

Appendix L. Drainage System Study

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TECHNICAL MEMORANDUM

To: De Novo Planning Group
From: Harris & Associates
RE: Drainage System Study for the Brea Core Specific Plan
Date: February 6, 2026

1. Introduction and Purpose

The City of Brea (City) is developing the Brea Core Specific Plan (BCSP) as part of its Focused General Plan Update. The BCSP is generally bounded by Lambert Road to the north, Imperial Highway (SR-90) to the south, Berry Street to the west, and SR-57 to the east. The BCSP proposes to increase both residential units and allowable non-residential square footage, as summarized in [Table 1](#).

Table 1. Proposed BCSP Land Use Change Summary

Land Use Designation	Existing Land Use	Proposed Land Use
Residential Units	1,417	4,752
Non-Residential Square Footage	5,113,863	6,379,588

This Technical Memorandum documents the analysis performed by Harris and Associates (Harris) to evaluate peak runoff flow rates associated with the proposed BCSP land uses at a programmatic level. The assessment examines potential impacts on the City’s drainage system based on incremental changes in peak runoff flow rates between the proposed BCSP land use and the existing land use. Hydraulic modeling of the storm drainage system was not included in the scope of this work.

2. Drainage Setting

The BCSP area is divided mostly between the regional watersheds of Brea Creek and Fullerton Creek. Both creeks are managed by OCFCD and flow in a southwesterly direction. The watershed boundaries generally follow North Brea Boulevard and are shown on [Figure 1](#). The areas west of North Brea Boulevard drain to Orange County Flood Control District (OCFCD) facilities associated with Brea Creek, and the areas to the east of North Brea Boulevard drain to Fullerton Creek OCFCD facilities. A small portion along the City’s southern boundary, including part of the BCSP area, lies outside the major regional watershed and drains southward into the City of Fullerton’s drainage system. [Table 2](#) provides a summary of the watershed areas within the BCSP area.

Table 2. Watershed Areas

Watershed Name	Watershed Area (acres)	Area Within City (acres)	Area within BCSP (acres)	Percentage by acres within BCSP (%)
Brea Creek	13,776	1,412	185	1.3
Fullerton Creek	3,114	2,546	551	17.7
Southerly Subbasins	N/A	668	10	N/A

Most of the BCSP area does not lie within a Federal Emergency Management Agency (FEMA) Special Flood Hazard Area (SFHA) and is designated as Zone X (unshaded) on FEMA Flood Insurance Rate Map (FIRM) Map Number 06059C0042J. Zone X (unshaded) are areas identified areas with minimal flood risk. There are two areas along the Brea Canyon Channel and Fullerton Creek that are designated as SFHA Zone AE and are subject to flooding by the 1% annual chance flood (Figure 2).

3. Drainage System Overview

The drainage system within the BCSP area consists of a network of City-owned pipes, manholes, and catch basins that drain into the OCFCD facilities of Brea Creek and Fullerton Creek or connects to the City of Fullerton drainage system. Figure 1 presents the existing storm drain system within the BCSP overlaid with the regional watersheds.

4. Methodology

Peak runoff rates to the City’s storm drainage system under the proposed BCSP land uses (Proposed Condition) were analyzed and compared with those under existing land uses (Existing Condition). The following assumptions were used:

- The Existing Condition land use was based on the *City’s Master Plan of Drainage* (MPD, 2013) analysis and is illustrated on Figure 3. Figure 4 presents the BCSP land uses, and Figure 5 highlights parcels with proposed land use changes.
- The same methodology used in the MPD was applied to the Proposed Condition analysis to ensure consistency and to evaluate incremental changes resulting from the BCSP land uses.
- The analysis of the 10-year and 25-year storm events was conducted in accordance with the *Orange County Hydrology Manual* (OCHM, 1986).
- The drainage basin areas delineated in the MPD were used to calculate peak runoff for the Proposed Condition. It was assumed that no significant changes to the drainage patterns would occur with the BCSP land use changes.

