# APPENDIX H

## Standard Urban Stormwater Mitigation Plan

FUSCOE ENGINEERING

STANDARD URBAN STORMWATER MITIGATION PLAN

# BRASADA

San Dimas, California

Prepared For
*NJD, LTD.*
*26152 Oroville Place*
*Laguna Hills, CA 92653*

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**Date Prepared: June 15, 2009**
**Date Revised: August 25, 2009**
**2nd Revision: June 24, 2010**

**Job Number: 349.04.01**

*full circle thinking®*

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# OWNER CERTIFICATION

## STANDARD URBAN STORMWATER MITIGATION PLAN

This Standard Urban Stormwater Mitigation Plan has been prepared for NJD Limited by FUSCOE ENGINEERING, INC. It is intended to comply with the requirements of the County of Los Angeles National Pollution Discharge Elimination Permit (Order No. 01-182, NPDES Permit No. CAS004001) issued by the Los Angeles Regional Water Quality Control Board. The undersigned is authorized to approve implementation of the provisions of this plan as appropriate and will strive to have the plan carried out by successors consistent with the County of Los Angeles SUSMP for Stormwater Management and the intent of the NPDES storm water program requirements.

| | |
|---|---|
| Signature | Date |
| Richard K. Jemison, Sr.<br>Name | General Partner<br>Title |

NJD Limited
26152 Oroville Place
Laguna Hills, CA 92653

# I. INTRODUCTION

Prior to issuance of any grading permits, the applicant shall submit a Stormwater Pollution Prevention Plan (SWPPP) program acceptable to the City Engineer to comply with the latest National Pollutant Discharge Elimination System (NPDES) Stormwater Regulations. The project shall incorporate both construction and operational Best Management Practices to minimize construction and urban pollutants in stormwater runoff. If required, the applicant shall obtain a State Water Resources Board General Construction Activities Storm Water Permit. The Engineering Department shall monitor compliance.

This SUSMP covers the post-construction operations on Brasada, in the City of San Dimas, California (see Figure 1, Vicinity Map). It has been developed as required under State Water Resources Control Board (SWRCB) Municipal NPDES Storm Water Permit for the County of Los Angeles and the Incorporated Cities of Los Angeles County, and in accordance with good engineering practices.

This SUSMP shall identify, at a minimum, the routine resources specified in the Countywide Development Planning for Stormwater Management, which details implementation of BMP's whenever they are applicable to a project; the assignment of long-term maintenance responsibilities; and show the Design Plan that will be implemented in order to mitigate post-construction stormwater runoff pollution.

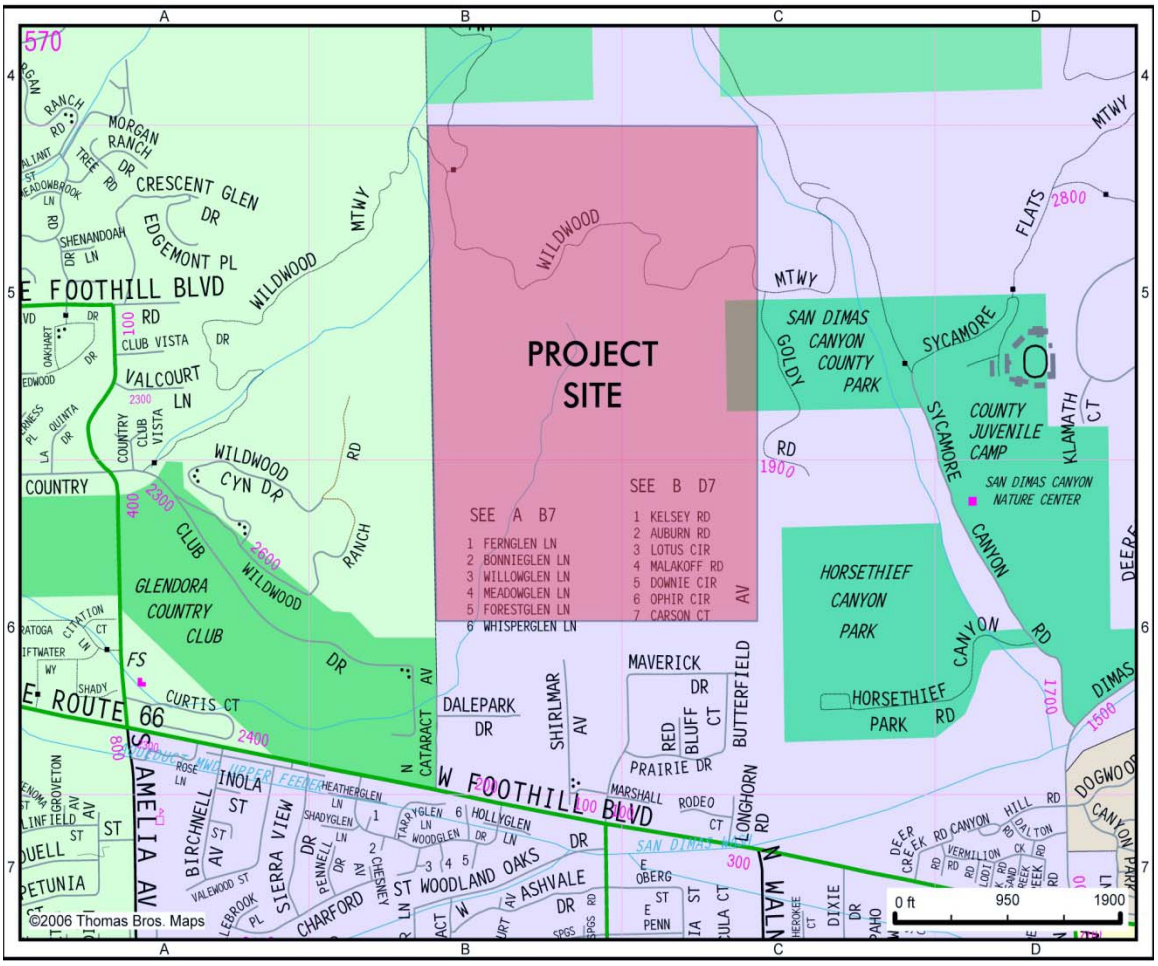



**Figure 1** Vicinity Map

# II. EXISTING SITE DESCRIPTION

The proposed Brasada project site is a 318.48-acre parcel located in the City of San Dimas, CA. The project site is bounded by open space within the City of Glendora on the west, the Angeles National Forest to the north, open space within the City of San Dimas to the east and residential lots north of Maverick Drive and Dalepark Drive to the south.

