



PRELIMINARY
WATER QUALITY MANAGEMENT PLAN (PWQMP)

TOWN CENTRE

TTM 17446

Lake Forest, California

Prepared For

BROOKFIELD RESIDENTIAL
3090 Bristol Street, Suite 200
Costa Mesa, CA 92626

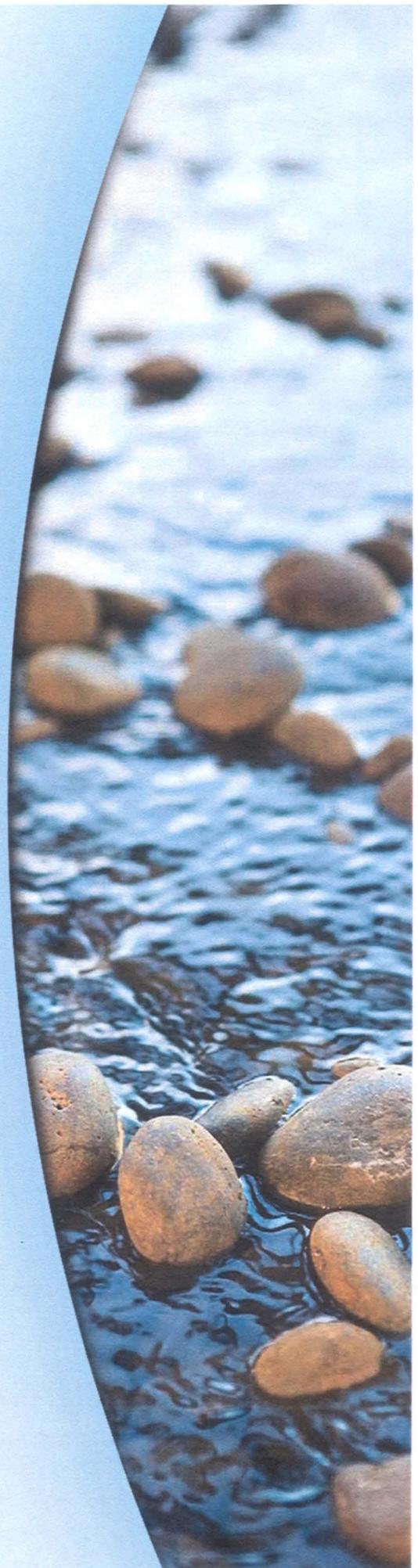
Prepared By

Fusco Engineering, Inc.
16795 Von Karman, Suite 100
Irvine, California 92606
949.474.1960
www.fusco.com

Project Manager:
Winnie Tham, PE

Date Prepared: January 31, 2012
Date Revised: April 6, 2012
2nd Revision: June 11, 2012
3rd Revision: July 23, 2012
Job Number: 308.44.01

full circle thinking[®]





PRELIMINARY WATER QUALITY MANAGEMENT PLAN (PWQMP)

TOWN CENTRE

TTM 17446

July 23, 2012

○

PRELIMINARY WATER QUALITY MANAGEMENT PLAN (PWQMP)

TOWN CENTRE

City of Lake Forest, County of Orange

71 AUTO CENTER DRIVE, FOOTHILL RANCH, CA 92610
APN 612-161-11 & 612-161-12

Prepared for:

BROOKFIELD RESIDENTIAL
3090 Bristol Street, Suite 200
Costa Mesa, CA 92626
714.427.6868

Prepared by:

FUSCOE ENGINEERING, INC.
16795 Von Karman, Suite 100
Irvine, CA 92618
949.474.1960

Date Prepared: January 31, 2012
Date Revised: April 6, 2012
2nd Revision: June 11, 2012
3rd Revision: July 23, 2012

PROJECT OWNER'S CERTIFICATION			
Permit/Application No.:	Pending	Grading Permit No.:	Pending
Tract/Parcel Map and Lot(s)No.:	TTM 17446	Building Permit No.:	Pending
Address of Project Site and APN:	71 Auto Center Drive, Foothill Ranch, CA 92610 612-161-11 & 612-161-12		

This Water Quality Management Plan (WQMP) has been prepared for BROOKFIELD RESIDENTIAL by FUSCOE ENGINEERING, INC. The WQMP is intended to comply with the requirements of the County of Orange NPDES Stormwater Program requiring the preparation of the plan.

The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan, including the ongoing operation and maintenance of all best management practices (BMPs), and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the current Orange County Drainage Area Management Plan (DAMP) and the intent of the non-point source NPDES Permit for Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the incorporated Cities of Orange County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend the WQMP. An appropriate number of approved and signed copies of this document shall be available on the subject site in perpetuity.

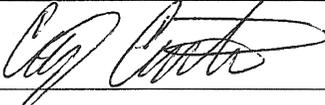
OWNER:	BROOKCAL LF LLC		
Name:	CRAIG CRISTINA		
Title:	DIRECTOR OF LAND ENTITLEMENT		
Company:	BROOKFIELD RESIDENTIAL		
Address:	3090 BRISTOL STREET, STE 220, COSTA MESA, 92626		
Email:	CRAIG.CRISTINA@BROOKFIELD RP.COM		
Telephone:	714-200-1605		
Signature:			Date: 4-9-12

TABLE OF CONTENTS

SECTION I	DISCRETIONARY PERMITS AND WATER QUALITY CONDITIONS	1
SECTION II	PROJECT DESCRIPTION	2
II.1	Project Description	2
II.2	Potential Storm Water Pollutants	3
II.3	Hydrologic Conditions of Concern	5
II.4	Post Development Characteristics	6
II.5	Property Ownership/Management	6
SECTION III	SITE DESCRIPTION	8
III.1	Physical Setting	8
III.2	Site Characteristics	8
III.3	Watershed Description	10
SECTION IV	BEST MANAGEMENT PRACTICES (BMPs)	11
IV.1	Project Performance Criteria	11
IV.2	Site Design and Drainage Plan	12
IV.2.1	Site Design BMPs	12
IV.2.2	Drainage Management Areas	12
IV.3	LID BMP Selection and Project Conformance Analysis	13
IV.3.1	Hydrologic Source Controls (HSCs)	13
IV.3.2	Infiltration BMPs	14
IV.3.3	Evapotranspiration, Rainwater Harvesting BMPs	15
IV.3.4	Biotreatment BMPs	18
IV.3.5	Hydromodification Control BMPs	23
IV.3.6	Regional/Sub-Regional LID BMPs	23
IV.3.7	Treatment Control BMPs	23
IV.3.8	Non-Structural Source Control BMPs	24
IV.3.9	Structural Source Control BMPs	26
IV.4	Alternative Compliance Plan	27
IV.4.1	Water Quality Credits	27
IV.4.2	Alternative Compliance Plan Information	28
SECTION V	INSPECTION/MAINTENANCE RESPONSIBILITY FOR BMPs	30
SECTION VI	SITE PLAN AND DRAINAGE PLAN	37
Exhibits	37
BMP Details	37

SECTION VII EDUCATIONAL MATERIALS.....39
APPENDICES.....40

Appendix A.....Supporting Calculations
Appendix B.....Notice of Transfer of Responsibility
Appendix C.....Educational Materials
Appendix D.....BMP Maintenance Supplement / O&M Plan
Appendix E.....Conditions of Approval
Appendix F.....Infiltration Test Results

SECTION I DISCRETIONARY PERMITS AND WATER QUALITY CONDITIONS

PROJECT INFORMATION	
Permit/Application No.:	GPA 2-12-2395 ZC 2-12-2394 SDP 2-12-2396
Tract/Parcel Map No.:	TTM 17446
Address of Project Site and APN:	71 Auto Center Drive, Foothill Ranch, CA 92610 612-161-11 & 612-161-12
WATER QUALITY CONDITIONS	
Water Quality Conditions:	Pending Issuance – to be provided in the final WQMP.
WATERSHED-BASED PLAN CONDITIONS	
Applicable conditions from watershed - based plans including WIHMPs and TMDLS:	The San Diego Creek / Newport Bay Watershed, of which this project site is a part of, has developed TMDLs for the following constituents: <ol style="list-style-type: none"> 1) Sediment/Siltation; 2) Nutrients; 3) Toxics (pesticides and metals); and 4) Fecal Coliform

SECTION II PROJECT DESCRIPTION

II.1 PROJECT DESCRIPTION

The Town Centre project site encompasses approximately 9.08 acres in the City of Lake Forest. The project site is bounded by Portola Parkway to the northeast, Bake Parkway to the northwest and Auto Center Drive to the east/southeast. A Vicinity Map is included in Section VI.

The project site consists of two parcels. The northern portion of the site is currently developed with a former car dealership while the southern portion is currently vacant land with minor vegetation and a few isolated piles of soil.

The proposed project includes the demolition of the existing dealership for the construction of a new multi-family residential development. The table below summarizes the proposed project.

