

and TGD, summarizes typical pollutants of concern for major land uses and project categories, including those that are proposed for the CollegeTown Specific Plan project.

**Table 14** Anticipated and Potential Pollutants Generated by Land Use Type

Priority Project Categories and/or Project Features	Suspended Solid/ Sediments	Nutrients	Heavy Metals	Pathogens (Bacteria/ Virus)	Pesticides	Oil & Grease	Toxic Organic Compounds	Trash & Debris
High Density Residential Development	E	E	N	E	E	E	N	E
Attached Residential Development	E	E	N	E	E	E <sup>b</sup>	N	E
Commercial/Institutional Development	E <sup>a</sup>	E <sup>a</sup>	E <sup>e</sup>	E <sup>c</sup>	E <sup>a</sup>	E	E	E
Restaurants	E <sup>a,b</sup>	E <sup>a</sup>	E <sup>b</sup>	E	E <sup>a</sup>	E	N	E
Parking Lots	E	E <sup>a</sup>	E	E <sup>d</sup>	E <sup>a</sup>	E	E	E
Streets, Highways, & Freeways	E	E <sup>a</sup>	E	E <sup>d</sup>	E <sup>a</sup>	E	E	E

Note:

E = expected to be of concern N = not expected to be of concern.

Source: County of Orange. (2011, May 19). Technical Guidance Document for the Preparation of Conceptual/ Preliminary and/or Project Water Quality Management Plans (WQMPs). Table 2.1.

a Expected pollutant if landscaping exists on-site, otherwise not expected.

b Expected pollutant if the project includes uncovered parking areas, otherwise not expected.

c Expected pollutant if land use involves food or animal waste products, otherwise not expected.

d Bacterial indicators are routinely detected in pavement runoff.

e Expected if outdoor storage or metal roofs, otherwise not expected.

**Bacteria/Pathogens.** Elevated pathogens are typically caused by the transport of human or animal fecal wastes from the watershed. Runoff that flows over land such as urban runoff can mobilize pathogens, including bacteria and viruses. Even runoff from natural areas can contain pathogens (e.g., from wildlife, plant matter, and soils). Other sources of pathogens in urban areas include pets and leaky sanitary sewer pipes. The presence of pathogens in runoff can impair receiving waters. Total and fecal coliform, enterococcus bacteria, and *E. coli* bacteria are commonly used as indicators for pathogens due to the difficulty of monitoring pathogens directly.

**Metals.** The primary sources of trace metals in storm water are metals typically used in transportation, buildings and infrastructure and also paints, fuels, adhesives and coatings. Copper, lead, and zinc are the most prevalent metals typically found in urban runoff. Other trace metals, such as cadmium, chromium, mercury are typically not detected in urban runoff or are detected at very low levels.<sup>16</sup> Trace metals have the potential to cause toxic effects on aquatic life and are a potential source of groundwater contamination.

<sup>16</sup> Los Angeles County, Department of Public Works. (2000, September). Los Angeles County 1994–2000 Integrated Receiving Water Impacts Report. Retrieved January 27, 2009, from <http://ladpw.org/WMD/npdes/InfTC.cfm>

**Nutrients.** Nutrients are inorganic forms of phosphorous and nitrogen. The main sources of nutrients in urban areas include fertilizers in lawns, pet wastes, failing septic systems, and atmospheric deposition from automobiles and industrial operations. The most common impact of excessive nutrient input is eutrophication of the receiving water body, resulting in excessive algal production, hypoxia or anoxia, fish kills and potential releases of toxins from sediment due to changes in water chemistry profiles.