The project site is located within the San Gabriel River watershed. The San Gabriel River watershed is located in the eastern portion of Los Angeles County. It is bound by the San Gabriel Mountains to the north, most of San Bernardino/Orange County to the east, the division of the Los Angeles River from the San Gabriel River to the west, and the Pacific Ocean to the south. The watershed is composed of approximately 640 square miles of land spanning over 37 cities with 26% of its total area developed.

The watershed drains into the San Gabriel River from the San Gabriel Mountains flowing 58 miles south until its confluence with the Pacific Ocean. Major tributaries to the San Gabriel River include Walnut Creek, San Jose Creek, Coyote Creek, and numerous storm drains entering from the 19 cities that the San Gabriel River passes through. Channel flows pass through different sections in the San Gabriel River, diverting from the riverbed into four different spreading grounds, held behind several rubber dams for controlled flow and ground water recharge, and controlled through 10 miles of concrete channel bottom from below Whittier Narrows Dam to past Coyote Creek.

Under existing conditions, the project site is undeveloped open space for the most part. There are equestrian uses on site. Adjacent land uses include open space to the east and west, the Angeles National Forest to the north and single family residential to the south.

Current land use is as single family very low estate with a density of 0 to 0.2 per acre. Zoning is SP-25 or specific plan.

Soil type is type 080 per County of Los Angeles soil type maps.

Prior to construction, 1% of the site is impervious, being mostly undeveloped. There are no on-site drainage facilities. The northern portion of the site drains to the west into the City of Glendora. The southeasterly portion of the site drains southerly into a drainage easement for the City of San Dimas where it flows southerly until it is picked up in catch basins on San Dimas Avenue near its intersection with Prairie Drive. The remainder of the site flows southwesterly down Shuler Canyon until it flows into the end of Cataract Street and is picked up by two catch basins and transported onto the Glendora Golf Course in the City of Glendora.

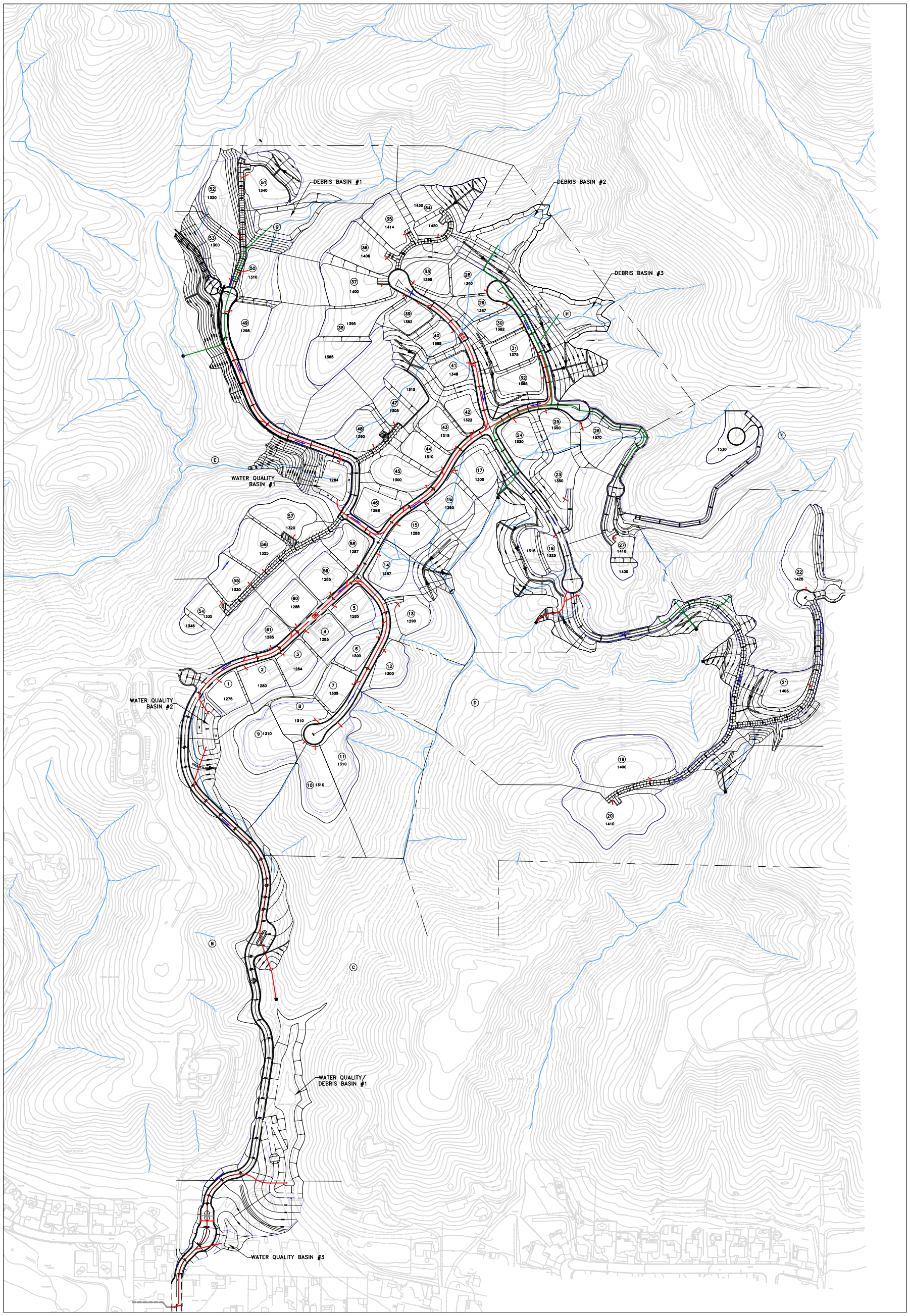
# III. PROJECT DESCRIPTION

The proposed project includes the development of 61 low-density residential lots ranging in size from 0.44 ac to 17.8 acre lots, with an average lot size of 2 acres. Additional utilities, drainage improvements, and landscaping is also proposed. Debris basins will be located around the development areas to capture off-site runoff and divert it through the project site, and on-site water quality basins are proposed to provide treatment of runoff from the development areas. In addition, one large debris basin is proposed at the downstream end to provide detention of storm flows and additional water quality treatment.

Overall, the existing drainage patterns will be maintained. Off-site runoff will be routed through the site via separate storm drain lines, and discharged at multiple locations to maintain the existing flowpaths of the canyons. Energy dissipaters are proposed to reduce potential for erosion and scour within the existing flowpaths. On-site runoff will be collected by a separate storm drain system and routed to water quality basins for treatment of low-flow and first-flush runoff. Two water quality basins are proposed, located in the southern portions of the site. Refer to the Proposed Hydrology Map included in Appendix 3 for locations of the major drainage facilities.