DESCRIPTION OF PROPOSED PROJECT					
WQMP Development Category:	8. All significant redevelopment projects, where significant redevelopment is defined as the addition or replacement of 5,000 or more square feet of impervious surface on an already developed site. Redevelopment does not include routine maintenance activities that are conducted to maintain original line and grade, hydraulic capacity, original purpose of the facility, or emergency redevelopment activity required to protect public health and safety.				
Project Area (ft²):	395,318 ft ² (9.08 ac)				
# of Dwelling Units:	151				
SIC Code:	Not applicable.				
Narrative Project Description:	The proposed project includes the demolition of the existing dealership for the construction of 151 motorcourt condominium units within 11 buildings. An additional recreational center with pool is also proposed. Parking will be provided on-site in the form of residential garages (279 spaces) and as surface spaces along the proposed street (76 spaces). Landscaping will be located surrounding the residential units, along the proposed street and around the proposed recreational area. Approximately 2.46 acres will be landscaped.				
Residential Details	Plan Type	# of Units	Bed/Bath	Unit Square Footage (±)	Total Square Footage (±)
	1	21	1BR/1.5BA	763	16,023
	2	22	2BR/2BA	1,081	23,782
	3	21	2BR/2BA	1,256	26,376
	3x	22	2BR/2BA	1,287	28,314
	4	21	3BR/2BA	1,577	33,117
	5	22	3BR/2.5BA	1,730	38,060
	6	22	3BR/2BA	1,747	38,434
Total	151	--	--	204,106	

Project Features	No specific site features of water quality concern are currently planned for the project site. The site is not anticipated to have any outdoor trash enclosures, loading docks, outdoor storage area, wash areas, or food preparation areas associated with food service establishments.			
Project Area:	Pervious Area (ac or ft²)	Pervious Area Percentage	Impervious Area (ac or ft²)	Impervious Area Percentage
Pre-Project Conditions:	4.09 ac	45%	4.99 ac	55%
Post-Project Conditions:	2.46 ac	14%	6.62 ac	73%
Drainage Patterns/ Connections:	Under existing conditions, the majority of runoff from the site drains to an existing 30" RCP storm drain pipe located south west and adjacent to the existing wall separating the existing dealership center from the adjacent vacant area of the project site. Under proposed conditions, new storm drains will be constructed on-site to collect runoff from the proposed residential units and streets. The new storm drain will drain to the existing 30" line at Bake Parkway.			

II.2 POTENTIAL STORM WATER POLLUTANTS

The table below, derived from Table 2 of the Countywide Model WQMP Technical Guidance Document (May 2011), summarizes the categories of land use or project features of concern and the general pollutant categories associated with them.

ANTICIPATED & POTENTIAL POLLUTANTS GENERATED BY LAND USE TYPE								
Priority Project Categories and/or Project Features	General Pollutant Categories							
	Suspended Solid/ Sediments	Nutrients	Heavy Metals	Pathogens (Bacteria/ Virus)	Pesticides	Oil & Grease	Toxic Organic Compounds	Trash & Debris
Detached Residential Development	E	E	N	E	E	E	N	E
Attached Residential Development	E	E	N	E	E	E ⁽²⁾	N	E
Commercial/Industrial Development	E ⁽¹⁾	E ⁽¹⁾	E ⁽⁵⁾	E ⁽³⁾	E ⁽¹⁾	E	E	E
Automotive Repair Shops	N	N	E	N	N	E	E	E
Restaurants	E ⁽¹⁾⁽²⁾	E ⁽¹⁾	E ⁽²⁾	E	E ⁽¹⁾	E	N	E
Hillside Development >5,000 ft ²	E	E	N	E	E	E	N	E
Parking Lots	E	E ⁽¹⁾	E	E ⁽⁴⁾	E ⁽¹⁾	E	E	E

ANTICIPATED & POTENTIAL POLLUTANTS GENERATED BY LAND USE TYPE								
Priority Project Categories and/or Project Features	General Pollutant Categories							
	Suspended Solid/Sediments	Nutrients	Heavy Metals	Pathogens (Bacteria/Virus)	Pesticides	Oil & Grease	Toxic Organic Compounds	Trash & Debris
Streets, Highways, & Freeways	E	E ⁽¹⁾	E	E ⁽⁴⁾	E ⁽¹⁾	E	E	E
Retail Gasoline Outlets	N	N	E	N	N	E	E	E
Notes: E = expected to be of concern N = not expected to be of concern (1) Expected pollutant if landscaping exists on-site, otherwise not expected. (2) Expected pollutant if the project includes uncovered parking areas, otherwise not expected. (3) Expected pollutant if land use involves food or animal waste products, otherwise not expected. (4) Bacterial indicators are routinely detected in pavement runoff. (5) Expected if outdoor storage or metal roofs, otherwise not expected. 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.								

POLLUTANTS OF CONCERN		
Pollutant	E = Expected to be of concern N = Not Expected to be of concern	Additional Information and Comments
Suspended Solid/Sediment	E	San Diego Creek Watershed TMDL
Nutrients	E	San Diego Creek Watershed TMDL
Heavy Metals	E	San Diego Creek Watershed TMDL
Pathogens (Bacteria/Virus)	E	San Diego Creek Watershed TMDL
Pesticides	E	San Diego Creek Watershed TMDL
Oil & Grease	E	
Toxic Organic Compounds	E	
Trash & Debris	E	

The project's primary pollutants of concern are sediment, nutrients, pesticides, metals and pathogens, as they are both an expected pollutant and also a pollutant with a TMDL established for the San Diego Creek/Newport Bay Watershed.

II.3 HYDROLOGIC CONDITIONS OF CONCERN

The purpose of this section is to identify any hydrologic conditions of concern (HCOC) with respect to downstream flooding, erosion potential of natural channels downstream, impacts of increased flows on natural habitat, etc. As specified in Section 2.3.3 of the 2011 Model WQMP, projects must identify and mitigate any HCOCs. A HCOC is a combination of upland hydrologic conditions and stream biological and physical conditions that presents a condition of concern for physical and/or biological degradation of streams.

In the North Orange County permit area, HCOCs are considered to exist if any streams located downstream from the project are determined to be potentially susceptible to hydromodification impacts and either of the following conditions exists:

- Post-development runoff volume for the 2-yr, 24-hr storm exceeds the pre-development runoff volume for the 2-yr, 24-hr storm by more than 5 percent

or

- Time of concentration (T_c) of post-development runoff for the 2-yr, 24-hr storm event exceeds the time of concentration of the pre-development condition for the 2-yr, 24-hr storm event by more than 5 percent.

If these conditions do not exist or streams are not potentially susceptible to hydromodification impacts, an HCOC does not exist and hydromodification does not need to be considered further. In the North Orange County permit area, downstream channels are considered not susceptible to hydromodification, and therefore do not have the potential for a HCOC, if all downstream conveyance channels that will receive runoff from the project are engineered, hardened, and regularly maintained to ensure design flow capacity, and no sensitive habitat areas will be affected.

Is the proposed project potentially susceptible to hydromodification impacts?

Yes **No (show map)**

Based on the 2011 Technical Guidance Document (TGD), the project site is located in an areas susceptible to hydromodification within the San Diego Creek Watershed (Figure XVI-3d, see Appendix A). In order to quantify the HCOC potential, the 2-year, 24-hour storm was evaluated for the existing and proposed project.

2-YEAR, 24-HOUR STORM SUMMARY				
Condition	Acreage	T _c	Peak Runoff	Volume
Pre-development	9.38 ac	8.5 min	13.75 cfs	0.90 ac-ft
Proposed	9.46 ac	11.03 min	11.91 cfs	1.15 ac-ft
Increase	+ 0.08 ac	+ 2.53 min	- 1.84 cfs	0.25 ac-ft
% Increase	0.8%	30%	13% Reduction	28%

The results indicate the 2-year time of concentration (Tc) increases by 30% as compared to existing conditions; however the TGD recognizes that increases in Tc are acceptable, as a longer Tc is generally associated with natural conditions and nearly universally results in lower concerns for hydromodification impacts (TGD, Section 2.2.3.1, footnote 4). The results also indicate that the change in volume increases by 28% as compared to the existing conditions. Due to the existing soil constraints (see Section III.2), infiltration of the increase in volume is not feasible, and reuse demands are not sufficient to draw down the volume within 48 hours. Therefore, as stated in the 4th Term Storm Water Permit, "In cases where the excess volume cannot be infiltrated or captured and reused, discharge from the site must be limited to a flow rate no greater than 110% of the pre-development 2-year peak flow." (Section XII.D.4) The 2-year peak flow rate reduces by 13% as compared to existing conditions, which is consistent with the Fourth Term MS4 permit. Therefore, the project complies with the hydromodification requirements and allowable discharge provisions. Calculations are provided in Appendix A.

II.4 POST DEVELOPMENT CHARACTERISTICS

New area drains and on-site storm drains will convey runoff from the project site, and connect to the existing public storm drain system in Bake Parkway (Bake Parkway Storm Drain, OCFCD Facility F19P06). Runoff is then conveyed south west along Bake Parkway, and outlets to the Los Alisos Channel (Facility F19S02) just upstream of Dimension. The Los Alisos Channel outlets to Serrano Creek (Facility F19), a tributary to the larger San Diego Creek (F05). San Diego Creek ultimately discharges to the Upper Newport Bay and Pacific Ocean. A map for the larger San Diego Creek watershed is included in Section VI.

