inlets, outlets, manholes, pipe runs.

(b) Elevation of flow lines and grates of all inlets, outlets and manholes.

(c) Contributing sheds.

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- (d) Q_{10} and Q_{100} flows.
 - (e) Capacity of inlets (in conformance with Stormwater Management Manual requirements).
 - (f) Any carry over flows.
 - (g) HGL elevations for 10 and 100 year events at all inlets, outlets, and manholes with available freeboard as applicable.
 - (h) Pipe diameters, lengths, slopes. If channels, applicable type, side slopes, bottom width, as well as length and slope.
 - (i) Velocities.
 - (j) n value used in design for pipes/channels and overland surfaces.
 - (k) Pipe, channel capacities as applicable.
 - (l) Depth of flow for channels and pipes not flowing full.
- (7) Summary table of detention basin design data.
- (8) For projects requiring HEC-1 and/or HEC-2 calculations, tabulate input as required by the Stormwater Management Manual and provide one copy of the output.
- (9) Additional information may be required to document other aspects of the design.

SEC. 5.07 DRAINAGE MAPS

(1) Separate drainage maps shall be submitted for pre- and post-development conditions. The scale shall be acceptable to the Engineer and shall normally be 1" = 100' or 1" = 50' for smaller sheds but not less than 1" = 800'. For drainage areas exceeding 1 square mile, USGS maps may be used provided the area under consideration can be clearly defined.

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(2) The following information shall be shown on the drainage maps:

(a) Site area shaded or otherwise delineated.

(b) Drainage area in acres.

(c) Existing and proposed contours/elevations with an appropriate contour interval shall be extended a minimum of 50 feet beyond the limits of the tributary area and further if needed to verify proper delineation of shed limits.

(d) Travel paths of overland and concentrated flows with each defined and applicable lengths and slopes noted.

(e) Flow to each drainage structure (cfs) for both the 10-year and 100-year events with any carry over flow noted.

(f) Each inlet, outlet and junction identified by letters or numbers corresponding to tables and calculations included in the drainage report.

SEC. 5.08 OVERLAND RELEASE POINTS

Overland release points for the 100 year storm shall be shown and properly identified. All associated grading and limits of required drainage easements shall be shown. The easements shall be large enough to ensure that these release areas can be maintained.

SEC. 5.09 DESIGN CRITERIA AND STANDARDS

(1) Culverts

(a) Design flow shall be as specified in the "Placer County Stormwater Management Manual". Culverts shall be designed to carry the design storm with no head (i.e. a ratio of height of water at inlet (H) to diameter of pipe (D) ≤ 1.0 unless it is part of an approved storm detention design. For upstream watersheds less than or equal to 200 acres, the 100-year storm may be conveyed with head providing the design complies with Table 6-1 of the current edition of the "Placer County Stormwater Management Manual". However, designs with $H/D > 1.5$ must be evaluated for pipe seam and joint strength to ensure no failure of the pipe from larger water pressures. All storm events must be analyzed as outlined in the SMM.

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(b) Minimum thickness of cover and required gage thickness for overflow conditions shall be determined from Plate 42 of this manual. Where minimum cover requirements cannot be met, the conduit will be encased, have a concrete cover, or protected in a manner approved by the Engineer.

(c) In corrosive or erosive environments, protective coating or a heavier gage may be required on metal pipe culverts.

(d) Culverts under driveways shall be designed to carry the design flow of the roadside ditch with a minimum diameter as outlined in the SMM.

(e) Pipe material shall conform to those specifications outlined in the current edition of the General Specifications.

(f) When outlet velocities exceed allowable velocities for the downstream drainage way or water course, suitable protection shall be provided.

(g) Trash racks shall be provided at inlets and outlets for closed systems on pipes with a diameter of 24 inches or larger.

(h) For culverts 48" diameter or less, inlets shall have flared end sections. Cut-off walls may be required. When inlet velocities exceed allowable velocities for the soil, adequate rip rap shall be provided. For culverts larger than 48", reinforced concrete headwalls and endwalls with cut-off walls shall be provided.

(i) Aluminum CMP shall have a minimum cover of 18", or a different acceptable pipe type shall be used and shall require other protection as in (b) above. Aluminum CMP shall not be used in conjunction with any portland cement concrete.

(2) Roadway Drainage

(a) Roadway drainage design includes the collection and removal of drainage from the roadway. Such drainage includes that which originates from within the right-of-way, as well as surface drainage outside the right-of-way which may be impacted by road construction or impact the road. This includes overland flows, channel flow and groundwater.

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(b) In the design of roadway drainage facilities, provisions shall be made for stormwater release at all natural channels.