The topography of the site precludes the use of swales, being much too steep for any effective treatment. Infiltration basins would not be feasible due to the topography and the proximity of fill slopes. Further details on the selection of treatment control BMPs is provided in Section IV.

The proposed project will disturb approximately 80 acres of the 318 acre site. The 80 acres will become 21% (LA County Hydrology – single family homes estate) impervious instead of the 1% impervious of the undeveloped site.




LEGEND

- PROPOSED OFF-SITE STORM DRAIN
- PROPOSED ON-SITE STORM DRAIN
- EXISTING STREAM / NATURAL FLOWPATH
- BMP DRAINAGE AREA
- DIRECTION OF FLOW (ON-SITE)

400' 0' 200' 400'

SCALE: 1" = 400'

N

Scale: 1" = 400'

Exhibit Date: 6-17-09

# SITE PLAN

## BRASADA
## SAN DIMAS, CA

# IV. SUSMP PROJECT CATEGORIES

Listed in the table below are the project categories subject to SUSMP requirements. Those categories that apply to the proposed project are indicated by a check mark on the left-hand column.

| CHECK BELOW (IF APPLICABLE) | PROJECT CATEGORIES |
|---|---|
| ✓ | 1. Single Family Hillside Residences* |
| ✓ | 2. Housing Developments (including, but not limited to, single-family homes, multi-family homes, condominiums, and apartments) of ten or more units |
| | 3. Industrial/commercial developments of one acre or more of impervious surface area |
| | 4. Automotive service facilities (SIC 5013, 5014, 5541, 7532-7534, 7536-7539)** |
| | 5. Retail Gasoline Outlets** |
| | 6. Restaurants (SIC 5812)** |
| | 7. Parking Lots with 5,000 square feet or more of surface area, including accessory driveways, or with 25 or more parking spaces, and potentially exposed to stormwater runoff. |
| | 8. Projects located in, directly adjacent to, or discharging directly to a designated ESA |

* Single-family hillside residential developments with less than one acre of impervious surface area are excluded from the numerical Structural and Treatment Control BMP design standard requirements.

** Projects in these categories with less than 5,000 sq. ft. of impervious surface area are excluded from the numerical Structural and Treatment Control BMP design standard requirements.

The proposed project consists of 10 or more single family hillside residential lots. The proposed project, therefore, qualifies as the following project Categories: 1 and 2.

## BMP SELECTION

The BMP matrix provided on the following page lists the project categories in the SUSMP that are applicable to the project site. Based on the pollutants that are anticipated to be generated when the Brasada Project is completed and in use, applicable, required, or suggested treatment and source control BMPs are correspondingly listed for each category. This report is responsible for determining, evaluating, and selecting the appropriate and applicable measures to treat the targeted pollutants to the MEP standard. One or a combination of two or more suggested treatment control BMPs can be selected as deemed applicable.

The proposed project is a hillside housing development (1 & 2). The anticipated pollutants for the project include nutrients, trash, debris, O&G, nutrients, metals and sediment.

BMP MATRIX FOR SUSMP PROJECT CATEGORIES (Excerpted from City of LA WPD's BMP Handbook)

| PROJECT CATEGORY | ANTICIPATED POLLUTANT GENERATED | SUSMP PROVISIONS AND REQUIREMENTS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | SOURCE CONTROL BMPs(a) | | | | | | | | | | | | | TREATMENT CONTROL BMPs (b) (c) | |
| | | Peak Stormwater Runoff Discharge Rates | Conserve Natural Areas | Minimize Stormwater Pollutants of Concern | Protect Slopes & Channels | Provide Storm Drain System Stenciling & Signage | Properly Design Outdoor Material Storage Areas | Properly Design Trash Storage Areas | Provide Proof of Ongoing BMP Maintenance | Properly Design Loading/Unloading Dock Areas | Properly Design Repair/Maintenance Bays | Properly Design Vehicle/Equipment/Accessory Wash Areas | Properly Design Fueling Area | Properly Design Parking Area | Properly Design to Limit Oil Contamination and Perform Maintenance | Design Standards for Treatment Control BMP(a) (b) | Catch Basin Insert, Catch Basin Screens, Infiltration Trench*, Infiltration Basin*, Extended/Dry Retention Basin*, Wet Ponds*, Dry Well*, Cisterns*, Vegetated Swales & Strips*, Constructed Wetlands*, Bioretention Facility*, Continuous Separation Systems, Vortex/Hydrodynamic Systems, Media Filtration, On-Line Filtration Systems, Clarifiers, Oil/Water Separators, Primary Wastewater Treatment, Off-Line Storage, Rain Diversion System, Porous Pavements, End-of-Pipe Systems |
| 7. Home Subdivision (10 or more units) | Nutrients, trash, debris, O&G, nutrients, metals, sediment | R | R | R | R | R | R | R | R | | | | | | | R | S |
| 8. Single-Family Hillside Residences (≥ 1 acre) | Nutrients, trash, debris, O&G, nutrients, metals, sediment | R | R | R | R | R | R | R | R | | | | | | | R | S |

BMPs – Best Management Practices
S – Select one or more applicable and appropriate treatment control BMPs from this list.
SUSMP – Standard Urban Stormwater Mitigation Plan
sf – square feet
(a) Refer to Appendix B of the BMP Handbook for detailed information.
(b) Refer to Appendix G of the BMP Handbook for design standards to be used for treatment control BMPs.

R – Required if applicable
HC – Hydrocarbons
O&G – Oil & Grease
* Case by case basis for use in San Fernando Valley Watershed
(c) Plumbing permits will be required for BMPs such as grease traps, sump pumps, and clarifiers.
(d) Refer to Appendix D of the BMP Handbook for detailed information.

## SOURCE CONTROL BMPS

Source control BMPs are required to be incorporated in all new development and redevelopment projects unless not applicable. 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.