**Oil and Grease.** The most common sources of oil and grease in urban runoff stem from spilled fuels and lubricants, discharge of domestic and industrial wastes, atmospheric deposition, and runoff. Runoff can contain leachate from roads, breakdown of tires/rubber and deposition of automobile exhaust. Some petroleum hydrocarbons, such as polycyclic aromatic hydrocarbons (PAHs), can bioaccumulate in aquatic organisms and are toxic at low concentrations. Hydrocarbons can be measured in a variety of ways including petroleum hydrocarbons, oil and grease, or as individual groups such as PAHs. Hydrocarbons can persist in sediment for long periods of time in the environment and can result in adverse impacts on the diversity and abundance of benthic communities.

**Organic Compounds.** Organic compounds are carbon-based, and are typically found in pesticides, solvents, and hydrocarbons. Dirt, grease, and other particulates can also adsorb organic compounds in rinse water from cleaning objects, and can be harmful or hazardous to aquatic life either indirectly or directly.

**Oxygen Demanding Substances.** Oxygen-demanding substances include biodegradable organic material as well as chemicals that react with dissolved oxygen in water to form other compounds, such as proteins, carbohydrates, fats, as well as ammonia and hydrogen sulfide. The oxygen demand of a substance can lead to depletion of dissolved oxygen in a water body and possibly the development of septic conditions, resulting in the growth of undesirable organisms and the release of odorous and hazardous compounds.

**Pesticides.** Pesticides (including herbicides) are chemical compounds commonly used to control insects, rodents, plant diseases, and weeds. Excessive application of a pesticide or impractical application of pesticides (i.e., right before rain events) may result in runoff containing toxic levels to receiving water bodies and the microorganisms.

**Sediment.** Sheet erosion and the transport and deposition of sediment in surface waters can be a significant form of pollution that may result in water quality problems. Increases in runoff velocities and volumes can cause excessive stream erosion and sediment transport altering the sediment equilibrium of a stream or channel. Excessive fine sediment, such as total suspended solids, can impair aquatic life through changes to the physical characteristics of the stream (light reduction, temperature changes, etc.).

**Trash and Debris.** Improperly disposed or handled trash such as paper, plastics and debris including the biodegradable organic matter such as leaves, grass cuttings, and food waste can accumulate on the ground surface where it can be entrained in urban runoff. The large amount of trash and debris can have significant negative impacts on the recreational value of water body. Excessive organic matter can create a high biochemical oxygen demand in a stream and lower its water quality.

### **WQMP Approach**

The overall approach to water quality treatment for the individual projects within the CollegeTown Specific Plan and individual Planning Areas will include incorporation of site design/low impact development (LID) strategies and source control measures throughout the sites in a systematic manner that maximizes the use of LID features to provide treatment of storm water and reduce runoff. In accordance with the Fourth-Term MS4 Permit for North Orange County, the use of LID features will be consistent with the prescribed hierarchy of treatment provided in the Permit: infiltration, evapotranspiration, harvest/reuse and biotreatment. For those areas of the site where LID features are not feasible or do not meet the feasibility criteria, treatment control BMPs with biotreatment enhancement design features will be utilized to provide treatment. Where applicable, LID features will be analyzed to demonstrate their ability to treat portions of the required design capture volume (DCV) and reduce the size of downstream on-site treatment control BMPs.

Consistent with regulatory requirements and design guidelines for water quality protection, the following principles are being followed for the project and will be supported by construction level documents in the final Water Quality Management Plans (WQMPs) per each phase of development and prior to grading permit(s) issuance by the City of Fullerton:

