

## **CHAPTER 6 DRAINAGE DESIGN REQUIREMENTS**

### **6.100 GENERAL INFORMATION.**

#### **6.101 *PURPOSE.***

The purpose of this chapter is to assist the engineer with the preparation of hydrology and hydraulics studies and calculations and with the design of storm drain facilities. This chapter also contains requirements pertaining to development within flood-prone areas.

The City of Encinitas requires drainage studies to be prepared based upon the most recent County of San Diego Hydrology and Drainage Design Manuals adopted by the City.

#### **6.102 *STANDARDS AND REFERENCES.***

The following resources, listed in order of precedence, are to be utilized for drainage analysis and design. In case of conflict, the document of higher precedence shall be used. The most current City-adopted version of all documents shall be used.

- A. City of Encinitas Municipal Code.
- B. Requirements and guidelines specified in this manual.
- C. City and staff policies.
- D. The City of Encinitas Best Management Practice Manual, Part II.
- E. County of San Diego Hydrology Manual.
- F. County of San Diego Drainage Design Manual.
- G. San Diego Area Regional Standard Drawings.

- H. Standard Specifications for Public Works Construction, a.k.a. "The Greenbook".
- I. Generally accepted standards for professional engineering and construction practices.

**6.103      *STORM WATER QUALITY REGULATIONS.***

Drainage designs shall also comply with the requirements of the Regional Water Quality Control Board and the City of Encinitas Jurisdictional Urban Runoff Management Plan, the Standard Urban Stormwater Mitigation Plan (SUSMP), and storm water pollution control requirements, which are discussed in Chapter 7 of this manual.

**6.104      *HYDROMODIFICATION AND LOW IMPACT DEVELOPMENT.***

Project designs shall comply with current low impact development and hydromodification objectives, such as limiting graded and hardscape areas to allow greater natural infiltration and to manage increases in the volume and rate of runoff above predevelopment levels. Hydromodification and low impact development requirements are discussed in the City of Encinitas Standard Urban Stormwater Mitigation Plan (SUSMP), which is discussed in Chapter 7 of this manual.

## **6.200 HYDROLOGY STUDY.**

### **6.201 GENERAL INFORMATION.**

The City of Encinitas requires drainage studies to be prepared based upon the most recent County of San Diego Hydrology and Drainage Design Manuals adopted by the City.

The hydrology study shall be composed utilizing available record drawings, information in the City GIS database, other applicable records maintained by the City, and a field review. The field review is essential to ensure all existing drainage facilities are appropriately represented in the study and that the drainage areas are accurate.

The most current version of the San Diego County Hydrology Manual shall be utilized for the study, with the modifications noted below.

### **6.202 HYDROLOGIC SOIL GROUP.**

Due to the variation in soils occurring in Encinitas, all hydrology studies shall assume soil group 'D' for the hydrology analysis. This approach ensures a conservative study since soils group 'D' allows the least infiltration of storm runoff.

### **6.203 COEFFICIENT OF RUNOFF.**

The following policies pertain to the calculation of the coefficient of runoff, the 'c' value, for drainage calculations.

6.203.1 Area-Weighted Coefficient of Runoff. The City of Encinitas requires the calculation of an area-weighted average coefficient of runoff. Studies shall calculate the average coefficient of runoff, 'c', by assuming a 'c' value of 0.9 for all roof, pavement, and other hardscape areas and a 'c' value of .45 for all pervious areas. A sample calculation is provided in Appendix 6.1.

6.203.2 Greenhouses and the Coefficient of Runoff. Because greenhouse facilities are not a use requiring a permit, the

construction of the greenhouse facilities would not have necessitated a drainage study or the construction of storm drain facilities to handle the runoff from the development. If greenhouse facilities exist onsite and will be demolished as a part of the proposed development, the coefficient of runoff for the predevelopment condition shall assume an undeveloped condition, vacant land.

**6.204      *STORM FREQUENCY.***

Drainage studies shall consider a 100-year storm frequency. Both six-hour and 24-hour storms shall be considered in the hydrology study.

**6.205      *TIME OF CONCENTRATION.***

The time of concentration is the time required for the runoff from the most remote region of the watershed to reach the point of concentration at which the flow is to be calculated. The minimum time of concentration as established by the San Diego County Hydrology Manual shall be assumed unless calculations for the time of concentration are included in the study.