The specific source control BMPs for the Brasada Project include:

| INCORPORATED SOURCE CONTROL BMP: | YES | N/A | DESCRIPTION |
|---|---|---|---|
| Peak Stormwater Runoff Discharge Rates | ☒ | ☐ | Because of downstream constraints, the storm peaks will be attenuated using debris/detention basin at the southwesterly discharge point. This is in addition to smaller water quality and debris basins located throughout the project site to further reduce peak runoff rates. |
| Conserve Natural Areas | ☒ | ☐ | The site will be designed to conserve natural areas. An environmental consultant has been engaged for this purpose. |
| Minimize Stormwater Pollutants of Concern | ☒ | ☐ | Water quality basins have been recommended as the selected BMP for this project (subject to approval of the soils engineer/geologist and verification of appropriate percolation rates.) |
| Protect Slopes & Channels | ☒ | ☐ | All manufactured slopes will be re-vegetated. All areas where flows are re-introduced to channels will be armored with appropriate rip-rap pads. |
| Provide Storm Drain System Stenciling & Signage | ☒ | ☐ | All storm drain inlets will be stenciled or signed per LA County standards. |
| Properly Design Outdoor Material Storage Areas | ☐ | ☒ | None proposed for site project. |
| Properly Design Trash Storage Areas | ☐ | ☒ | There will be no central trash storage areas. Single family homes will be responsible for trash can storage on individual lots. |
| Provide Proof of Ongoing BMP Maintenance | ☒ | ☐ | An HOA will be formed once the project has been completed. Until such time, the owner/developer will be responsible for BMP maintenance. |
| Properly Design Loading/Unloading Dock Areas | ☐ | ☒ | None proposed for site project. |
| Properly Design Repair/Maintenance Bays | ☐ | ☒ | None proposed for site project. |
| Properly Design Vehicle/ Equipment/ Accessory Wash Areas | ☐ | ☒ | None proposed for site project. |

| INCORPORATED SOURCE CONTROL BMP: | YES | N/A | DESCRIPTION |
|---|---|---|---|
| Design Standards for Treatment Control BMPs | ☒ | ☐ | County of LA standards are to be followed for design. Details are provided in Appendix 3. |

## EQUESTRIAN RELATED BMPS

Due to the equestrian activities proposed for the project site, additional source control BMPs will be implemented to minimize the generation of bacteria, sediment, and nutrients in storm water runoff. Potential impacts from equestrian activities will be controlled through facility design, collection and storage of manure, and grooming (i.e. washwater management). The BMPs for equestrian activities are summarized below.

- Use designated trails for horse riding. Restrict horse access within creek, utilizing bridges for crossing.
- All unpaved and paved surfaces shall be swept and cleaned regularly to assure regular manure removal and disposal. Manure shall be removed from trails, corrals, arenas and other exposed areas on a daily basis.
- Manure shall be removed daily, or kept in a covered manure storage area that is located away from drainage courses. Manure storage area will be graded to minimize contact with runoff, stored on an impervious surface, and shall be covered to minimize contact with precipitation. Manure shall not be kept on-site for more than one week.
- Within the stable areas where horses are kept, bedding will be provided to capture as much urine as possible, which will be disposed of in a trash storage area that is covered and elevated to protect urine from rainfall and potential surface runoff.
- Ensure that chemicals and other contaminates handled on-site are not disposed of in any manure, litter, or storm water storage or treatment system unless specifically designed to treat such chemicals and other contaminates

The Project Owner will be responsible for maintaining the BMPs listed above to ensure adequate protection of receiving waters from pollutants associated with equestrian activities. Proof of on-going maintenance is required in accordance with LA County SUSMP requirements, including but not limited to, inspection, documentation, and reporting requirements, where applicable.

## TYPICAL WATER QUALITY SITE DESIGN & MAINTENANCE MEASURES FOR EQUESTRIAN AREAS

Note: Features are typical for a medium-sized concentrated animal feeding operation (CAFO) horse facilities per EPA regulations. Source: "Equestrian Related Best Management Practices." Prepared by the County of Orange, June 2004.

Trails & Access to Water Bodies

- Provide bridges over water bodies, or designate access points to reduce erosion
- Trail should meander along slope to avoid erosion
- Construct berms to direct water away from trail
- Water should sheet flow across trail to buffer zones, not parallel and not accept run-on
- Provide buffer area between trails and water

The following source control BMP fact sheets are provided in Appendix 9 of this report as a reference to the design plans and/or specifications for the Brasada Project:

- SD-10 Site Design & Landscape Planning
- SD-11 Roof Runoff Controls
- SD-12 Efficient Irrigation
- SD-13 Storm Drain Signage

## SITE DESIGN BMPs

The following table 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.

| SITE DESIGN CONCEPT 1: MINIMIZE STORM WATER RUNOFF, MINIMIZE PROJECT'S IMPERVIOUS FOOTPRINT, AND CONSERVE NATURAL AREAS | | | |
|---|---|---|---|
| DESIGN CONSIDERED: SPECIFIC BMP | YES | NO | DESCRIPTION |
| Maximize permeable area. | ☒ | ☐ | Approximately 25% of the site will be disturbed. The other portion will be preserved in its natural state. |
| Conserve natural areas. | ☒ | ☐ | Approximately 25% of the site will be disturbed. The other portion will be preserved in its natural state. |
| 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. | ☐ | ☒ | The project is to produce lots for sale for single family homes. Purchasers will be provided with materials encouraging the use of pervious materials for landscape/ hardscape. |
| Construct streets, sidewalks, and parking lot aisles to the minimum widths necessary, provided that public safety and a pedestrian friendly environment are not compromised[1]. Incorporate landscaped butter areas between sidewalks and streets. | ☒ | ☐ | Proposed streets are to be the minimum width approved by the City of San Dimas. |
| Reduce widths of street where off-street parking is available[2]. | ☒ | ☐ | Proposed streets are to be the minimum width approved by the City of San Dimas. |
| Maximize canopy interception and water conservation by preserving existing native trees and shrubs, and planting additional native or drought-tolerant trees and large shrubs. | ☒ | ☐ | Approximately 75% of the existing site will be left in its natural state. The environmental consultant will advise on any needed mitigation. |
| Minimize the use of impervious surfaces, such as decorative concrete, in the landscape design. | ☐ | ☒ | The project is to produce lots for sale for single family homes. Purchasers will be provided with materials encouraging the use of pervious materials for landscape/ hardscape. |
| Use of natural drainage systems. | ☒ | ☐ | Existing drainage pathways will be preserved for off-site runoff. In addition, water quality basins are proposed to provide treatment of runoff. |

| SITE DESIGN CONCEPT 1: MINIMIZE STORM WATER RUNOFF, MINIMIZE PROJECT'S IMPERVIOUS FOOTPRINT, AND CONSERVE NATURAL AREAS | | | |
|---|---|---|---|
| DESIGN CONSIDERED: SPECIFIC BMP | YES | NO | DESCRIPTION |
| Where soils conditions are suitable, use perforated pipe or gravel filtration pits for low flow infiltration[3]. | ☐ | ☒ | The project is to produce lots for sale for single family homes. Purchasers will be provided with materials encouraging the use of pervious materials for landscape/hardscape. |
| Construct on-site ponding areas, rain gardens, or retention facilities to increase opportunities for infiltration, while being cognizant of the need to prevent the development of vector breeding areas. | ☒ | ☐ | Both debris basins and water quality basins will provide opportunities for infiltration. |
| Other comparable site design options that are equally effective. | ☐ | ☒ | None proposed. |