- Where feasible, LID features will be sized for water quality treatment credit according to local Regional Board sizing criteria as defined in the Fourth-Term MS4 Permit for either flow-based or volume-based BMPs. There will be a significant effort to integrate LID techniques within the internal development areas (site design objectives), thereby providing treatment of low-flow runoff directly at the source and runoff reduction of small (i.e., more frequent) storm event runoff (first-flush). In most instances, LID features will be sized by volume-based analyses to demonstrate compliance with the required design capture volume for the project.
- Detailed field investigations, drainage calculations, grading, and BMP sizing to occur during the detailed design phase and future project-specific WQMP documentation.
- All LID features identified in this report are preliminary in nature but have been sized to show their relative footprint requirements for technical planning purposes (siting, treatment volumes, typical profiles, etc.). Detailed drainage calculations, grading, and confirmation of sizing to occur during the detailed design phase and subsequent WQMP documentation for the individual projects.
- Where feasible, LID features will be designed to infiltrate and/or reuse treated runoff on-site in accordance with feasibility criteria as defined in the 2011 Countywide Model WQMP and Technical Guidance Document (TGD).<sup>17,18</sup>
- For those areas of the project where infiltration is not recommended or acceptable and harvest/reuse landscaping demands are insufficient, biotreatment LID features will be designed to treat runoff and discharge controlled effluent flows to downstream receiving waters.

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<sup>17</sup> County of Orange Planning Division. (2011, May 19). Exhibit 7.II Model Water Quality Management Plan (WQMP).

<sup>18</sup> County of Orange Planning Division. (2011, May 19). Model Water Quality Management Plan (WQMP). Technical Guidance Document (TGD).

Unlike flood control measures that are designed to handle peak storm flows, LID BMPs and treatment control BMPs are designed to retain, filter or treat more frequent, low-flow runoff or the “first-flush” runoff from storm events. In accordance with the Fourth-Term MS4 Permit for North Orange County, the LID BMPs shall be sized and designed to ensure on-site retention of the volume of runoff produced from a 24-hour 85<sup>th</sup> percentile storm event, as determined from the County of Orange’s 85<sup>th</sup> Percentile Precipitation Map.<sup>19</sup> This is termed the “design capture volume”, or DCV. The 2011 Model WQMP and its companion Technical Guidance Document provides design criteria, hydrologic methods and calculations for combining use of infiltration, retention, and biofiltration BMPs to meet the required design capture volume.

In order to conceptually size LID and other treatment control BMPs for the purposes of this study, the overall project has been divided into Drainage Management Areas (DMAs) based on the individual Planning Areas and primary land uses. Specific drainage areas based on individual site grading, drainage patterns, storm drain and catch basin locations, final BMP design and sizing calculations will be identified and documented during future individual project WQMP development.

**Table 15** *CollegeTown Drainage Management Areas (DMAs)*

<i>Planning Area</i>	<i>Land Use</i>	<i>Drainage Area (ac)</i>	<i>% Impervious<sup>a</sup></i>	<i>Design Storm Depth<sup>b</sup> (in)</i>	<i>Rainfall Intensity<sup>c</sup> (in/hr)</i>	<i>DCV<sup>d</sup> (ft<sup>3</sup>)</i>	<i>Q<sub>Design</sub><sup>e</sup> (cfs)</i>
PA 1	MU/MFR	14.9	85%	0.9	0.26	38,411	3.06
PA 2	MU/I	11.3	85%	0.9	0.26	29,124	2.32
PA 3	MU/I	8.2	90%	0.9	0.26	22,047	1.75
PA 4	C/O	5.0	90%	0.9	0.26	13,476	1.07
PA 5	MU	10.7	90%	0.9	0.26	28,813	2.29
PA 6	MU	10.4	90%	0.9	0.26	28,112	2.24
PA 7	MU	8.5	95%	0.9	0.26	23,895	1.90
Streets & Public R/W		19.0	95%	0.9	0.26	53,623	4.27
<b>Total Specific Plan</b>		<b>88.0</b>	<b>90%</b>	<b>0.9</b>	<b>0.26</b>	<b>237,184</b>	<b>18.88</b>

*Notes:*

DMA Drainage Management Area DCV Design Capture Volume MU Mixed Use

MFR Multi-Family Residential R/W Right of Way cfs cubic feet per second

<sup>a</sup> Based on typical cover for land use types per Figure C-4 of the Orange County Hydrology Manual (County of Orange, 1986).

<sup>b</sup> Per Figure II.4 of the Technical Guidance Document (County of Orange, 2011). See also Appendix E.