II.5 PROPERTY OWNERSHIP/MANAGEMENT

PROPERTY OWNERSHIP/MANAGEMENT	
Public Streets:	City of Lake Forest
Private Streets:	Brookfield Residential / HOA
Landscaped Areas:	Brookfield Residential / HOA
Open Space:	None.
Easements:	City of Lake Forest – easements are described further in Section III.2 Ingress/egress, scenic easement, landscape easement Storm drain – to be quit-claimed Sewer & water to IRWD
Parks:	None.
Buildings:	Brookfield Residential / HOA
Structural BMPs:	Brookfield Residential / HOA

A Home Owners Association (HOA) will be formed upon project completion. The HOA will be responsible for inspecting and maintaining all BMPs prescribed for Town Centre. Until a HOA is formally established, Brookfield Residential shall assume all BMP maintenance and inspection responsibilities for the proposed project. Inspection and maintenance responsibilities are outlined in Section V of this report.

SECTION III SITE DESCRIPTION

III.1 PHYSICAL SETTING

Planning Area/ Community Name	Town Centre
Location/Address:	71 Auto Center Drive, Foothill Ranch, CA 92610
Project Area Description	Located south of the intersection of Bake Parkway and Portola Parkway along Auto Center Drive.
Land Use:	Existing: Commercial Proposed: Multi-Family Residential
Zoning:	PC-8 (Foothill Ranch Planned Community) Commercial
Acreage:	9.08 acres
Predominant Soil Type:	D

III.2 SITE CHARACTERISTICS

Precipitation Zone:	Design Storm Depth = 0.95 inches
Topography:	In general, the site is graded to drain to the southwest corner of the area. In the southern boundary of the site, a small descending slope with a toe-of-slope retaining wall is located adjacent to the existing commercial site. A descending variable slope is also located adjacent to Bake Parkway along the western boundary of the site. At the northern boundary of the site, an east-west trending berm currently exists, with a gentle gradient down to Portola Parkway at the north side and a steeper gradient down to the south side that has a small retaining wall at the toe.
Existing Drainage Patterns/Connections:	Under existing conditions, the majority of runoff from the site drains to an existing 30" RCP storm drain pipe located south west and adjacent to the existing wall separating the existing dealership center from the adjacent vacant area of the project site. The vacant portion of the project site has apparently been mass graded. It drains from the wall at the existing auto dealership on the north, southerly to the south corner of the site at Auto Center Drive and the existing retail site. It leaves the site and drains into a catch basin in Auto Center Drive near Towne Centre Drive connected to an 18" pipe.

<p>Proposed Drainage Patterns/Connections:</p>	<p>Under proposed conditions, new storm drains will be constructed on-site to collect runoff from the proposed residential units and streets. The new storm drain will drain to the existing 30" line at Bake Parkway, which ultimately drains to the Los Alisos Channel and Serrano Creek located southeast of the project site.</p>
<p>Soil Type, Geology, and Infiltration Properties:</p>	<p>The western portions of the site consist generally of engineered fill placed during the grading activities for nearby Bake Parkway. The eastern/northeastern portion of the site generally consists as cut bedrock at the surface, with the exception of the placement of engineered fill for over-excavation of a cut to fill transition in support of the existing car dealership structure at the northeast portion of the site.</p>
<p>Hydrogeologic (Groundwater) Conditions:</p>	<p>Groundwater was not encountered during the geotechnical investigation.</p>
<p>Geotechnical Conditions (relevant to infiltration):</p>	<p>Infiltration testing was conducted on-site at three locations. The results show an average infiltration rate of 0.04 in/hr prior to applying a safety factor. After a safety factor of 3, the design infiltration rate is 0.014 in/hr, which is well below the minimum rate required for infiltration feasibility (0.3 in/hr). Infiltration of storm water runoff is considered infeasible. Further details are provided in Section IV.3.2.</p>
<p>Off-Site Drainage:</p>	<p>A proposed storm drain line will collect runoff from a portion of Auto Center Drive, and convey through the site to the existing 30" pipe on the north side of the vacant parcel.</p>
<p>Utility and Infrastructure Information/Easements:</p>	<p>Existing easements for scenic preservation, drainage and landscape maintenance run along and adjacent to the southerly side of Portola and along the easterly side of Bake Parkway. Additionally an easement for storm drain runs along the northeasterly property line of the vacant parcel, which provides for an existing 30" pipe that is connected to the main line in Bake Parkway. The easement then turns southwesterly parallel to Bake Parkway terminating approximately 200 feet from the southwesterly site boundary line. The existing storm drain easement will be quit-claimed under proposed conditions.</p>

III.3 WATERSHED DESCRIPTION

Receiving Waters:	Serrano Creek, San Diego Creek Reach 2
303(d) Listed Impairments:	<p>Per the 2010 List:</p> <ul style="list-style-type: none"> ▪ Serrano Creek: ammonia (unionized), indicator bacteria, pH ▪ San Diego Creek Reach 2: indicator bacteria, nutrients, sedimentation/siltation, unknown toxicity ▪ San Diego Creek Reach 1: fecal coliform, nutrients, pesticides, sedimentation/siltation, selenium, toxaphene ▪ Upper Newport Bay: chlordane, copper, DDT, indicator bacteria, metals, nutrients, PCBs, pesticides, sediment toxicity, sedimentation/siltation ▪ Lower Newport Bay: chlordane, copper, DDT, indicator bacteria, nutrients, PCBs, pesticides, sediment toxicity
Applicable TMDLs:	<p>The San Diego Creek / Newport Bay Watershed, of which this project site is a part of, has developed TMDLs for the following constituents:</p> <ol style="list-style-type: none"> 1) Sediment/Siltation; 2) Nutrients; 3) Toxics (pesticides and metals); and 4) Fecal Coliform
Pollutants of Concern for the Project:	<p>The project's primary pollutants of concern are sediment, nutrients, pesticides, metals and pathogens, as they are both an expected pollutant and also a pollutant with a TMDL established for the San Diego Creek/Newport Bay Watershed.</p>
Environmentally Sensitive and Special Biological Significant Areas:	<p>The project site is located within the larger San Diego Creek watershed, which is listed as impaired on the 303(d) list of impaired water bodies, and is designated as an Environmentally Sensitive Area (ESA) according to the OC DAMP. There are no Areas of Special Biological Significance (ASBS) within the project site.</p>

SECTION IV BEST MANAGEMENT PRACTICES (BMPs)

IV.1 PROJECT PERFORMANCE CRITERIA

Is there an approved WIHMP or equivalent for the project area that includes more stringent LID feasibility criteria or if there are opportunities identified for implementing LID on regional or sub-regional basis?

Yes No

PROJECT PERFORMANCE CRITERIA	
<p>Hydromodification Control Performance Criteria (Model WQMP Section 7.II-2.4.2.2)</p>	<p>If a hydrologic condition of concern (HCOC) exists, priority projects shall implement onsite or regional hydromodification controls such that:</p> <ul style="list-style-type: none"> ▪ Post-development runoff volume for the two-year frequency storm does not exceed that of the predevelopment condition by more than five percent, and ▪ Time of concentration of post-development runoff for the two-year storm event is not less than that for the predevelopment condition by more than five percent. <p>Where the Project WQMP documents that excess runoff volume from the two-year runoff event cannot feasibly be retained and where in-stream controls cannot be used to otherwise mitigate HCOCs, the project shall implement on-site or regional hydromodification controls to:</p> <ul style="list-style-type: none"> ▪ Retain the excess volume from the two-year runoff event to the MEP, and ▪ Implement on-site or regional hydromodification controls such that the post-development runoff two-year peak flow rate is no greater than 110 percent of the predevelopment runoff two-year peak flow rate.
<p>LID Performance Criteria (Model WQMP Section 7.II-2.4.3)</p>	<p>Infiltrate, harvest and use, evapotranspire, or biotreat/biofilter, the 85th percentile, 24-hour storm event (Design Capture Volume). LID BMPs must be designed to retain, on-site, (infiltrate, harvest and use, or evapotranspire) storm water runoff up to 80 percent average annual capture efficiency</p>
<p>Treatment Control BMP Performance Criteria (Model WQMP Section 7.II-3.2.2)</p>	<p>If it is not feasible to meet LID performance criteria through retention and/or biotreatment provided on-site or at a sub-regional/regional scale, then treatment control BMPs shall be provided on-site or offsite prior to discharge to waters of the US. Sizing of treatment control BMP(s) shall be based on either the unmet volume after claiming applicable water quality credits, if appropriate.</p>
<p>LID Design Storm Capture Volume</p>	<p>8.2 acres, ~86% impervious (per hydrology map) DCV = 22,538.7 ft³ <i>Note: DCV is greater than HCOC volume</i></p>

IV.2 SITE DESIGN AND DRAINAGE PLAN

The following section describes the site design BMPs used in this project and the methods used to incorporate them. Careful consideration of site design is a critical first step in storm water pollution prevention from new developments and redevelopments.