5. Peak Runoff Estimates

A modified rational method, consistent with the MPD and in compliance with the OCHM, was adopted to estimate peak runoff. The peak runoff is calculated as follows:

$$Q = 0.9(I-F_m)A$$

where:

- Q = peak runoff (cubic feet per second, cfs)
- I = rainfall intensity (inches per hour, in/hr)
- F_m = loss coefficient, product of pervious-to-total area ratio (a_p) and soil loss rate for pervious areas (F_p)
- A = subbasin drainage area (acres)

The parameters were estimated as follows:

Rainfall Intensity. Rainfall intensities for each subbasin drainage area were assumed to remain generally consistent between the Existing and Proposed Conditions. The MPD estimated rainfall intensities using OCHM’s Precipitation-Intensity-Curves and the precipitation duration was assumed equal to the time of concentration for each subbasin drainage area. At this planning-level analysis, without detailed development plans, the time of concentration was also assumed to remain largely unchanged between the Existing and Proposed Conditions.

Soil Loss Rate (F_p). Soil infiltration rates by soil type are provided in the OCHM and are as follows:

- Type A: 0.40 in/hr
- Type B: 0.30 in/hr
- Type C: 0.25 in/hr
- Type D: 0.20 in/hr

The soil type within the BCSP subbasins were taken from the Natural Resources Conservation Services (NRCS) State Soil Geographic (STATSGO) database and is shown on [Figure 6](#). The averaged soil infiltration rate for each subbasin based on the OCHM soil loss rates (F_p) is provided in [Table 4](#).

Previous-to-total area ratio (a_p). Impervious cover for the different land use types were adopted from the OCHM and is provided in [Attachment A](#). Mixed-use categories were not included in the OCHM and were instead estimated based on the proportional percentage of residential, commercial, and open space areas, using the corresponding pervious area percentages for each subcategory. These values were adopted for the Existing and Proposed Condition analysis for comparison purposes and are shown in [Table 3](#).

Table 3. Impervious Area Percentage by Land Use Type

Land Use Designation	Ai, Area Impervious, %	Ap, Area Pervious, %
Major Shopping Center	90	10
General Commercial	90	10
Industrial Commercial	90	10
Administration and Professional Office	90	10
Floodplain	0	100
Light Industrial	90	10
General Industrial	90	10
Mixed Use I (50% residential, 40% commercial, 10% open-space)	68.5	31.5
Mixed Use II (50% residential, 40% commercial, 10% open-space)	68.5	31.5
Mixed Use III (50% residential, 40% commercial, 10% open-space)	68.5	31.5
Mixed Use 18	68.5	31.5
Mixed Use 50	68.5	31.5
Parks/Recreation/Open Space-Parks Recreation	0	100
Public Facilities	40	60
Single-Family Residential	30	70
Multiple Family	65	35

6. Results

Of the 62 subbasin drainage areas that fall entirely or partially within the BCSP boundary, 30 include parcels with proposed land use change. [Figure 1](#) illustrates these parcels within their respective subbasin drainage areas.

The incremental change in peak flow between the Existing and Proposed Conditions is summarized in the attached [Table 4](#), which also provides the following information:

- 10-year and 25-year peak runoff rates per subbasin drainage area for Existing and Proposed Conditions
- Total drainage basin acreage
- Acreage by land use category under Existing and Proposed Conditions
- Percentage of each drainage area affected by proposed land use changes
- Soil loss factor, pervious ratio, and weighted area loss coefficient for each subbasin drainage area

Overall, the analysis indicates that the Proposed Condition BCSP land uses are expected to generate lower peak runoff rates compared to the Existing Condition land uses. The estimated reduction of peak runoff with the Proposed Condition BCSP land uses during both the 10-year and 25-year event is 8.90 cubic feet per second compared to the Existing Condition. This reduction is due to the conversion of commercial land use to mixed use land use. Mixed use has an anticipated higher pervious area due to residential and open-space uses, which results in more surface infiltration and interception, increasing storage and attenuating of the peak runoff that enters the storm drain system.