**6.206      *COMPUTER-AIDED STUDIES.***

When a computer program is utilized in the preparation of the drainage study, the computer data shall be added to the study submitted to the City. This shall include the name, version, and maker of the program, an explanation of the required inputs and the values entered, and a list of the variables used by the program.

**6.207      *DRAINAGE AREAS AND DRAINAGE AREA MAPS.***

Drainage area maps shall be prepared as discussed below.

6.207.1      General Information. Separate drainage area maps shall be included for the existing and proposed conditions in order to avoid confusion when the existing drainage pattern is being modified. Existing and offsite drainage area maps shall include topography contours for the entire area of concern imposed upon an aerial photograph of the

drainage area. When a grading plan is being prepared, it shall be used as the base for the proposed condition drainage area map, with the pertinent hydrology study information shown and plan features not related to the hydrology study excluded. Grades shown on the drainage area map and used in the study shall be based upon the North American Vertical Datum of 1988 (NAVD 88). Storm drain systems, inlets, culverts, natural water courses, and cross-gutters shall be included with the flow tributary to each labeled. The drainage area map shall clearly show each drainage area used in the study labeled with the number corresponding to the study, the acreage, and the  $Q_{100}$  value. The direction of flow for the longest time of concentration, points of confluence, and discharge point locations shall be labeled.

- 6.207.2 Offsite Tributary Areas. Runoff from offsite tributary areas that discharge to or across the project site shall be considered in the hydrology study, and the proposed drainage system shall be designed to accommodate flows originating onsite and in offsite tributary areas. The calculations for onsite and offsite areas shall be presented separately in the study. When necessary for clarity, separate drainage area maps shall be presented to show the onsite and offsite areas at appropriate scales.

**6.208**      ***OTHER CALCULATIONS REQUIRED.***

The project planchecker may require that any necessary calculations for storm water pollution control facilities be included in the hydrology study. Storm water pollution control requirements are discussed in Chapter 7 of this Manual. Similarly, the hydrology study shall include any calculations necessary to demonstrate the impact of the proposed development on downstream properties. Pipe strength and/ or loading calculations may be required for cases in which the D-load table does not apply. If detention/ infiltration basin is required for the project, basin routing and staging calculations may be required.

### **6.300 HYDRAULICS.**

Drainage systems shall be designed such that the flows from a 100-year storm will be contained within the underground storm drain systems and/or the street; the maximum depth of street flow shall be below the top of curb elevation. On circulation element roads and higher street classifications, a 12' wide travel lane shall be maintained for each direction of travel during a 100-year storm, unless otherwise authorized by the City Engineer. Cross-gutters shall be constructed only at street intersections, unless otherwise allowed by the City Engineer.

Storm drain inlet, drainage swale, and pipe sizing/ capacity calculations shall be provided. Where applicable, velocity calculations showing that non-erosive velocities are maintained shall be provided. At the discretion of the City Engineer, a downstream drainage study may be required to assess the capacity of the storm drain system to handle runoff from the proposed development.

If a detention/ infiltration basin is required to mitigate cross-lot drainage, calculations shall be provided showing that the impact of the proposed development on downstream properties does not exceed the predevelopment condition. Basin routing calculations shall be provided. Design requirements for detention/ infiltration systems are discussed in Section 6.601 below.

## **6.400 STORM DRAIN DESIGN.**

The following are the minimum design requirements for storm drain systems. More stringent design criteria may be required by the City Engineer. Requirements are for public systems unless otherwise noted.

### **6.401 SLOPE.**

The minimum allowable pipe slope is 0.5%. A flatter slope may be approved in special situations by the City Engineer.

### **6.402 CLEANOUTS AND ACCESS STRUCTURES.**

Cleanouts shall be provided at angle points, grade breaks, and as necessary to ensure proper access for maintenance and repair. The maximum cleanout spacing shall be 300' for 30" or smaller storm drains and 400', 600', and 800' respectively for 30"-42", 42"-60", and greater than 60" storm drains. All intersections, changes in direction, and changes in pipe cross-sectional dimensions shall have an access structure approved by the City Engineer. Existing substandard downstream drainage structures may be required to be replaced, at the discretion of the City Engineer.