IV.2.1 Site Design BMPs

Minimize Impervious Area

The project will increase impervious surfaces as compared to existing conditions. However, landscaping will be provided throughout the site within the common areas as well as around the perimeter of the building.

Maximize Natural Infiltration Capacity

Due to presence of Type D soils and high depths to groundwater, infiltration is not recommended on-site.

Preserve Existing Drainage Patterns and Time of Concentration

Runoff will continue to flow to the existing storm drain along Bake Parkway as under existing conditions. Time of Concentrations will not decrease (shorten) as compared to existing conditions.

Disconnect Impervious Areas

Landscaping will be provided adjacent to sidewalks and between the proposed buildings. Low-flows and first-flush runoff will drain to bioretention units for water quality treatment.

Protect Existing Vegetation and Sensitive Areas, and Revegetate Disturbed Areas

Under existing conditions, approximately half of the site is developed, and the remaining half of the site exists as a previously graded lot and there are no natural areas to conserve. All disturbed areas will either be paved or landscaped.

Xeriscape Landscaping

Native and/or tolerant landscaping will be incorporated into the site design consistent with City guidelines.

IV.2.2 Drainage Management Areas

In accordance with the MS4 permit and the new Model WQMP, the Design Capture Volumes (DCVs) presented in the following table represent the minimum volume of storm water runoff required to be treated by LID and/or treatment control BMPs for the proposed project. The total DCV noted in the table represents the treatment requirement for all of the development areas. Preliminary footprints and depths required by each BMP are summarized in the following sections. Detailed calculations are provided in Appendix A. Final design and calculations will be identified and documented during project Final WQMP development.

DRAINAGE MANAGEMENT AREAS								
Drainage Area Name	Drainage Area (acres)	% impervious	Runoff Coefficient	Design Storm Depth (in)	Average 2-year Tc (min)	Rainfall Intensity (in/hr)	DCV (ft ³)	Q (cfs)
A1+A2 (Filterra #1)	1.59	90%	0.83	0.95	9.11	0.23	4,531.8	0.30
A3 (Filterra #2)	1.12	80%	0.75	0.95	9.21	0.23	2,902.5	0.19
A4 (Filterra #3)	1.65	85%	0.79	0.95	9.7	0.225	4,489.4	0.29
A6 (Filterra #4)	1.29	90%	0.83	0.95	10	0.225	3,676.7	0.24
A5 North (Filterra #5)	1.25	85%	0.79	0.95	10	0.225	3,401.1	0.22
A5 South (Filterra #6)	1.30	85%	0.79	0.95	9	0.23	3,537.1	0.24
Total	8.20	86.07%	0.80	0.95	9.5	0.225	22,538.7	1.47

Notes:
 1. Per Figure XVI-1 of the Model WQMP Technical Guidance Document (2011, May 19). See also Appendix A.
 2. Per Figure III.4 of the Model WQMP Technical Guidance Document (2011, May 19). See also Appendix A.

IV.3 LID BMP SELECTION AND PROJECT CONFORMANCE ANALYSIS

Low Impact Development (LID) BMPs are required in addition to site design measures and source controls to reduce pollutants in storm water discharges. LID BMPs are engineered facilities that are designed to retain or biotreat runoff on the project site. The 4th Term MS4 Storm Water Permit (Order R9-2009-0009) requires the evaluation and use of LID features using the following hierarchy of treatment: infiltration, evapotranspiration, harvest/reuse, and biotreatment. The following sections summarize the LID BMPs proposed for the project in accordance with the permit hierarchy and performance criteria outlined in Section IV.1.

IV.3.1 Hydrologic Source Controls (HSCs)

Hydrologic source controls (HSCs) can be considered to be a hybrid between site design practices and LID BMPs. HSCs are distinguished from site design BMPs in that they do not reduce the tributary area or reduce the imperviousness of a drainage area; rather they reduce the runoff volume that would result from a drainage area with a given imperviousness compared to what would result if HSCs were not used.

HYDROLOGIC SOURCE CONTROLS		
ID	Name	Included?
HSC-1	Localized on-lot infiltration	<input type="checkbox"/>
HSC-2	Impervious area dispersion (e.g. roof top disconnection)	<input checked="" type="checkbox"/>

HYDROLOGIC SOURCE CONTROLS		
ID	Name	Included?
HSC-3	Street trees (canopy interception)	<input type="checkbox"/>
HSC-4	Residential rain barrels (not actively managed)	<input type="checkbox"/>
HSC-5	Green roofs/Brown roofs	<input type="checkbox"/>
HSC-6	Blue roofs	<input type="checkbox"/>
HSC-7	Impervious area reduction (e.g. permeable pavers, site design)	<input type="checkbox"/>

The project will utilize hydrologic source controls (impervious area dispersion) throughout the site with disconnected downspouts and sidewalks draining to adjacent landscaping. At this time, however, HSCs were not accounted for during design of downstream BMPs for a conservative sizing approach. HSC's will be accounted for during final design and the cumulative volume of the HSC's will be subtracted from the required treatment volume in the Final WQMP.

In addition, two rain gardens (bioretention cells) will be located in the northeast portion of the site to capture and treat a portion of runoff prior to discharging into downstream BMPs. These rain gardens will function similar to bioretention cells with underdrains as well as HSCs, and are sized in accordance with the Model WQMP TGD. Refer to Section IV.3.4 for details on the sizing of the proposed rain gardens in combination with biotreatment BMPs.

IV.3.2 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.

INFILTRATION		
ID	Name	Included?
INF-3 INF-4	Bioretention Without Underdrains	<input type="checkbox"/>
	Rain Gardens	<input type="checkbox"/>
	Porous Landscaping	<input type="checkbox"/>
	Infiltration Planters	<input type="checkbox"/>
	Retention Swales	<input type="checkbox"/>
INF-2	Infiltration Trenches	<input type="checkbox"/>

INFILTRATION		
ID	Name	Included?
INF-1	Infiltration Basins	<input type="checkbox"/>
INF-5	Drywells	<input type="checkbox"/>
INF-7	Subsurface Infiltration Galleries	<input type="checkbox"/>
--	French Drains	<input type="checkbox"/>
INF-6	Permeable Asphalt	<input type="checkbox"/>
	Permeable Concrete	<input type="checkbox"/>
	Permeable Concrete Pavers	<input type="checkbox"/>
	Other:	<input type="checkbox"/>

A geotechnical study with infiltration testing was conducted for the project site. Soils on-site generally consist of engineered fill in the western portion, and cut bedrock with some fill in the eastern/northeastern portions of the site. The infiltration testing conducted utilized three hollow-stem auger borings that were drilled to depths of approximately 16 feet below ground surface. The results of the testing indicated very low infiltration rates, and the geotechnical engineer recommended a design infiltration rate of 0.014 inches per hour after applying a safety factor of 3 (per Worksheet H, see Appendix A).

The Model WQMP TGD, Section 2.4.2.4 requires a minimum measured infiltration rate after applying safety factors of 0.3 inches per hour to be considered feasible. Since the design rate provided by the geotechnical engineer for infiltration is less than 0.3 in/hr, infiltration of the entire DCV is not recommended for the project. A copy of the geotechnical study with infiltration testing results is included as Appendix F. Feasibility worksheets for infiltration are included in Appendix A.

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

Evapotranspiration BMPs are a class of retention BMPs that discharges stored volume predominately to ET, though some infiltration may occur. ET includes both evaporation and transpiration, and ET BMPs may incorporate one or more of these processes. BMPs must be designed to achieve the maximum feasible ET, where required to demonstrate that the maximum amount of water has been retained on-site. Since ET is not the sole process in these BMPs, specific design and sizing criteria have not been developed for ET-based BMPs.

EVAPOTRANSPIRATION		
ID	Name	Included?
--	HSCs, see Section IV.3.1	<input checked="" type="checkbox"/>
--	Surface-based infiltration BMPs	<input type="checkbox"/>
--	Biotreatment BMPs, see Section VI.3.4	<input checked="" type="checkbox"/>
	Other:	<input type="checkbox"/>

Bioretention BMPs are proposed which utilize evapotranspiration as physical process for runoff volume reduction. Bioretention BMPs are described further in Section IV.3.4.

Harvest and use (aka. Rainwater Harvesting) BMPs are LID BMPs that capture and store storm water runoff for later use. These BMPs are engineered to store a specified volume of water and have no design surface discharge until this volume is exceeded. Harvest and use BMPs include both above-ground and below-ground cisterns. Examples of uses for harvested water include irrigation, toilet and urinal flushing, vehicle washing, evaporative cooling, industrial processes and other non-potable uses.