<sup>c</sup> Per Figure II.2 of the Technical Guidance Document (County of Orange, 2011) for 5 minute Time of Concentration (T<sub>c</sub>). See also Appendix E.

<sup>d</sup> Simple Method DCV per Section III.1.1 of the Technical Guidance Document (County of Orange, 2011). Details are provided in Appendix E.

<sup>e</sup> Capture Efficiency Method for Flow-Based BMPs per Section III.3.3 of the Technical Guidance Document (County of Orange, 2011). Details are provided in Appendix E.

<sup>19</sup> Figure XVI-1 in the Technical Guidance Document (County of Orange, May 19, 2011).

Based on the proposed land plan, the DCV requirements are calculated for each Planning Area and public right-of-way (i.e., streets). However, certain streets may not undergo redevelopment which would not trigger any treatment requirements. In addition, some streets may undergo removal and replacement of existing surfaces at the same line and grade which would also not trigger any treatment requirements. The detailed site plans for each project will ultimately determine the total design capture volume requirements for each project.

### ***Site Design BMPs & Hydrologic Source Controls (HSCs)***

Careful consideration of site design is a critical first step in storm water pollution prevention from new developments and redevelopments. In general, site design objectives include a combination of factors that may include: minimization of impervious surfaces including roads and parking lots; preservation of native vegetation and root systems; minimization of erosion and sedimentation from susceptible areas such as slopes; incorporation of bioretention features, biofiltration swales, etc. where such measures are likely to be effective and technically and economically feasible; and minimization of impacts from storm water and urban runoff on the biological integrity of natural drainage systems and water bodies. In accordance with the current MS4 Permit, OC DAMP and City of Fullerton LIP, new development and redevelopment projects are required to implement site design BMPs to minimize directly connected impervious areas and promote infiltration of runoff. The OC DAMP and 2011 Model WQMP identifies example site design BMPs to be implemented where applicable and feasible. Site design measures are listed below that may be applicable to the projects within the Specific Plan area.

- Maximize the permeable area. This can be achieved in various ways, including, but not limited to increasing building density (number of stories above or below ground) and increasing the amount of landscaping above the minimum city requirements for commercial development. Decreasing the project's footprint can reduce the project's impacts to water quality and hydrologic conditions;
- Construct walkways, trails, patios, overflow parking lots, alleys, driveways, low-traffic streets and other low-traffic areas with open-jointed paving materials or permeable surfaces, such as pervious concrete, porous asphalt, unit pavers, and granular materials;
- Construct streets, sidewalks and parking lot aisles to the minimum widths necessary, provided that public safety and a walkable environment for pedestrians are not compromised;
- Incorporate landscaped buffer areas between sidewalks and streets;
- Maximize canopy interception and water conservation by preserving existing native trees and shrubs, and planting additional native or drought tolerant trees and large shrubs;
- Where soils conditions are suitable, use perforated pipe or gravel filtration pits for low flow infiltration;
- Where landscaping is proposed, drain rooftops into adjacent landscaping prior to discharging to the storm drain. Drain impervious sidewalks, walkways, trails, and patios into adjacent landscaping;

- Increase the use of vegetated drainage swales in lieu of underground piping or imperviously lined swales;

Many of the site design BMPs may also be considered low impact development (LID) features. The goal of using LID features is to mimic the sites existing hydrology by using design measures that capture, filter, store, evaporate, and detain runoff, rather than runoff flowing directly to piped or impervious systems. This includes directing runoff to vegetated areas, protecting native vegetation, and reducing the amount of impervious surfaces. These integrated site design controls (also referred to as “hydrologic source controls,” or HSCs in the Model WQMP) are effective at reducing the amount of runoff on-site and may be designed to capture a portion of the DCV for the project. Examples of these features include use of disconnected downspouts, rain barrels, and localized dispersion.