(c) The limits of flooding used in the design of roadway drainage facilities shall be as set forth in the project drainage report. The limits shall conform to Table 6-1 of the "Placer County Storm Water Management Manual".

(d) At locations of changes in cross slope or superelevation, collected drainage shall not be permitted to cross into opposing lanes of traffic.

(e) Drop inlet types shall conform to the designs shown in the State of California Department of Transportation Standard Plans.

(f) The hydraulic design of storm drain systems shall conform to the following:

1. New systems shall be designed for open channel flow with the design storm flow (i.e., hydraulic grade line is at or below the crown of the pipe). The system shall be designed for larger flows, as required by the Stormwater Management Manual.

2. For existing systems, the hydraulic grade line shall be 0.50 feet or more below the inlet grate and/or top of manhole. Desired minimum velocity shall be 2.0 fps for the design storm. For design storms greater than the 10-year event, and watersheds greater than 200 acres, refer to the Stormwater Management Manual. Reduced velocities must be approved by the Engineer.

(g) Joints and seams of pipes under pressure must be evaluated for leakage for all new pipes and for all existing pipes if increased heads are proposed.

(h) It is recommended that manholes be located outside the travelled way and shoulder areas where possible. Pipelines shall be located parallel and concentric to road centerlines as close as possible. Meandering and unnecessary angular changes of pipeline shall be avoided.

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(i) Mainline angular changes within a manhole or junction box shall not be greater than 90 degrees except laterals entering from drain inlets may be at greater than 90 degrees from the direction of flow through the structure. If laterals entering a structure are greater than 90 degrees from the main flow, the invert of the lateral shall be at or above the crown elevation of the main storm drain line. Where angle points in alignment exceed 5 degrees, a manhole or inlet type junction structure, or circular bends may be used, as approved by the engineer.

(j) Manholes shall be located at pipe junctions, and changes in gradient or size. For pipes 24" or less in diameter on curves with radii at 200-400 feet, manholes shall be placed at the B.C. or E.C. of the curve and then on 400 feet maximum intervals along the curve. The spacing of manholes may be increased to 500 feet when the pipe diameter is greater than 24 inches. Approval by the Engineer will be required for curve radii less than 200 feet.

(k) Drainage inlets shall have a maximum spacing of 500 feet as measured longitudinally along the road.

(l) Junction boxes shall be constructed of reinforced concrete. Minimum wall thickness shall be 8 inches for cast-in-place structures. Approved precast reinforced concrete structures may have a minimum wall thickness of 6 inches. Inside dimension shall be such as to provide a minimum of 3 inches clearance on the outside diameter of the largest pipe in each face for rectangular boxes and 8 inches minimum clearance between pipes along inside wall of circular junction boxes. Junction boxes deeper than 4 feet shall have a minimum width/diameter of 48 inches.

(m) Downstream pipes in a storm drain system shall be designed with the same or larger size as the upstream pipe(s).

(n) Pipes entering and leaving junction boxes shall be designed with matching crowns, or the upstream pipe(s) may be higher. In no case will the crown of a smaller upstream pipe be below the crown of the downstream pipe unless specifically approved as part of the design of a detention facility or BMP.

(o) Longitudinal gutter grades shall not be flatter than 0.50 percent.

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(p) Pipe materials shall conform to requirements of Sec. 5.09(2)(e).

(q) Ditches shall be designed to accommodate the effects of supercritical flow when changing direction of a ditch. No erosion or scouring is allowed. The effect of roadside superelevation must also be evaluated on direction changes.

(r) Ditch materials are listed in order of County preference: Portland cement concrete; asphalt concrete; earth; rock lined; grass. Overall preference is a closed storm drain system with dikes/curbs as appropriate and minimizing roadside ditches.

(3) Drainage Disposal by Pumping

(a) The use of drainage pumps shall be avoided if at all possible. When pumps are required, drainage originating outside the local depressed drainage area shall be excluded.

(b) When the use of drainage pumps is permitted, the drainage system shall be designed to provide for gravity outfall during summer months and periods of low water stages. If a low stage gravity outfall appears impractical, an alternate pump of small capacity for the low stage may be considered.

(c) Drainage pumps shall be equipped with standby power and pumps. Pumps shall be designed to alternate between pumping cycles.

(d) The outfall shall be equipped with approved flood gates.

(e) Pump design shall accommodate the design storm specified by the Engineer.

(f) Pump stations shall be designed such that gravity flow does not flow through the pump pit.

(g) Designs requiring a pump system shall also incorporate adequate release points for larger storms and potential pump failure in accordance with the requirements of the Stormwater Management Manual.

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(h) Each pumping installation shall be individually reviewed and approved for all design features by the Engineer.