HARVEST & REUSE / RAINWATER HARVESTING		
ID	Name	Included?
HU-1	Above-ground cisterns and basins	<input type="checkbox"/>
HU-2	Underground detention	<input type="checkbox"/>
--	Other:	<input type="checkbox"/>

In order to quantify harvested water irrigation demand for the common areas of the project, the Modified Estimated Applied Water Use (EAWU) method was used, consistent with Appendix X of the Model WQMP's Technical Guidance Document (TGD), dated May 19, 2011.

The Modified EAWU method is modified from the OC Irrigation Code (County Ordinance No. 09-010) to account for the wet season demand and storm events (assuming that no irrigation would be applied for approximately 30% of the days in the wet season).

The equation used to calculate the Modified EAWU is:

$$\text{Modified EAWU} = \frac{(ET_{o_{wet}} \times K_L \times LA \times 0.015)}{IE}$$

Where:

Modified EAWU = estimated daily average water use during wet season

$ET_{O_{wet}}$ = average reference ET from November through April (inches per month) per Table X.2 of the TGD

K_L = landscape coefficient (Table X.4 of the TGD)

LA = landscape area irrigated with harvested water (square feet)

IE = irrigation efficiency (assumed at 90%)

Note: In the equation, the coefficient (0.015) accounts for unit conversions and shut down of irrigation during and for three days following a significant precipitation event.

For a system to be considered "feasible", the system must be designed with a storage volume equal to the DCV from the tributary area and achieve more than 40% capture. The system must also be able to drawdown in 30 days to meet the 40% capture value. In addition, Table X.6 of the Technical Guidance Document sets forth the demand thresholds for minimum partial capture.

TABLE X.6: HARVESTED WATER DEMAND THRESHOLDS FOR MINIMUM PARTIAL CAPTURE	
Design Capture Storm Depth, inches	Wet Season Demand Required for Minimum Partial Capture, gpd per impervious acre
0.60	490
0.65	530
0.70	570
0.75	610
0.80	650
0.85	690
0.90	730
0.95	770
1.00	810

The following table summarizes the estimated applied water use for the common area landscaping of the project. Although specific irrigated areas and landscaping types are not available at this time, assumptions can be made based on similar product types and associated landscaping irrigation demands. For the purposes of this analysis, landscaping was assumed to consist of 50% turf and 50% conservation-type landscaping.

ESTIMATED APPLIED WATER USE (EAWU) FOR COMMON AREA LANDSCAPING										
Landscape Type	Total Area (ac)	% Impervious	Impervious Tributary (ac)	Irrigated LS Area (sf)	ET _{oWet} ⁽¹⁾ (in/mo)	K _L ⁽²⁾	Modified EAWU (gpd)	Modified EAWU per impervious acre (gpd/ac)	Minimum Capture Threshold ⁽³⁾ (gpd/ac)	Meet Minimum Feasibility Threshold?
Mix of Turf & Conservation Landscaping Types	8.2	86%	7.06	1.14	3.0	0.55	1,368.3	193.9	770	No
Design Capture Volume (gal)				168,584	Drawdown (days)				123.2	No
Notes:										
1 Per Table X.2 for Irvine Region (similar climate type), Model WQMP Technical Guidance Document, dated May 19, 2011.										
2 Per Table X.4 of the Model WQMP Technical Guidance Document, dated May 19, 2011.										
3 Per Table X.6 of Model WQMP Technical Guidance Document, dated May 19, 2011.										

Based on the results of the minimum threshold analysis, harvest and use for landscaping is not considered feasible, as the irrigation demand is insufficient to meet the minimum harvest demand threshold. The captured DCV would not be able to drawdown in 30 days required for feasibility. Similarly, the resultant irrigated area to tributary impervious area is below the minimum threshold for capture feasibility.

IV.3.4 Biotreatment BMPs

Biotreatment BMPs are a broad class of LID BMPs that reduce storm water volume to the maximum extent practicable, treat storm water using a suite of treatment mechanisms characteristic of biologically active systems, and discharge water to the downstream storm drain system or directly to receiving waters. Treatment mechanisms include media filtration (though biologically-active media), vegetative filtration (straining, sedimentation, interception, and stabilization of particles resulting from shallow flow through vegetation), general sorption processes (i.e., absorption, adsorption, ion-exchange, precipitation, surface complexation), biologically-mediated transformations, and other processes to address both suspended and dissolved constituents. Examples of biotreatment BMPs include bioretention with underdrains, vegetated swales, constructed wetlands, and proprietary biotreatment systems.

BIOTREATMENT		
ID	Name	Included?
BIO-1	Bioretention with underdrains	<input checked="" type="checkbox"/>
	Storm Water planter boxes with underdrains	<input type="checkbox"/>
	Rain gardens with underdrains	<input type="checkbox"/>
BIO-5	Constructed wetlands	<input type="checkbox"/>
BIO-2	Vegetated swales	<input type="checkbox"/>

BIOTREATMENT		
ID	Name	Included?
BIO-3	Vegetated filter strips	<input type="checkbox"/>
BIO-7	Proprietary vegetated biotreatment systems	<input checked="" type="checkbox"/>
BIO-4	Wet extended detention basin	<input type="checkbox"/>
BIO-6	Dry extended detention basins	<input type="checkbox"/>
--	Other:	<input type="checkbox"/>

Since both infiltration and harvest and reuse are considered infeasible, biotreatment BMPs will be utilized on-site for water quality treatment. Proprietary biotreatment units (Filtterra[®] or equivalent) were selected for use on-site due to the limited amount of landscaping between the buildings and required setbacks. These systems were selected based on their ability to treat the project's pollutants of concerns to a medium or high effectiveness, in accordance with Table 4.2 of the Model WQMP Technical Guidance Document.

Table 4.2 Relative Treatment Performance Ratings of Biotreatment BMPs

Unit Operations and Process	Assumed Principal Unit Operations and Processes Provided	Suspended solids / sediment/ turbidity	Nitrogen compounds	Phosphorus	Heavy metals	Microbial / viral pathogens	Oils and grease	Dissolved toxic organic compounds	Trash and debris
Bioretention system	<ul style="list-style-type: none"> Particulate Settling Size Exclusion Inert Media Filtration Sorption/Ion Exchange Microbial Competition/Predation Biological Uptake Volume loss (via infiltration, ET) 	H	L	L	H	M	H	M	H
Bioretention system with internal water storage zone and nutrient sensitive media design	Bioretention UOPs, plus: <ul style="list-style-type: none"> Microbially Mediated Transformations (if designed with internal water storage zone) 	H	M	M	H	M	H	M	H
Dry extended detention basin	<ul style="list-style-type: none"> Particulate Settling Size Exclusion Floatable Capture Vegetative Filtration (with low-flow channel) Volume loss (via infiltration, ET) 	M	L	M	M	L	M	L	H
Dry extended detention basin with vegetated sand filter outlet structure	Dry extended detention basin UOPs, plus: <ul style="list-style-type: none"> Inert Media Filtration 	H	L	M	M	M	M	L	H
Vegetated Swale	<ul style="list-style-type: none"> Vegetative Filtration Sorption/Ion Exchange Volume loss (via infiltration, ET) 	M	L	L	M	L	M	M	M
Vegetated Filter Strip	<ul style="list-style-type: none"> Vegetative Filtration Sorption/Ion Exchange Volume loss (via infiltration, ET) 	M	L	L	M	L	M	M	L
Wet detention basins and constructed stormwater wetlands	<ul style="list-style-type: none"> Particulate Settling Size Exclusion Floatable Capture Sorption/Ion Exchange Microbially Mediated Transformations Microbial Competition/Predation Biological Uptake Solar Irradiation Volume loss (via infiltration, ET) 	H	M	M	M	M	H	M	H
Proprietary Biotreatment and Treatment Control	<ul style="list-style-type: none"> Varies by product. 	Expected performance should be based on evaluation of unit processes provided by BMP and available testing data. Testing data should be evaluated based primarily on the effluent quality achieved by the BMP and the ability of the BMP to provide statistically significant removal under average conditions. Percent removal alone should not be used to evaluate the performance of proprietary BMPs (See Wright Water Engineers and Geosyntec Consultants, 2007). The basis for determining the rating of proposed proprietary BMPs must be documented in the Project WQMP. Approval is based on the discretion of the reviewing agency. Product-specific rankings may be published in the Technical Guidance Document at a later date.							

Sources

Strecker, E.W., W.C. Huber, J.P. Heaney, D. Bodine, J.J. Sansalone, M.M. Quigley, D. Pankani, M. Leisenring, and P. Thayumanavan, "Critical assessment of Stormwater Treatment and Control Selection Issues." Water Environment Research Federation, Report No. 02-SW-1. ISBN 1-84339-741-2. 290pp

International Stormwater Best Management Practices (BMP) Database Pollutant Category Summary: Bacteria.

<http://www.bmpdatabase.org/Docs/BMP%20Database%20Bacteria%20Paper%20Dec%202010.pdf>

International Stormwater Best Management Practices (BMP) Database Pollutant Category Summary: Nutrients.

<http://www.bmpdatabase.org/Docs/BMP%20Database%20Nutrients%20Paper%20December%202010%20Final.pdf>

International Stormwater Best Management Practices (BMP) Database Pollutant Category Summary: Sediment (Pre-publication).