1. Sidewalk widths must still comply with Americans with Disabilities Act regulations and other life safety requirements.
2. However, street widths must still comply with life safety requirements for fire and emergency vehicle access.
3. However, projects must still comply with hillside grading ordinances that limit or restrict infiltration of runoff. Infiltration areas may be subject to regulation as Class V injection wells and may require a report to the US EPA.

| SITE DESIGN CONCEPT 2: MINIMIZE DIRECTLY CONNECTED IMPERVIOUS AREAS | | | |
|---|---|---|---|
| DESIGN CONSIDERED: SPECIFIC BMP | YES | NO | DESCRIPTION |
| Where landscaping is proposed, drain rooftops into adjacent landscaping prior to discharging to the storm drain. | ☐ | ☒ | The project is to produce lots for sale for single family homes. Purchasers will be provided with materials encouraging the use of pervious materials for landscape/hardscape. |
| Where landscaping is proposed, drain impervious sidewalks, walkways, trails, and patios into adjacent landscaping. | ☐ | ☒ | The project is to produce lots for sale for single family homes. Purchasers will be provided with materials encouraging the use of pervious materials for landscape/hardscape. |
| Increase the use of vegetated drainage swales in lieu of underground piping or imperviously lined swales. | ☐ | ☒ | The project is to produce lots for sale for single family homes. Purchasers will be provided with materials encouraging the use of pervious materials for landscape/hardscape. |
| USE ONE OR MORE OF THE FOLLOWING: | | | |
| Rural Swale System: street sheet flows to vegetated swale or gravel shoulder, curbs at street corners, culverts under driveways and street crossings. | ☐ | ☒ | The site is too steep to utilize a swale system effectively. |
| Urban curb/swale system: street slopes to curb; periodic swale inlets drain to vegetated swale/ biofilter. | ☐ | ☒ | The site is too steep to utilize a swale system effectively. |

| SITE DESIGN CONCEPT 2: MINIMIZE DIRECTLY CONNECTED IMPERVIOUS AREAS | | | |
|---|---|---|---|
| DESIGN CONSIDERED: SPECIFIC BMP | YES | NO | DESCRIPTION |
| Dual drainage system: first flush captured in street catch basins and discharged to adjacent vegetated swale or gravel shoulder, high flows connect directly to municipal storm drain systems. | ☐ | ☒ | The site is too steep to utilize a swale system effectively. |
| Other comparable design concepts that are equally effective. | ☒ | ☐ | Water quality basins are proposed to provide treatment of storm water runoff. |
| USE ONE OR MORE OF THE FOLLOWING FOR THE DESIGN OF DRIVEWAYS AND PRIVATE RESIDENTIAL PARKING AREAS: | | | |
| Design driveways with shared access, flared (single lane at street) or wheel strips (paving only under tires); or, drain into landscaping prior to discharging to the municipal storm drain system. | ☒ | ☐ | Where possible, shared driveways are proposed. Due to the topography, that is not always possible. |
| Uncovered temporary or guest parking on private residential lots may be paved with a permeable surface; or, designed to drain into landscaping prior to discharging to the municipal storm drain system. | ☐ | ☒ | Individual lot design is to be per separate permit. Finished pad only is provided. |
| Other comparable design concepts that are equally effective. | ☐ | ☒ | Individual lot design is to be per separate permit. Finished pad only is provided. |
| USE ONE OR MORE OF THE FOLLOWING FOR THE DESIGN OF PARKING AREAS: | | | |
| Where landscaping is proposed in parking areas, incorporate landscape areas into the drainage design. | ☐ | ☒ | No parking areas are proposed. |
| Overflow parking (parking stalls provided in excess of the minimum parking requirements) may be constructed with permeable paving. | ☐ | ☒ | No parking areas are proposed |
| Other comparable design concepts that are equally effective. | ☐ | ☒ | No parking areas are proposed |

## TREATMENT CONTROL BMPS

The following table describes County of Los Angeles approved treatment control BMPs that will be incorporated into this project. The treatment BMPs in this table are included in the project design to mitigate any pollutants of concern that were identified in the water quality planning process. If necessary, details describing the design of the BMPs will be provided below.

| TREATMENT CONTROL BMPS | | | |
|---|---|---|---|
| INCORPORATED BMP | YES | N/A | DESCRIPTION |
| CATCH BASIN INSERT | ☐ | ☒ | |
| CATCH BASIN SCREENS | ☐ | ☒ | |
| INFILTRATION TRENCH | ☐ | ☒ | |
| INFILTRATION BASIN | ☐ | ☒ | |
| EXTENDED/DRY DETENTION BASIN | ☒ | ☐ | Two water quality basins are proposed to treat runoff from the development areas of the project site. In addition, one large detention basin is proposed at the downstream portion of the site to detain peak flows and provide additional treatment. |
| WET PONDS | ☐ | ☒ | |
| DRY WELL | ☐ | ☒ | |
| CISTERNS | ☐ | ☒ | |
| VEGETATED SWALES AND STRIPS | ☐ | ☒ | |
| CONSTRUCTED WETLANDS | ☐ | ☒ | |
| BIORETENTION FACILITY | ☐ | ☒ | |
| CONTINUOUS SEPARATION SYSTEMS | ☐ | ☒ | |
| VORTEX/HYDRODYNAMIC SYSTEMS | ☐ | ☒ | |
| MEDIA FILTRATION | ☐ | ☒ | |
| ON-LINE FILTRATION SYSTEMS | ☐ | ☒ | |

| TREATMENT CONTROL BMPS | | | |
|---|---|---|---|
| INCORPORATED BMP | YES | N/A | DESCRIPTION |
| CLARIFIERS | ☐ | ☒ | |
| OIL WATER SEPARATORS | ☐ | ☒ | |
| PRIMARY WASTEWATER TREATMENT | ☐ | ☒ | |
| OFF-LINE STORAGE | ☐ | ☒ | |
| RAIN DIVERSION SYSTEM | ☐ | ☒ | |
| POROUS PAVEMENTS | ☐ | ☒ | |
| END-OF-PIPE SYSTEMS | ☐ | ☒ | |

Three water quality basins are proposed to treat runoff from the residential areas of the project. These basins will be located adjacent to Lot 48 and Lot 61, as well as in the downstream portion of the site. In addition, one detention basin is proposed at the downstream end of the project located along the main access road to the site. Water quality and detention basins are areas where excess storm water is stored or held temporarily and then slowly drains via infiltration, evaporation, and via a controlled outlet. As site runoff collects in the basin, contaminants such as nutrients, trash, and metals are settled or filtered out via infiltration, creating added benefit. The basin will have a water quality storage depth of 3 feet, and may be vegetated with drought tolerant species such as alkali heath, saltgrass, alkali mallow, and saltbush shrubs. If planted, temporary irrigation would likely be utilized to establish the vegetation due to long periods without rainfall. See Appendix 2 for further details on water quality and detention basins.