(4) Subsurface Drainage

(a) Where subsurface drainage is encountered, special investigations and reports by a qualified engineer shall be required.

(b) All subsurface drainage shall include perforated pipes.

(c) Minimum inside pipe diameter for underdrains shall be 6 inches for lengths of 500 feet or less. For lengths exceeding 500 feet, the minimum diameter shall be 8 inches.

(d) Surface drainage shall not be permitted to discharge into an underdrain which is designed to intercept groundwater. The discharge of an underdrain into a storm drain or culvert is permissible. Designs shall include the outfall above the hydraulic grade line of the structure, unless specifically approved by the Engineer.

(e) A terminal cleanout shall be installed at the upper end of the underdrain, and intermediate cleanouts shall be installed at all angles and as approved by the Engineer. The riser diameter shall be equal to the diameter of the underdrain. A suitable marker stake shall be provided for permanent reference.

(f) The underdrain grade shall not be flatter than 0.5 percent unless approved by the Engineer.

(g) Outlets shall be provided at intervals of not more than 500 feet.

(h) Rodent guards shall be installed on all outlets.

(i) A 10 foot minimum length of solid pipe shall be installed upstream of the outlet.

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SEC. 5.11 EASEMENTS

(1) General

(a) Drainage conduits and improved channels when not located in a public street, road, alley, or within a public right-of-way must be located in a dedicated and recorded public drainage easement. Necessary dedication must be completed before the improvement will be approved for construction. A dedicated and recorded meandering drainage easement (MDE) shall be provided for all existing natural drainage swales.

(2) Standards

(a) Easements for closed conduits:

1. The minimum drainage easement width shall be 10', with the conduit centered within the easement.

2. A temporary construction easement shall be provided to ensure adequate access and working space rights during construction.

3. For pipes 24" diameter and greater or where trench depth exceeds 5 feet, additional easement width may be necessary to provide adequate working space.

(b) Easements for open channels (man made waterways):

1. Shall have sufficient width to contain the channel and, where required, a service road with turnaround.

2. Minimum easement requirements are the same as for closed conduits.

(c) Easements for culverts:

1. Provide sufficient easements for maintenance purposes including at inlets and outlets.

(d) Easements for overland release areas for the 100 year storm event.

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SEC. 5.13 FENCING

Suitable fencing or barriers shall be installed in accordance with the current edition of the Placer County General Specifications, should the Engineer determine that they are needed for safety or security reasons.

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STANDARD DRAINAGE PIPE SIZES

CORRUGATED METAL PIPE (CMP) DIAMETER (IN.)	CROSS-SECTIONAL AREA (SQ FT.)	CORRUGATED METAL PIPE ARCH (CMPA) EQUIVALENTS (IN. X IN.) (SPAN X RISE)	CORRUGATIONS
12	0.8	NO CMPA EQUIVALENT	2-2/3" X 1/2"
15	1.2	17X13	2-2/3" X 1/2"
18	1.8	21X15	2-2/3" X 1/2"
21	2.4	24X18	2-2/3" X 1/2"
24	3.1	28X20	2-2/3" X 1/2"
30	4.9	35X24	2-2/3" X 1/2"
36	7.1	42X29	2-2/3" X 1/2"
42	9.6	49X33	2-2/3" X 1/2"
48	12.6	57X38 53X41	2-2/3" X 1/2" 3" X 1"
54	15.9	64X43 60X46	2-2/3" X 1/2" 3" X 1"
60	19.6	71X47 66X51	2-2/3" X 1/2" 3" X 1"
66	23.8	77X52 73X55	2-2/3" X 1/2" 3" X 1"
72	28.3	83X57 81X59	2-2/3" X 1/2" 3"X1"; 5"X1"
78	33.2	87X63	3"X1"; 5"X1"
84	38.5	95X67	3"X1"; 5"X1"
90	44.2	103X71	3"X1"; 5"X1"
96	50.3	112X75	3"X1"; 5"X1"
102	56.7	117X79	3"X1"; 5"X1"
108	63.6	128X83	3"X1"; 5"X1"
114	70.9	137X87	3"X1"; 5"X1"
120	78.5	142X91	3"X1"; 5"X1"
126	86.6	NO CMPA EQUIVALENT	3"X1"; 5"X1"
132	95.0	NO CMPA EQUIVALENT	3"X1"; 5"X1"
138	103.9	NO CMPA EQUIVALENT	3"X1"; 5"X1"
144	113.1	NO CMPA EQUIVALENT	3"X1"; 5"X1"

NOTE: Circular pipe in diameters of 12" to 96" has 2-2/3" x 1/2" corrugations, and circular pipe in diameters of 48" to 144" has 3" x 1" and/or 5" x 1" corrugations.

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