Overview of Performance by BMP Category and Common Pollutant Type, International Stormwater Best Management Practices (BMP) Database [1998-2008]

<http://www.bmpdatabase.org/Docs/Performance%20Summary%20Cut%20Sheet%20June%202008.pdf>

Oil and grease, Organics, and Trash and Debris based on review of unit operations and processes; comprehensive dataset not generally available. BMP must include design elements to address pollutants of concern.

Wright Water Engineers and Geosyntec Consultants, 2007. *Frequently Asked Questions Fact Sheet for the International Stormwater BMP Database: Why does the International Stormwater BMP Database Project omit percent removal as a measure of BMP performance?* (as posted on www.bmpdatabase.org)



POLLUTANTS OF CONCERN AND PERFORMANCE RATINGS		
Pollutant of Concern ⁽¹⁾	Treatment Effectiveness	
	Bioretention System ⁽²⁾	Filtterra® Proprietary Bioretention Units ⁽³⁾
Oil & Grease	High	High
Trash & Debris	High	N/A
Primary Pollutant of Concern		
Metals	High	High
Bacteria	Medium	High ⁽⁴⁾
Suspended Solids/Sediments	High	High
Pathogens/Bacteria	Medium	High ⁽⁴⁾
Nutrients	Low	High
Pesticides	N/A	N/A
1 See Section II.2 of this WQMP. 2 Per Table 4.2 of the Model WQMP Technical Guidance Document dated May 19, 2011. 3 Designated as "high" if tested effluent concentrations were reduced based on significance level $p < 0.05$. Source: Herrera Environmental Consultants and Geosyntec Consultants. (2010, September 20). Filtterra® Bioretention Systems: Technical Basis for High Flow Rate Treatment and Evaluation of Stormwater Quality Performance. 4 When used with Bacterra® blend media. Coffman, L.S., and Ruby. M. (n.d.) Bacterra™ by Filtterra® Advanced Bioretention System Discussion of the Benefits, Mechanisms and Efficiencies for Bacteria Removal.		

Filtterra® units by Americast are structural media filtration device that also utilize bioretention processes for storm water treatment (functional equivalents are also acceptable). Filtterra units feature a specially designed media filter mixture within a below-grade concrete box. One tree or large shrub is planted within the media to provide additional pollutant removal, and function similar to bioretention cells. The filter media is designed to capture and filter pollutants during the first-flush storm event, while biological processes degrade, metabolize, detoxify, and volatilize the pollutants during and between storms. Runoff enters the units through curb flow or area drains may be piped into the top of the unit. The adjacent catch basin serves as the high flow bypass, and also accepts treated flows from the unit.

The Filtterra bioretention BMP blend is currently designed to remove typical stormwater pollutants such as TSS, phosphorus, nitrogen and heavy metals. Through extensive studies Bacterra media blend has been optimized to capture and destroy bacteria such as fecal coliform, E.coli and enterococcus. Once the Bacterra media blend has matured it develops a complex natural microbiological ecosystem that enhances predation, and other physical, chemical and biological processes that all contribute to the removal process, achieving removal efficiencies ranging from 77% to 99%.

For the northeastern-most drainage area, rain gardens are proposed to be utilized in combination with Filtterra units, functioning similar to HSCs. Rain gardens are a form of bioretention cells with underdrains, and are plant-based biotreatment systems that typically consist of a ponding area, mulch layer, planting soils and plants. As storm water passes down through the planting soil, pollutants are filtered, adsorbed, biodegraded and sequestered by the soil and plants. Perforated underdrains may be provided for soils with low infiltration rates to discharge treated water back into the storm drain system.

In accordance with the Model WQMP, the bioretention/biofiltration BMPs will be sized to capture and treat the volume of runoff produced from a 24-hour, 85th percentile storm event (termed Design Capture Volume [DCV]). The DCV is determined by the following equation:

$$DCV = C \times d \times A \times 43,560 \frac{sf}{ac} \times \frac{1}{12} ft/in$$

Where:

- DCV* = runoff volume during the design storm event (cubic feet)
- C* = runoff coefficient, where $C = (0.75 \times imp + 0.15)$
- imp* = impervious fraction of drainage area
- d* = design capture storm depth per Figure XVI-1 of the Model WQMP
- A* = tributary area (acres)

To calculate a flow rate (*Q*) associated with a water quality design storm intensity:

$$Q = C \times i_{design} \times A$$

Where:

- Q* = design flow rate (cfs)
- C* = runoff coefficient, where $C = (0.75 \times imp + 0.15)$
- imp* = impervious fraction of drainage area
- i_{design}* = design intensity based on time of concentration (*T_c*) per Model WQMP Figure III.4
- A* = tributary area (acres)

Preliminary sizes for the Filterra units are summarized below. Final designs will be detailed in the Final WQMP. Maintenance requirements and frequencies for the LID BMPs are discussed in Section V (BMP Inspection & Maintenance) of this report.

FILTERRA UNIT BMP DESIGN SUMMARY ⁽¹⁾								
Drainage Area Name	Drainage Area (acres)	% Impervious	Design Storm Depth (in)	Average 2-year Tc (min)	Rainfall Intensity (in/hr)	DCV (ft ³)	Q (cfs)	Filterra Unit Sizes
A3 (Filterra #2)	1.12	80%	0.95	9.21	0.23	2,902.5	0.19	2 units 6'x8'
A4 (Filterra #3)	1.65	85%	0.95	9.7	0.225	4,489.4	0.29	2 units 6'x12'
A6 (Filterra #4)	1.29	90%	0.95	10	0.225	3,676.7	0.24	2 units 6'x10'
A5 North (Filterra #5)	1.25	85%	0.95	10	0.225	3,401.1	0.22	2 units 6'x8'
A5 South (Filterra #6)	1.30	85%	0.95	9	0.23	3,537.1	0.24	2 units 6'x10'
Notes:								
1. Detailed calculations and worksheets are provided in Appendix A.								
2. Per Figure XVI-1 of the Model WQMP Technical Guidance Document (2011, May 19). See also Appendix A.								
3. Per Figure III.4 of the Model WQMP Technical Guidance Document (2011, May 19). See also Appendix A.								

For the northeastern-most drainage area (Areas A1 & A2), the Capture Efficiency, Constant Drawdown BMP sizing methodology was utilized in accordance with the Model WQMP TGD Appendix III to achieve the target capture efficiency of 80%.

RAIN GARDEN BMP SIZING SUMMARY ⁽¹⁾ (80% CAPTURE METHOD)										
Drainage Area Name	Drainage Area (ac)	% Impervious	Design Storm Depth ⁽²⁾ (in)	Average 2-year Tc (min)	Intensity ⁽³⁾ (in/hr)	DCV (ft ³)	Q _{Treat} (cfs)	BMP Type/Size	Capture Efficiency	Combined Capture Efficiency
A1+A2	1.59	90%	0.95	9.11	0.23	4,531.8	0.3	Rain Garden 370 ft ³	40%	80%
					0.17	4,531.8	0.22	Filterra 2 units 6'x8'	--	
Notes:										
1. Detailed calculations and worksheets are provided in Appendix A.										
2. Per Figure XVI-1 of the Model WQMP Technical Guidance Document (2011, May 19). See also Appendix A.										
3. Per Figure III.4 of the Model WQMP Technical Guidance Document (2011, May 19). See also Appendix A.										

IV.3.5 Hydromodification Control BMPs

As identified in Section II.3, the 2-year volume does not increase by more than 5% as compared to existing conditions, the time of concentration does not reduce (get shorter) and the 2-year peak discharge rate falls under the allowable discharge rate (110% of pre-development rate). The Project therefore complies with the hydromodification requirements and allowable discharge provision. No additional hydromodification control BMPs are required.

IV.3.6 Regional/Sub-Regional LID BMPs

Not applicable. LID BMPs (Biotreatment) will be utilized for water quality treatment on-site in accordance with the MS4 Permit hierarchy identified at the beginning of this Section.

IV.3.7 Treatment Control BMPs

Treatment control BMPs can only be considered if the project conformance analysis indicates that it is not feasible to retain the full design capture volume with LID BMPs.

TREATMENT CONTROL BMPs		
ID	Name	Included?
TRT-1	Sand Filters	<input type="checkbox"/>
TRT-2	Cartridge Media Filter	<input type="checkbox"/>
PRE-1	Hydrodynamic Separation Device	<input type="checkbox"/>

TREATMENT CONTROL BMPs		
ID	Name	Included?
PRE-2	Catch Basin Insert	<input type="checkbox"/>
	Other:	<input type="checkbox"/>

Not applicable. LID BMPs (Biotreatment) will be utilized for water quality treatment on-site in accordance with the MS4 Permit hierarchy identified at the beginning of this Section.

IV.3.8 Non-Structural Source Control BMPs

The table below indicates all BMPs to be incorporated in the project. For those designated as not applicable (N/A), a brief explanation why is provided.