- Localized on-lot infiltration, which includes collecting on-site runoff from smaller impervious areas and diverting to small rain gardens, French drains, or other surface depressions for infiltration.
- Impervious area dispersion, such as diverting runoff from impervious areas such as rooftops, walkways and patios to adjacent pervious areas where runoff is dispersed uniformly via splash blocks or similar methods.
- Use of street trees for retention of runoff canopy interception.
- Residential rain barrels and similar small-scale above-ground storage vessels to capture runoff from roof downspouts for later reuse as irrigation.
- Use of green roofs or providing vegetation on rooftops to reduce impervious surfaces and increase runoff retention opportunities.

The effects of HSCs are accounted for in LID sizing calculations as an adjustment to the design storm depth, based on the type and magnitude of HSCs employed for the drainage area. In some instances, the combined retention effects of the HSCs may be sufficient to be considered “self-retaining” and not require any additional downstream LID features or treatment BMPs.

Due to the large amounts of landscaping in relation to the sidewalks and other impervious surfaces, use of HSCs and self-treating areas will likely be feasible within the Nutwood Plaza land use overlay area, and may be sufficient to reduce the sizing of or eliminate the need for downstream BMPs.

Though several of the above-mentioned HSCs and site design BMPs are inherent in the site’s conceptual design, the selection of appropriate site design BMPs, HSCs and LID features will be determined at the Project’s design development phase, when the individual projects within the study area are no longer conceptual in nature.

#### Low Impact Development (LID) BMPs

Under the Fourth-Term MS4 Permit and 2011 Model WQMP, an on-site feasibility analysis shall be conducted to determine the amount of runoff that 1) can feasibly be retained (via infiltration, harvest and reuse, or evapotranspired), and 2), if not completely retained then bio-treated on-site. Table 16 provides examples of the various LID features that may be used for on-site retention of runoff when properly sized and designed in accordance with the Model WQMP and Fourth-Term MS4 Permit requirements.

**Table 16** Low Impact Development (LID) BMP Options

<i>Infiltration</i>	<i>Harvest and Reuse</i>	<i>Evapotranspiration</i>	<i>Biotreatment</i>
<ul style="list-style-type: none"> <li>▪ Bioretention without underdrains</li> <li>▪ Infiltration trenches</li> <li>▪ Infiltration basins</li> <li>▪ Drywells</li> <li>▪ Underground infiltration</li> <li>▪ Permeable pavement</li> </ul>	<p><i>Storage Options:</i></p> <ul style="list-style-type: none"> <li>▪ Above-ground cisterns</li> <li>▪ Underground detention</li> </ul> <p><i>Potential Reuse Options:</i></p> <ul style="list-style-type: none"> <li>▪ Irrigation</li> <li>▪ Toilet flushing</li> <li>▪ Vehicle/equipment washing</li> <li>▪ Evaporative cooling</li> <li>▪ Industrial processes</li> <li>▪ Other non-potable uses</li> </ul>	<ul style="list-style-type: none"> <li>▪ Green roofs</li> <li>▪ Brown roofs</li> <li>▪ Blue roofs</li> </ul>	<ul style="list-style-type: none"> <li>▪ Bioretention with underdrains</li> <li>▪ Vegetated swales</li> <li>▪ Vegetated filter strips</li> <li>▪ Proprietary biotreatment</li> </ul>

*Notes:*

Source: County of Orange Planning Division. (2011, May 19). Model Water Quality Management Plan (WQMP). Technical Guidance Document (TGD). Table 4.1 with minor revisions.

Selection of LID features for water quality treatment is based on the pollutants of concern for the specific project site and the BMP’s ability to effectively treat those pollutants, in consideration of site conditions and constraints. The Model WQMP recognizes that certain factors may limit infiltration on-site, such as presence of low-infiltrating soils, shallow groundwater, or unstable slope conditions. Similarly, harvest and reuse of storm water runoff may not be suitable for sites where there is insufficient demand to reuse the collected volume of runoff (e.g., no landscape irrigation demand exists for periods longer than 1 week following a first-flush storm event). In these instances, LID biofiltration BMPs with underdrain systems may be designed and used on-site to treat any remaining runoff.