Within the BCSP drainage area, certain storm drain segments were identified as operating under pressured conditions during the 10-year storm event, however, these segments were not flooding. Given the anticipated reduction in peak runoff rates associated with the Proposed Condition BCSP land uses, these pressurized segments are not expected to experience increased flooding risk.

The MPD did find localized curb ponding along the north side of Lambert Road at the northern boundary of the BCSP area and recommended improvement projects within that vicinity. The projects consist of new catch basins and 18-inch and 24-inch diameter piping at the ponding locations to collect runoff and convey it to the existing storm drain system. Project location and total pipe length recommended is summarized in **Table 5** and is shown on **Figure 1**. Although the MPD recommended improvements at these locations, only a few parcels affected by the BCSP will drain to these areas. In addition, the anticipated land uses under the BCSP includes a greater percentage of pervious surfaces, which is expected to reduce runoff and further improve conditions at these locations.

Table 5. MPD Recommended Improvements on Lambert Road

Location	Length (feet)
Lambert Road, between N Berry Street and Tamarack Ave	625
Lambert Road, between Cliffwood Park Street and Cashew Ave	625
Lambert Road, between Cashew Ave and N State College Blvd	570

7. Recommendations

A comparison of the existing and proposed land uses within the BCSP area indicates minimal potential for increased imperviousness. Most proposed changes involve allowing industrial or commercial areas to be converted into mixed-use developments. Because the former uses typically have high impervious surface coverage, these land use transitions are expected to result in lower overall imperviousness, and consequently, lower peak runoff rates. Therefore, no significant adverse impacts on the existing drainage system are anticipated.

However, changes to on-site drainage systems on large parcels could alter localized drainage patterns within the BCSP area. The City should review each development project proposal and compare it to the existing impervious coverage and drainage patterns assumed in the MPD, as well as to actual field conditions.

8. References

Master Plan of Drainage 2013, prepared by Willdan Engineering for the City of Brea, December 2013.

Orange County Hydrology Manual, prepared by Orange County Environmental Management Agency, October 1986.

Orange County Hydrology Manual Addendum No. 1, prepared by Orange County Environmental Management Agency, 1996.

ACTUAL IMPERVIOUS COVER		
Land Use (1)	Range-Percent	Recommended Value For Average Conditions-Percent (2)
Natural or Agriculture	0 - 0	0
Public Park	10 - 25	15
School	30 - 50	40
most of the public facilities in the study area are schools		
Single Family Residential: (3)		
2.5 acre lots	5 - 15	10
1 acre lots	10 - 25	20
2 dwellings/acre	20 - 40	30
3-4 dwellings/acre	30 - 50	40
5-7 dwellings/acre	35 - 55	50
8-10 dwellings/acre	50 - 70	60
More than 10 dwellings/acre	65 - 90	80
Multiple Family Residential:		
Condominiums	45 - 70	65
Apartments	65 - 90	80
Mobile Home Park	60 - 85	75
Commercial, Downtown Business or Industrial	80 - 100	90

Notes:

1. Land use should be based on ultimate development of the watershed. Long range master plans for the County and incorporated cities should be reviewed to insure reasonable land use assumptions.
2. Recommended values are based on average conditions which may not apply to a particular study area. The percentage impervious may vary greatly even on comparable sized lots due to differences in dwelling size, improvements, etc. Landscape practices should also be considered as it is common in some areas to use ornamental gravels underlain by impervious plastic materials in place of lawns and shrubs. A field investigation of a study area shall always be made, and a review of aerial photos, where available, may assist in estimating the percentage of impervious cover in developed areas.
3. For typical equestrian subdivisions increase impervious area 5 percent over the values recommended in the table above.

ORANGE COUNTY
HYDROLOGY MANUAL

ACTUAL IMPERVIOUS COVER
FOR
DEVELOPED AREAS