## DESIGN STANDARDS FOR TREATMENT CONTROL BMPS

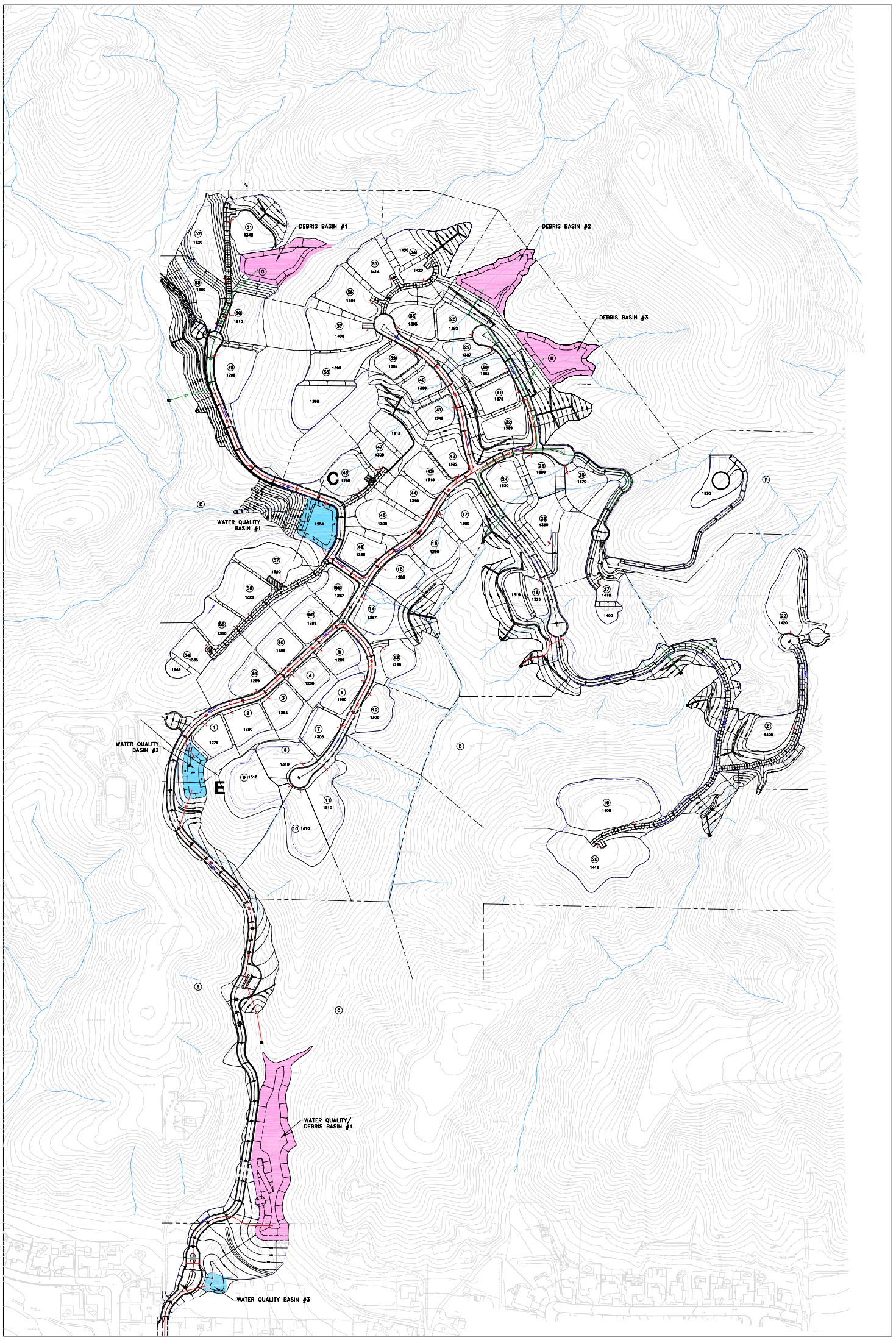
Treatment Control BMPs must incorporate, at a minimum, either a volumetric or flow based treatment control design standard, or both, to mitigate (infiltrate, filter, or treat) stormwater runoff. For the proposed treatment control BMPs selected for the project site, a volume-based design standard was utilized. Each of the selected treatment control BMPs have the capacity to treat:

THE VOLUME PRODUCED FROM 0.75 INCHES OF RAINFALL

Detailed volume calculations for the Brasada filtration basins are provided in Appendix 3 of this report. As illustrated in the table below, all treatment control BMPs selected for the project site meet the required minimum treatment flow rate for each of their respective drainage

areas. Refer to the SUSMP Exhibit on the following page for locations of the water quality basins.

| BMP NAME | DIMENSIONS | MINIMUM TREATMENT REQUIREMENT | BMP TREATMENT CAPACITY |
|---|---|---|---|
| Water Quality Basin #1 (near Lot 48) | ~24,500 $ft^2$ top footprint<br>5 ft depth; 3:1 slopes<br>54.7 ac tributary area | 50,633 $ft^3$ | ~96,600 $ft^3$ |
| Water Quality Basin #2 (near Lot 61) | ~17,670 $ft^2$ top footprint<br>5 ft depth; 3:1 slopes<br>22.86 ac tributary area | 21,160 $ft^3$ | ~60,800 $ft^3$ |
| Water Quality Basin #3 (downstream) | ~6,150 ft2 top footprint<br>2 ft depth, 3:1 slopes<br>2.95 ac tributary area | 2,731 $ft^3$ | ~12,300 |
| Off-Site Debris Basin #1 | ~39,400 $ft^2$ top footprint<br>Design Debris Event = 7,200 cy<br>20.81 ac tributary area | | |
| Off-Site Debris Basin #2 | ~40,700 $ft^2$ top footprint<br>Design Debris Event = 3,360 cy<br>9.0 ac tributary area | | |
| Off-Site Debris Basin #3 | ~39,400 $ft^2$ top footprint<br>Design Debris Event = 4,800 cy<br>12.14 ac tributary area | | |
| Water Quality / Debris Basin #1 | ~86,600 $ft^2$ top footprint<br>Design Debris Event = 27,360 cy<br>92.36 ac tributary area | | |