NON-STRUCTURAL SOURCE CONTROL BMPs				
ID	Name	Included?	Not Applicable?	If Not Applicable, Provide Brief Reason
N1	Education for Property Owners, Tenants and Occupants	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
N2	Activity Restrictions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
N3	Common Area Landscape Management	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
N4	BMP Maintenance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
N5	Title 22 CCR Compliance (How development will comply)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable – no hazardous waste on-site.
N6	Local Industrial Permit Compliance	<input type="checkbox"/>	<input checked="" type="checkbox"/>	The City of Lake Forest does not issue water quality permits.
N7	Spill Contingency Plan	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable – no hazardous waste on-site.
N8	Underground Storage Tank Compliance	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No underground storage tanks are proposed.
N9	Hazardous Materials Disclosure Compliance	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable – no hazardous waste on-site.
N10	Uniform Fire Code Implementation	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable – no hazardous waste on-site.
N11	Common Area Litter Control	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
N12	Employee Training	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
N13	Housekeeping of Loading Docks	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No loading docks are proposed.

NON-STRUCTURAL SOURCE CONTROL BMPs				
ID	Name	Included?	Not Applicable?	If Not Applicable, Provide Brief Reason
N14	Common Area Catch Basin Inspection	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
N15	Street Sweeping Private Streets and Parking Lots	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
N16	Retail Gasoline Outlets	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No retail gasoline outlets are proposed.

N1, Education for Property Owners, Tenants and Occupants

The HOA will ensure that all homeowners will be given a copy of the recorded CC&Rs which will contain details on educational materials and restrictions to reduce pollutants from reaching the storm drain system. The owner shall establish requirements that these educational materials are distributed by the HOA to all members of the HOA, and periodically thereafter by the HOA after the first sale of the units. Examples of the environmental awareness materials are listed in Section VII. In addition, pet waste stations with waste removal bags and instructions will be provided throughout the common areas to encourage pet owners to remove pet waste from common areas.

N2, Activity Restrictions

The Owner shall develop activity restrictions (via CC&Rs or equivalent) that include language to restrict activities that have the potential to create adverse impacts on water quality. Activities include but are not limited to: the handling and disposal of contaminants, trash management and litter control, irrigation and landscaping practices, fertilizer applications and household waste management practices, prohibition of vehicle washing on-site, prohibiting washing or hosing of walkways and driveways, etc.

N3, Common Area Landscape Management

Management programs will be designed and implemented by the HOA, which will maintain all the common areas within the project site (via landscape contractor). These programs will cover how to reduce the potential pollutant sources of fertilizer and pesticide uses, utilization of water-efficient landscaping practices and proper disposal of landscape wastes in accordance with local guidelines, ordinances, consistent with Management Guidelines for Use of Fertilizers (DAMP Section 5.5) and City ordinances.

N4, BMP Maintenance

The HOA will be responsible for the implementation and maintenance of each applicable non-structural BMP, as well as scheduling inspections and maintenance of all applicable structural BMP facilities through its landscape contractor and any other necessary maintenance contractors. Further details on maintenance for source control and treatment control BMPs are included in Section V.

N11, Common Area Litter Control

The HOA will be responsible for performing trash pickup and sweeping of littered common areas on a weekly basis or whenever necessary. Responsibilities will also include noting improper disposal materials by homeowners and reporting such violations to the HOA for investigation.

N12, Employee Training

All employees of the HOA and any contractors of the HOA will require training to ensure that employees are aware of maintenance activities that may result in pollutants reaching the storm drain. Materials that may be utilized during training are listed in Section VII.

N14, Common Area Catch Basin Inspection

All private catch basins will be maintained and cleaned by the HOA. All public catch basins will be maintained and cleaned by the City of Lake Forest. These activities will be done prior to the rainy season, no later than October 1st of each year.

N15, Street Sweeping Private Streets and Parking Lots

All private streets and parking areas shall be swept by the HOA prior to the rainy season, no later than October 1st each year.

IV.3.9 Structural Source Control BMPs

The table below indicates all BMPs to be incorporated in the project. For those designated as not applicable (N/A), a brief explanation why is provided.

STRUCTURAL SOURCE CONTROL BMPs				
ID	Name	Included?	Not Applicable?	If Not Applicable, Provide Brief Reason
S1 SD-13	Provide storm drain system stenciling and signage	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
S2 SD-34	Design and construct outdoor material storage areas to reduce pollution introduction	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable – no hazardous waste on-site.
S3 SD-32	Design and construct trash and waste storage areas to reduce pollution introduction	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No trash storage areas are proposed on-site.
S4 SD-12	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
S5	Protect slopes and channels and provide energy dissipation	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
S6 SD-31	Properly Design: Dock areas	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No loading docks are proposed.
S7 SD-31	Properly Design: Maintenance bays	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No maintenance bays are proposed.

STRUCTURAL SOURCE CONTROL BMPs				
ID	Name	Included?	Not Applicable?	If Not Applicable, Provide Brief Reason
S8 SD-33	Properly Design: Vehicle wash areas	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No vehicle wash areas are proposed.
S9 SD-36	Properly Design: Outdoor processing areas	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No outdoor processing areas are proposed.
S10	Properly Design: Equipment wash areas	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No equipment wash areas are proposed.
S11 SD-30	Properly Design: Fueling areas	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No fueling areas are proposed.
S12 SD-10	Properly Design: Hillside landscaping	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. Project site is not located on a hillside.
S13	Properly Design: Wash water control for food preparation areas	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No food preparation areas are proposed.
S14	Properly Design: Community car wash racks	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No community car wash racks are proposed.

S1/SD-13, Provide storm drain system stenciling and signage

The developer will be responsible for the stenciling of all catch basins to include a legible message such as “No Dumping - Drains to Ocean” or an equally effective phrase. The HOA will be responsible for maintaining and replacement of signage when necessary.

S4/SD-12, Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control

The developer will be responsible for the installation and maintenance of all common landscape areas utilizing similar planting materials with similar water requirements to reduce excess irrigation runoff. The developer will be responsible for implementing all efficient irrigation systems for common area landscaping including but not limited to provisions for water sensors and programmable irrigation cycles. The irrigation systems shall be in conformance with water use efficiency guidelines.

S5, Protect slopes and channels and provide energy dissipation

All slopes shall be vegetated and stabilized to prevent erosion, in accordance with “Efficient Irrigation and Landscape Design” source control BMP to prevent erosion.

IV.4 ALTERNATIVE COMPLIANCE PLAN

IV.4.1 Water Quality Credits

Local jurisdictions may develop a water quality credit program that applies to certain types of development projects after they first evaluate the feasibility of meeting LID requirements on-site. If it is not feasible to meet the requirements for on-site LID, project proponents for specific project types can apply credits that would reduce project obligations for selecting and sizing other treatment BMPs or participating in other alternative programs.



WATER QUALITY CREDITS	
Credit	Applicable?
Redevelopment projects that reduce the overall impervious footprint of the project site.	<input type="checkbox"/>
Brownfield redevelopment, meaning redevelopment, expansion, or reuse of real property which may be complicated by the presence or potential presence of hazardous substances, pollutants or contaminants, and which have the potential to contribute to adverse ground or surface water quality if not redeveloped.	<input type="checkbox"/>
Higher density development projects which include two distinct categories (credits can only be taken for one category): those with more than seven units per acre of development (lower credit allowance); vertical density developments, for example, those with a Floor to Area Ratio (FAR) of 2 or those having more than 18 units per acre (greater credit allowance)	<input type="checkbox"/>
Mixed use development, such as a combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that can demonstrate environmental benefits that would not be realized through single use projects (e.g. reduced vehicle trip traffic with the potential to reduce sources of water or air pollution).	<input type="checkbox"/>
Transit-oriented developments, such as a mixed use residential or commercial area designed to maximize access to public transportation; similar to above criterion, but where the development center is within one half mile of a mass transit center (e.g. bus, rail, light rail or commuter train station). Such projects would not be able to take credit for both categories, but may have greater credit assigned	<input type="checkbox"/>
Redevelopment projects in an established historic district, historic preservation area, or similar significant city area including core City Center areas (to be defined through mapping).	<input type="checkbox"/>
Developments with dedication of undeveloped portions to parks, preservation areas and other pervious uses.	<input type="checkbox"/>
Developments in a city center area.	<input type="checkbox"/>
Developments in historic districts or historic preservation areas.	<input type="checkbox"/>
Live-work developments, a variety of developments designed to support residential and vocational needs together – similar to criteria to mixed use development; would not be able to take credit for both categories.	<input type="checkbox"/>
In-fill projects, the conversion of empty lots and other underused spaces into more beneficially used spaces, such as residential or commercial areas.	<input type="checkbox"/>

At this time, however, no water quality credits have been applied to the project's DCV. Should any applicable credits be applied in the future, they shall be documented in the Final WQMP.

IV.4.2 Alternative Compliance Plan Information

Not applicable. LID BMPs (Biotreatment) will be utilized for water quality treatment on-site in accordance with the MS4 Permit hierarchy identified at the beginning of this Section.