### **6.403 PIPE MATERIAL.**

Storm drains shall be constructed of reinforced concrete pipe (RCP). Drainage structures shall be cast-in-place reinforced concrete; precast concrete components may be allowed if inspected in the manufacturing plant by the City. The strength classification or gauge shall be shown on the plans; RCP shall be 1350-D minimum. HDPE pipe or other alternative pipe materials may be utilized with prior written approval by the City Engineer; HDPE pipe shall be encased in concrete as protection from future construction activities in the area of the pipe and to avoid accidental cuts into the pipe once it is installed.

### **6.404 PIPE SIZING.**

The minimum allowable pipe size shall be 18", unless otherwise approved by the City Engineer. Calculations for

the determination of the required pipe size shall be included in the drainage study. The storm drain pipe may not connect to a smaller pipe downstream.

**6.405      *HORIZONTAL CURVES.***

Horizontal curves shall be as per the manufacturer's specifications or as approved by the City Engineer. Where horizontal curves are proposed, the plan shall be labeled with the radius, length, and delta of the curve.

**6.406      *FLOW VELOCITY.***

The drainage system shall be designed with a minimum flow velocity of four feet per second (fps) and with a maximum of 20 fps. Exceptions shall be approved in advance by the City Engineer. In cases in which the velocity exceeds 20 fps and excessive erosion of the pipe due to sedimentation may occur, a special wall RCP may be required. Energy dissipater systems to the satisfaction of the City Engineer shall be utilized to provide protection from erosive velocities at discharge points.

**6.407      *SEPARATION FROM WATER AND RECLAIMED WATER LINES.***

Water-tight joints will be required for locations in which a storm drain must cross within five feet of a water or reclaimed water main.

**6.408      *REQUIREMENT FOR WATER-TIGHT JOINTS.***

Pressure flow may be allowed at the discretion of the City Engineer for storm frequencies equal to or greater than a 10-year storm provided that the depth below surface allows adequate head to prevent potential flooding throughout the system. When such systems are allowed, they shall be designed to the satisfaction of the City Engineer for water-tight joints in the pressurized sections of pipe and an additional safety length beyond the pipe length experiencing pressure flow. The additional safety length required shall be at the discretion of the City Engineer based upon the Q<sub>100</sub>, pipe size, and flow velocity.

**6.409      *PIPE DEPTH.***

Storm drain systems shall be constructed with the top of pipe a minimum of two feet deep, unless otherwise allowed by the City Engineer. Storm drains constructed at a depth greater than fifteen feet are deep storm drains and shall be avoided whenever possible. When the City Engineer approves the construction of a deep system, oversized specially designed access holes, pipe encasements, greater pipe size, increased easement requirements for maintenance access, water-tight joints, and/or additional pipe thickness may be required.

**6.410      *STORM DRAIN EASEMENT REQUIREMENTS.***

Storm drain maintenance and/ or access easements shall be required in order to ensure adequate access to any public storm drain facilities. Requirements for storm drain easements and all-weather access roads parallel those for sewer easements, which are discussed in Chapter 4, Section 4.400.

## **6.500 STORM DRAIN IMPROVEMENT PLANS.**

### **6.501 GENERAL INFORMATION.**

The construction of public storm drain improvements requires a public improvement permit from the City of Encinitas. At the discretion of the City Engineer, private storm drain improvements may be permitted with the grading permit. Grading and improvement plans are required to be prepared by a qualified civil engineer licensed within the state of California. Storm drain plans shall satisfy the requirements discussed below.

### **6.502 PLAN PREPARATION.**

6.502.1 Plan Requirements. The storm drain improvement plan shall include a plan and profile view of the proposed drainage improvements. The plan view of the storm drain shall be shown on the same sheet as any proposed grading or pavement work in order to facilitate checking of proposed grades. The plan shall show curb, gutter, and other drainage structures within the vicinity of the proposed project with flow line elevations. Proposed flowline elevations shall be labeled to show continuity of flow. Where stationing from a previous improvement plan exists in the area of the proposed work, the same stationing shall be used to prepare the plan.

6.502.2 Profile Requirements. Each segment of the profile shall be labeled with pipe invert elevations, slope, length, material, D-loading, and  $Q_{100}$ . The hydraulic and energy grade lines shall be shown. Each inlet or other drainage structure shall be shown on the profile and labeled. The existing and proposed ground elevations shall be shown, and all infrastructure crossings and potential conflicts shall be indicated on the profile with the minimum clearance distance called out.

6.502.3 Cross-Section Requirements. Cross sections and construction details shall be provided through swales, detention/ infiltration basins, and non-standard drainage facilities and structures. Swale and basin sideslopes shall

not exceed a 2:1 ratio without prior approval from the City Engineer. Parabolic or trapezoidal cross-sections are encouraged for swales due to enhanced storm water pollution treatment capabilities.