LEGEND

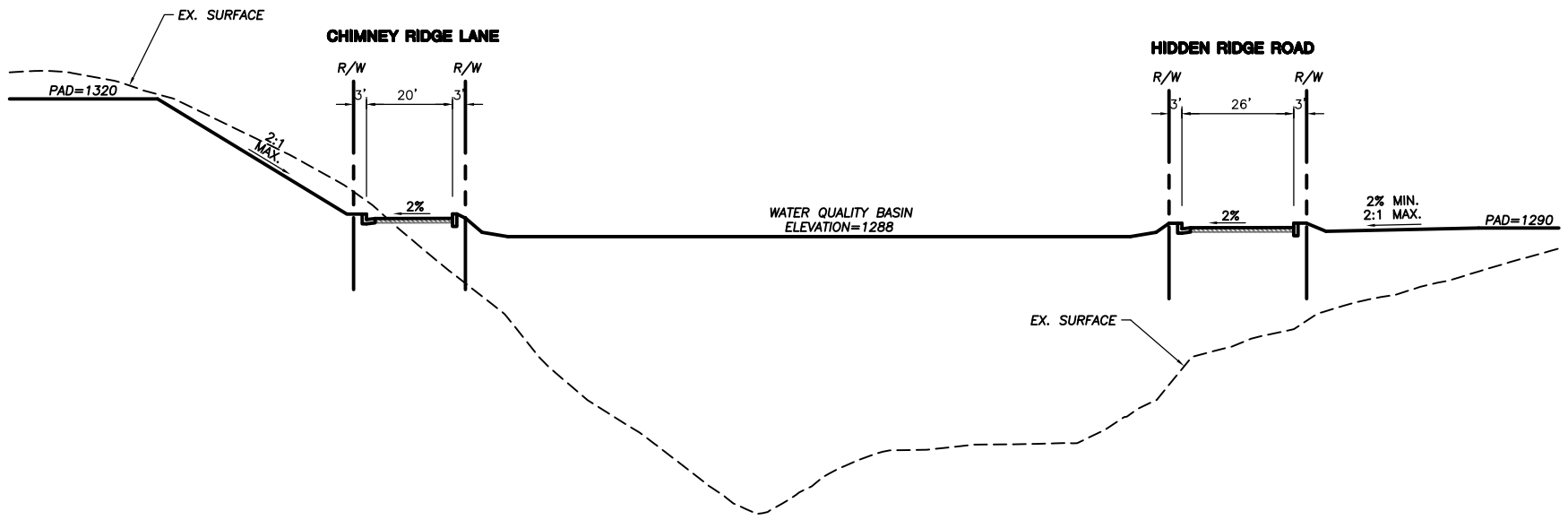
- PROPOSED WATER QUALITY BASIN
- PROPOSED DEBRIS BASIN (OFF-SITE FLOW)
- RIPRAP/OUTLET PROTECTION
- PROPOSED OFF-SITE STORM DRAIN
- PROPOSED ON-SITE STORM DRAIN
- BMP DRAINAGE AREA
- EXISTING STREAM / NATURAL FLOWPATH
- DIRECTION OF FLOW (ON-SITE)

NORTH
SCALE: 1"=200'

FUSCOE ENGINEERING
16795 Von Karman, Suite 100
Irvine, California 92606
tel 949.474.1960 • fax 949.474.5315
www.fuscoe.com

BRASADA
TENTATIVE TRACT
**PROPOSED SUSMP EXHIBIT**

SHEET
1 of 1

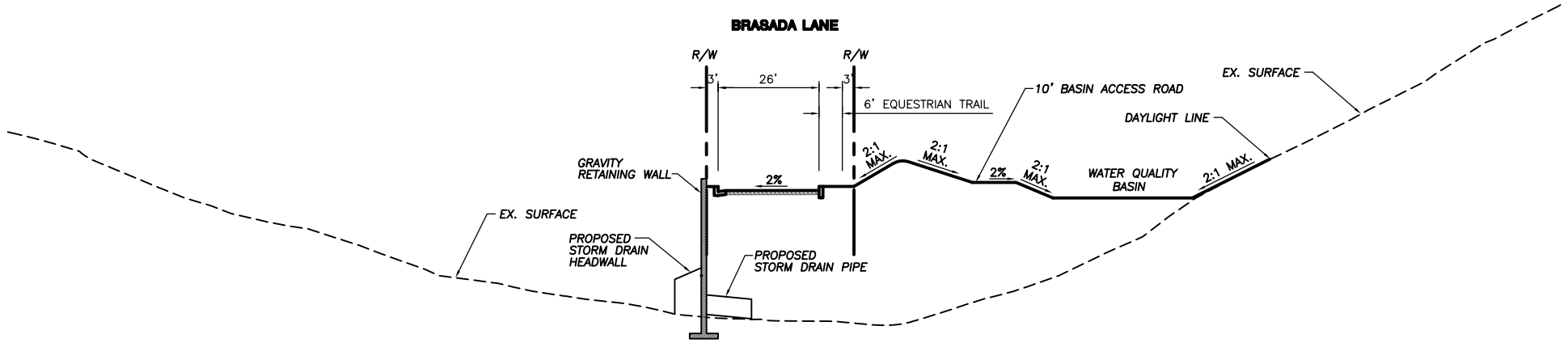



**CROSS SECTION 'C'**

NTS


**SAMPLE STORM DRAIN INLET STENCILING**

NTS




**CROSS SECTION 'E'**

NTS

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Irvine, California 92606
tel 949.474.1960 • fax 949.474.5315
www.fuscoe.com

Not-to-Scale

Exhibit Date: 6-17-09

# SUSMP DETAILS

BRASADA
SAN DIMAS, CA

# V. SITE SPECIFIC MITIGATION PLANS

In addition to SUSMP project categories, new development and redevelopment projects may have specific site characteristics that may cause or contribute to adverse impacts on stormwater quality. These areas must incorporate a site-specific plan to mitigate stormwater pollution. Below is a list of those site specific areas that the San Dimas has identified as requiring a design plan that incorporates appropriate stormwater mitigation measures, which details the source and treatment control BMP(s), and must also submit the O&M Plan for the treatment control BMPs.

| CHECK BELOW (IF APPLICABLE) | AREAS OF CONCERN |
|---|---|
| | 1. Vehicle or equipment fueling areas |
| | 2. Vehicle or equipment maintenance areas |
| | 3. Commercial or industrial waste handling or storage |
| | 4. Outdoor handling and storage of hazardous materials |
| | 5. Outdoor manufacturing areas |
| | 6. Outdoor food handling or processing |
| | 7. Outdoor animal care, confinement or slaughter |
| | 8. Outdoor horticulture activities |
| | 9. Major Transportation Projects |

The proposed Brasada project does not include the above-listed site characteristics and does not require a site specific mitigation plan.