SECTION V INSPECTION/MAINTENANCE RESPONSIBILITY FOR BMPs

It has been determined that Brookfield Residential (via HOA) shall assume all BMP inspection and maintenance responsibilities for the Town Centre project.

Contact Name:	Pending – to be provided in the Final WQMP.
Title:	
Company:	
Address:	
Phone:	
Fax:	
Email:	

Should the maintenance responsibility be transferred at any time during the operational life of Town Centre, such as when an HOA or POA is formed for a project, a formal notice of transfer shall be submitted to the City of Lake Forest at the time responsibility of the property subject to this WQMP is transferred. The transfer of responsibility shall be incorporated into this WQMP as an amendment.

The Owner/HOA shall verify BMP implementation and ongoing maintenance through inspection, self-certification, survey, or other equally effective measure. The certification shall verify that, at a minimum, the inspection and maintenance of all structural BMPs including inspection and performance of any required maintenance in the late summer / early fall, prior to the start of the rainy season. A form that may be used to record implementation, maintenance, and inspection of BMPs is included in Appendix D.

The City of Lake Forest may conduct verifications to assure that implementation and appropriate maintenance of structural and non-structural BMPs prescribed within this WQMP is taking place at the project site. The HOA shall retain operations, inspections and maintenance records of these BMPs and they will be made available to the City or County upon request. All records must be maintained for at least five (5) years after the recorded inspection date for the lifetime of the project.

The Owner/HOA shall ensure long-term funding for BMP maintenance is provided. Should a HOA be formed, Brookfield Residential, which will set up the HOA, shall oversee that adequate funding for BMP maintenance is included within the HOA fee structure including annual maintenance fees and long-term maintenance reserve funds.

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX				
	BMP	Inspection/Maintenance Activities	Minimum Frequency	Responsible Party
BIOTREATMENT BMPs				
BIO-1	Biotreatment: Rain Gardens	Inspections should occur semi-annually or after major storm events to check for the following and remove accordingly: standing water, sediment, and trash & debris. Inspections should also look for potential clogging and clean planters or, if necessary, replace the entire filter bed. Inspect for weeds, and prune and/or replace plants in accordance with routine landscape maintenance activities. Replace mulch and prune shrubs as necessary.	2x per year	Brookfield Residential / HOA
BIO-7	Proprietary Biotreatment: Filterra® or equivalent	Annual maintenance consists of a minimum of two scheduled visits, one after the rainy season to clean up after the wet season, and one before the wet season to inspect and clean the unit. Each maintenance visit consists of the following: Inspection; removal of trash, debris, sediment; Filter media and plant health evaluation and replacement if necessary; replacement of mulch.	2x per year	Brookfield Residential / HOA
NON-STRUCTURAL SOURCE CONTROL BMPs				



BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX				
	BMP	Inspection/Maintenance Activities	Minimum Frequency	Responsible Party
N1	Education for Property Owners, Tenants and Occupants	Educational materials will be provided to residents/tenants, annually. Examples include tips for pet care, proper waste oil disposal, and other household tips. Tenants will be provided storm water pollution prevention materials by the Property Management prior to occupancy and annually thereafter.	Annually	Brookfield Residential / HOA
N2	Activity Restrictions	The Owner will prescribe activity restrictions to protect surface water quality, through lease terms or other equally effective measure, for the property.	Ongoing	Brookfield Residential / HOA
N3	Common Area Landscape Management	Maintenance shall be consistent with City requirements, plus fertilizer and/or pesticide usage shall be consistent with County Management Guidelines for Use of Fertilizers (OC DAMP Section 5.5). Maintenance includes mowing, weeding, and debris removal on a weekly basis. Trimming, replanting and replacement of mulch shall be performed on an as-needed basis. Trimmings, clippings, and other waste shall be properly disposed of off-site in accordance with local regulations. Materials temporarily stockpiled during maintenance activities shall be placed away from water courses and storm drain inlets.	Monthly	Brookfield Residential / HOA

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX			
BMP	Inspection/Maintenance Activities	Minimum Frequency	Responsible Party
N4 BMP Maintenance	Maintenance of BMPs implemented at the project site shall be performed at the frequency prescribed in this WQMP. Records of inspections and BMP maintenance shall be maintained by the Owner and shall be available for review upon request.	Ongoing	Brookfield Residential / HOA
N5 Title 22 CCR Compliance (How development will comply)	Not Applicable		
N6 Local Industrial Permit Compliance	Not Applicable		
N7 Spill Contingency Plan	Not Applicable		
N8 Underground Storage Tank Compliance	Not Applicable		
N9 Hazardous Materials Disclosure Compliance	Not Applicable		
N10 Uniform Fire Code Implementation	Not Applicable		
N11 Common Area Litter Control	Litter patrol, violations investigation, reporting and other litter control activities shall be performed weekly and in conjunction with maintenance activities. The Owner shall educate all new employees/managers on storm water pollution prevention, particularly good housekeeping practices, prior to the start of the rainy season (October 1). Refresher courses shall be conducted on an as needed basis. Materials that may be utilized on BMP maintenance are attached to this WQMP.	Weekly	Brookfield Residential / HOA
N12 Employee Training		Annually	Brookfield Residential / HOA

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX				
BMP	Inspection/Maintenance Activities	Minimum Frequency	Responsible Party	
N13	Housekeeping of Loading Docks	Not Applicable		
N14	Common Area Catch Basin Inspection	On-site catch basin inlets and other drainage facilities shall be inspected after each storm event and once per year. Inlets and other facilities shall be cleaned prior to the storm season by October 1 st each year.	Annually	Brookfield Residential / HOA
N15	Street Sweeping Private Streets and Parking Lots	Private streets and parking areas within the project shall be swept at a minimum frequency quarterly as well as once per year prior to the storm season, no later than October 1 st each year.	Quarterly	Brookfield Residential / HOA
N16	Retail Gasoline Outlets	Not Applicable		
STRUCTURAL SOURCE CONTROL BMPs				
S1 SD-13	Provide storm drain system stenciling and signage	Storm drain stencils shall be inspected for legibility, at minimum, once prior to the storm season, no later than October 1 st each year. Those determined to be illegible will be re-stenciled as soon as possible.	Annually	Brookfield Residential / HOA
S2 SD-34	Design and construct outdoor material storage areas to reduce pollution introduction	Not Applicable		
S3 SD-32	Design and construct trash and waste storage areas to reduce pollution introduction	Not Applicable		



BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX				
BMP	Inspection/Maintenance Activities	Minimum Frequency	Responsible Party	
S4 SD-12	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	In conjunction with routine maintenance activities, verify that landscape design continues to function properly by adjusting properly to eliminate overspray to hardscape areas, and to verify that irrigation timing and cycle lengths are adjusted in accordance with water demands, given time of year, weather, and day or nighttime temperatures based on system specifications and local climate patterns. System testing shall occur twice per year. Water from testing/flushing shall be collected and properly disposed to sewer system and shall not discharge to storm drain system.	Monthly	Brookfield Residential / HOA
S5	Protect slopes and channels and provide energy dissipation	To be performed in conjunction with maintenance activities. Maintain vegetative cover and/or mulch to eliminate exposed soils. Any eroded surfaces to be repaired immediately. Inspections to be performed twice each year (spring and fall) and after major storm events to check for signs of erosion, gullies, and sloughing.	Monthly	Brookfield Residential / HOA
S6 SD-31	Properly Design: Dock areas	Not Applicable		
S7 SD-31	Properly Design: Maintenance bays	Not Applicable		
S8 SD-33	Properly Design: Vehicle wash areas	Not Applicable		

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX				
	BMP	Inspection/Maintenance Activities	Minimum Frequency	Responsible Party
S9 SD-36	Properly Design: Outdoor processing areas	Not Applicable		
S10	Properly Design: Equipment wash areas	Not Applicable		
S11 SD-30	Properly Design: Fueling areas	Not Applicable		
S12 SD-10	Properly Design: Hillside landscaping	Not Applicable		
S13	Properly Design: Wash water control for food preparation areas	Not Applicable		
S14	Properly Design: Community car wash racks	Not Applicable		

Any waste generated from maintenance activities will be disposed of properly. Wash water and other waste from maintenance activities is not to be discharged or disposed of into the storm drain system. Clippings from landscape maintenance (i.e. prunings) will be collected and disposed of properly off-site, and will not be washed into the streets, local area drains/conveyances, or catch basin inlets.

SECTION VI SITE PLAN AND DRAINAGE PLAN

The exhibits provided in this section are to illustrate the post construction BMPs prescribed within this WQMP. Drainage flow information of the proposed project, such as general surface flow lines, concrete or other surface drainage conveyances, and storm drain facilities are also depicted. All structural source control and treatment control BMPs are shown as well.

EXHIBITS

- Vicinity Map
- Site Plan / Preliminary WQMP Exhibit

BMP DETAILS

- Bioretention with Underdrains
- Filterra[®] Bioretention Units

VICINITY MAP