- 6.502.4 Maintenance Responsibility. The long-term maintenance responsibility of the storm drain facilities shall be indicated for each element on the improvement plan. If a system is public, it shall be labeled as such. If a private party or a homeowner's association will be responsible for the maintenance, the name, contact phone number, and address shall be provided on the plan. A covenant for perpetual private maintenance of the storm drain system may be required to record against the property, at the discretion of the City Engineer. If so, the recoding information for the covenant shall be entered on the improvement plan.

## **6.600 SPECIAL DRAINAGE SITUATIONS.**

### **6.601 *CROSS-LOT DRAINAGE.***

New cross-lot drainage situations shall not be allowed under any circumstances, and existing cross-lot drainage shall not be allowed if an alternate solution is feasible. If the historic drainage pattern is cross-lot, alternatives shall be examined that evaluate the impact on other downstream properties of re-routing the runoff. At the discretion of the City Engineer, Private Maintenance Agreements for the drainage facilities and/ or a Hold Harmless for Drainage covenant shall be recorded against the property. Examples of these documents are included in Appendices 1.18 and 1.19.

In cases in which an alternative to the historical cross-lot drainage situation is infeasible, the development shall be designed in such a way as to ensure that the impact of the drainage on the downstream property following development does not exceed the pre-development impact. This is typically achieved by minimizing new paved and hard-surface areas and by draining the impervious areas to an infiltration and/ or detention basin that is designed and sized in accordance with Engineering Department standards. Drainage systems to mitigate cross-lot drainage shall be designed for the 100-year storm. Both six and 24 hour storm durations shall be analyzed to determine the required detention capacity. Calculations for the required and provided detention/ infiltration volumes shall be included in the project drainage study.

A sample design for an infiltration basin is included as Appendix 6.2. The basin is designed to receive all site runoff discharging onto the adjacent property and is constructed underground, lined with filter fabric, and filled with 3/4" crushed rock. Surface runoff enters the crushed rock storage through a grate inlet and is dispersed via a 4" perforated pipe running laterally through the crushed rock.

The designs of infiltration systems shall allow for a controlled release of the runoff and shall include an emergency overflow and/ or spillway. The discharge of any proposed system that drains cross-lot shall ensure

that the post-development pattern of drainage to the adjacent property mimics the pre-development pattern, typically by designing a system that allows sheet flow to the downstream property. Concentration of runoff to an adjacent property shall not be allowed. An example of a spreading basin is included as Appendix 6.3 of this manual.

**6.602 DRAINAGE OF BLUFF-TOP PROPERTIES.**

Discharge of storm water and irrigation runoff over the top of a bluff shall not be allowed. Infiltration areas are discouraged on bluff-top properties because of the potential of the runoff for disturbing the stability of the bluff. Bluff-top properties shall be graded to drain away from the bluff. If surface drainage away from the bluff is not possible due to the existing/ proposed grades, a drainage system shall be constructed to intercept the runoff prior to it flowing over the bluff. The runoff shall be routed to a holding tank/ wet well designed to handle the 50-year storm event and then pumped to a discharge point from which the runoff can surface flow off the property. Bluff-top drainage requirements do not alleviate the project of the obligation to comply with storm water pollution control requirements.

If an automatic irrigation system is proposed for a bluff-top property, the system shall be designed to avoid excess watering. An automatic shut-off system, moisture shut-off sensors, and other advanced controls will be required for the installation of the automatic irrigation system. The system shall be approved by the City Engineer prior to installation.

In order to mitigate to the maximum extent the drainage impact of proposed development on the bluff, projects shall incorporate native, drought-tolerant plant material appropriate for the exposed coastal bluff area. All plant material shall have the ability to naturalize without supplemental irrigation after an establishment period of three years or less. A landscape plan may be required by the City in order to ensure that the irrigation impacts have been appropriately addressed.