Several of the LID features listed in Table 16 are also considered “green street” features identified the US EPA’s guidance, “Managing Wet Weather with Green Infrastructure: Green Streets”, which outlines various LID approaches specific to street, roads, or highway projects. Green streets are carefully designed roadways that incorporate sustainable design elements that may include narrower pavement widths, canopy street trees, traffic calming features, and alternative street lighting systems. In addition, landscaping along the street edges and within setback areas provide additional opportunities for treatment of storm water runoff from the streets and adjacent development areas. The proposed project includes opportunities for Green Street Features for several of the streets within the study area including the conversion of Nutwood Avenue into a pedestrian plaza area, N. Commonwealth Avenue and portions of College Place, Langsdorf Avenue, Titan Avenue and Chapman Avenue.

*Infiltration BMPs*

Infiltration BMPs are LID BMPs that capture, store and infiltrate storm water runoff. These BMPs are engineered to store a specified volume of water and have no design surface discharge (underdrain or outlet structure) until this volume is exceeded. Examples of

infiltration BMPs include infiltration trenches, bioretention without underdrains, drywells, permeable pavement, and underground infiltration galleries.

When properly designed to store and infiltrate the entire DCV, infiltration BMPs are considered highly effective at treating pollutants of concern from a project site. However, the 2011 Model WQMP identifies several site constraints that may limit the use of infiltration BMPs or reduce their treatment effectiveness. These include conditions where the infiltration of storm water would result in significant risk to drinking water and groundwater quality by the presence of shallow groundwater (i.e., less than 10 ft below the BMP), presence of water supply wells within 100 ft of the BMP, presence of existing groundwater contaminants, and other factors that cannot be reasonably and technically mitigated. In addition, infiltration BMPs should not be used in Type D soils and where measured infiltration rates are less than 0.3 inch per hour on-site. Under these situations, infiltration is not recommended and other LID BMPs should be utilized.

#### *Study Area Soil Conditions*

For the CollegeTown Specific Plan, there are two sources available to characterize soil and groundwater conditions and these include the 2011 Technical Guidance Document which summarizes regional soil conditions based on Natural Resources Conservation Service (NRCS) Hydrologic Soil Groups Map and a site specific geotechnical investigation for the University House Project. Both sources are important to identify the potential for infiltration-based LID features.

Based on the Natural Resources Conservation Service (NRCS) Hydrologic Soil Groups Map provided as Figure XVI-2a in the TGD, the project site is located in Hydrologic Soil Group (HSG) B soils, which have moderate infiltration characteristics and are generally considered feasible for infiltration-based LID features. These features could include permeable pavement and dry wells.

The geotechnical investigation for the University House Project was prepared to provide site specific grading, structural, seismic and other geotechnical related recommendations for the proposed project. Considering the University House project is surrounded by the proposed project on three sides, it is an excellent resource to identify the types of soil present for the project area. Based on six boring logs, the near-surface soils at the project site consisted of sand and silt of varying proportions of silt, clay and gravel. Clay layers with thickness ranging from 5 to 10 feet were also encountered in some of the borings and were generally below 25 feet.<sup>20</sup> The presence of sandy silty clay for the first 25 feet indicates the potential for infiltration-based BMPs as feasible for full DCV infiltration or partial DCV infiltration.

#### *Project-Specific Infiltration BMPs and Green Street Features*

Based upon the best available soils information, infiltration is considered feasible. As part of the site-specific site plan, additional geotechnical investigations are required to determine specific soils types within the project area and mandatory infiltration/percolation tests in accordance with the 2011 TGD. The site-specific infiltration tests will determine if the minimum infiltration of 0.3"/hour is met within the project area.

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<sup>20</sup>