**6.603 PRIVATE LANDSCAPE DRAINAGE SYSTEMS.**

For ease of maintenance and for the benefits storm water pollution control and low impact development, engineers are encouraged to design systems that allow gravity flow from the project site to the street with minimal use of storm drain pipes that don't allow storm water treatment. The location of the proposed area drains and drainage facilities are required to be shown on the grading plan. Inlets and catch basins shall be located within pervious areas that provide storm water treatment, and the use of inlets and catch basins shall be limited in order to allow the maximum time of travel of the storm water runoff over those treatment areas/ or building permit site plan. The installation of a drainage system not shown on the grading plan and/ or building permit site plan and not approved by the City Engineer may violate the storm water pollution control BMPs approved by the City, and it therefore will require a permit from the Engineering Department unless determined otherwise by the City Engineer. Drainage systems not shown on the grading plan and/or building permit site plan are subject to a construction permit requirement and potential removal/ redesign/ relocation, at the discretion of the City Engineer.

Any landscape drainage system required within the public right-of-way requires prior approval from the City Engineer and an encroachment permit. The encroachment permit shall be issued prior to issuance of the grading permit, and the recording information for the encroachment permit shall be shown on the grading plan.

## **6.700 FLOODPLAIN AND FLOODWAY.**

Work within the floodplain/ floodway as shown on the most recent Flood Insurance Rate Map (FIRM) shall comply with FEMA requirements and the Chapter 23.40 of the Municipal Code. Boundaries of the 100-year and 500-year floodplain and floodway are also available at City Hall through the City GIS system.

### **6.701 CONSTRUCTION WITHIN THE FLOODPLAIN.**

No grading is allowed in the floodplain unless a hydrological study is prepared and approved by both the City Engineer and FEMA and a Conditional Letter of Map Revision (CLOMR) and a Letter of Map Revision (LOMR) are processed with FEMA. New construction and any substantial improvement of any structure shall have the lowest floor, including any basement, elevated at least two feet above the 100-year floodplain or meet the standards in Section 23.40.040(A)(3)(c) of the Municipal Code.

Structures and/ or portions of structures below the 100-year base flood elevation shall be of materials not readily susceptible to water damage. Enclosed areas below the base flood elevation shall be designed to allow the free passage of floodwaters through openings. The openings shall be deigned such that the bottom is no more than one foot above grade and shall allow a total open area of one square inch for every square foot of enclosed area below the base flood elevation. The City Engineer may require that the building plans or a portion of the building plans be attached and approved with the grading plan in order to ensure that the Municipal Code and City requirements are being met.

The elevation of the lowest floor shall be certified upon completion of construction by a registered professional engineer or surveyor to be constructed at an elevation as required by Municipal Code 23.40.040. Any non-habitable construction below the 100-year base flood elevation shall be certified by a registered professional engineer to be in compliance with the requirements of the Municipal Code and the City Engineer. The certifications shall be

submitted for review and approval by the City Engineer prior to final of the project.

**6.702      *DEVELOPMENT WITHIN THE FLOODWAY.***

Encroachments including earthwork, new construction, improvements, and other development in the floodway are prohibited without a permit from the City. Floodway encroachment or improvement is allowed only if a hydrological study approved by the City and by FEMA shows that no adverse impacts, including no rise in the flood water surface elevation and if the Conditional Letter of Map Revision (CLOMR) and Letter of Map Revision (LOMR) are processed with FEMA. Any proposed improvements shall meet with the federal requirements for development within the floodway.

**6.703      *LEUCADIA SPECIAL FLOOD AREA.***

A study of the flooded area along North Coast Highway 101 in Leucadia was performed by Rick Engineering and is on file with the City. The study specifies the area affected by the Leucadia flood and provides sections with water surface elevation profiles along the corridor. The study is available for review from the Engineering Department, and the bounds of the flooded areas are identified in the City digital GIS database and are available to the public.

Development proposed within the area of the Leucadia special flood shall be constructed such that the floor elevation of all habitable areas are at or above the 100-year water surface elevation specified in the study. Development within the Leucadia Special Flood Area shall be designed to ensure that the proposed development will provide an onsite floodwater storage capacity equal to the volume of runoff displaced by the development in a 10-year storm event. This is typically achieved by providing above- or below-ground stormwater storage. The storage area shall be designed to fill without reliance on pumps or mechanical systems and shall include a discharge system that will release flows uniformly and within six hours after the storm. The storage area shall be designed to fill automatically during a storm and to discharge the runoff slowly after the storm peak. The storage pump system

shall be designed as a part of the grading plan, and the system and pump specifications shall be approved prior to approval of the plan. The storage area shall be designed with a manhole access that is accessible by a vac-con truck or similar equipment to allow regular maintenance and emergency pumping in the event of a system failure.