# VI. INSPECTION/MAINTENANCE RESPONSIBILITY

It has been determined that NJD Limited shall assume all BMP inspection and maintenance responsibilities for the Brasada Project. NJD Limited will be responsible for maintenance of all storm drain inlets, collectors, v-ditches or any other related flood control or storm water control device. Furthermore, all interior streets and/or roadways, landscape, recreation areas, facilities and/or open space within the project limits will be maintained by NJD Limited. A Master Covenant and Agreement regarding on-site stormwater treatment devices maintenance shall be completed prior to completion and release of the Project by the City of San Dimas, Los Angeles County (see Appendix 5).

## LONG-TERM FUNDING FOR BMP MAINTENANCE

Long term funding will be through HOA fees.

## RESPONSIBLE PARTY CONTACT INFORMATION

Name: Richard K. Jemison, Sr.

Address: 26152 Oroville Place
Laguna Hills, CA 92653

Tel: 949.463.2921

# VII. OPERATION & MAINTENANCE PLAN

Proper O&M is an important element of a stormwater mitigation plan to ensure BMPs remove pollution effectively. Routine maintenance or service also contributes to the efficiency and continuous operation of a system. The post development BMP maintenance responsibility and frequency matrix provided in this section detail the specific party to perform the inspection and maintenance of each BMP for the Brasada Project and details the maintenance and inspection activities to be performed, and the frequency with which each shall be performed. Further Operations and Maintenance details can be found in Appendix 7.

| STRUCTURAL BMP | RESPONSIBLE PARTY | MAINTENANCE FREQUENCY |
|---|---|---|
| WATER QUALITY & DETENTION BASINS | NJD Limited (HOA Enforced) | Maintained in conjunction with regular landscaping activities, including removal of trash/debris/sediment, moving, weed control, and watering during drought conditions. Damaged or dead plant areas shall be repaired upon detection.<br><br>Frequency: 2x PER YEAR |

Operation and maintenance activities for the water quality detention basins would include site inspections, temporary irrigation system inspection and adjustment, minor vegetation removal and thinning, snag removal, and integrated pest/plan management. The treatment basins may periodically require major maintenance and possibly repairs to ensure that the basins operate at their maximum efficiency and treatment capacity. Major activities would include structural modifications and repairs, major vegetation removal and planting, and major sediment removal.

The water quality basins should be inspected at a minimum of twice per year, prior to the start of the storm season (October 1st) and at the end of the storm season. Basins should be inspected for standing water (in excess of 36 hours after a storm event), excess sediment, trash, and debris accumulation, possible vector harborage, and for the condition of safety features (such as fences and signs). Trash and debris should be removed in the basin and around the outlet during the inspections. In the water quality detention basins, weeding will be performed on a monthly basis during the first six months of the project, and quarterly during years 2 and 3 as directed by the professional biologist/restoration specialist employed for the inspections. Excess sediment shall be removed and disposed of properly when the debris component of the basin exceeds 10% of the basin volume. It is recommended that the professional biologist evaluate the water quality basin for plant survival, species coverage and species composition on an annual basis.

# VIII. APPENDICES

# APPENDIX 1

# SUSMP/SITE SPECIFIC PLAN CHECKLIST

**COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS**
**BUILDING AND SAFETY DIVISION - DRAINAGE & GRADING SECTION**

# STANDARD URBAN STORMWATER MITIGATION PLAN (SUSMP) REVIEW SHEET

Urban and storm water runoff is considered to be one of the largest sources of pollution to both local waterways and coastal areas of the United States. Los Angeles County was issued a National Pollutant Discharge Elimination System permit for municipal stormwater and urban runoff discharges within the County of Los Angeles on December 13, 2001, by the Los Angeles Regional Water Quality Control Board. Under this permit, the County is required to prohibit the discharge of pollutants from private property developments. Preventing these pollutants from entering stormwater discharge system will be accomplished by requiring the installation and maintenance of post-construction treatment control Best Management Practices (BMPs) on qualifying projects.

## PROJECT INFORMATION

| SITE ADDRESS | CITY/LOCATION | DISTRICT NO. | GRADING/BUILDING PLAN CHECK NO. |
|---|---|---|---|

DESIGN ENGINEER/APPLICANT _____ TELEPHONE NO. _____

OWNER/DEVELOPER _____ TELEPHONE NO. _____

PLAN CHECKER _____ ENTRY DATE _____

PROJECT DESCRIPTION/PROPOSED OCCUPANCY _____

- ❑ The project as proposed is exempt from the requirements of the Development Construction provisions of the County NPDES permit.

**The following is a list of new development and redevelopment projects/activities requiring the incorporation of Best Management Practices (BMPs) into the project plans. If the proposed new development or redevelopment and/or activity falls into one of these categories as indicated below, BMPs shall be incorporated into project plans to satisfy SUSMP requirements. Details of SUSMP provisions must be prepared and submitted as part of the project building or grading plans (see Section 106.4.3 of the Los Angeles County Building Code).**

Project/Activities requiring BMPs under the SUSMP provisions:

- ❑ Single family hillside development. "Hillside" means property located in an area where the development contemplates grading on any natural slope that is twenty-five percent or steeper.
- ❑ Industrial/Commercial development that creates an area of one acre or more of impermeable area.
- ❑ Retail gasoline outlet, gas station, or fuel dispensing.
- ❑ Automotive repair shop, automotive and/or equipment maintenance areas.
- ❑ Restaurant, outdoor food handling or processing.
- ❑ Parking lot creating 5,000 square feet or more of surface area, or with 25 or more parking spaces and potentially exposed to stormwater runoff.
- ❑ Projects located within, directly adjacent to, or directly tributary to an environmentally sensitive area.

- ❑ Automotive or equipment washing or cleaning area(s).
- ❑ Outdoor hazardous material, waste handling or storage.
- ❑ Commercial or industrial waste.
- ❑ Outdoor manufacturing areas such as equipment or product fabrication including welding, cutting, sawing, metal fabrication, assembly, application of paints, coatings, or finishes, pre-cast concrete fabrication, equipment or machinery repair and/or maintenance, etc.
- ❑ Outdoor horticulture activities.
- ❑ Animal slaughtering, animal confinement, pet care facilities, stables, kennels, etc.
- ❑ Ten or more unit homes.

- **REDEVELOPMENT PROJECTS**

"Redevelopment" means land-disturbing activity that results in creation, addition or replacement of 5,000 square feet or more of impervious surface area on an already developed site. Redevelopment includes, but is not limited to, the expansion of a building footprint, addition or replacement of a structure; replacement of impervious surface that is not part of a routine maintenance activity; and land disturbing activities related with structural or impervious surfaces. It does not include routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of facility, nor does it include emergency construction activities required to immediately protect public health and safety. Where redevelopment results in an alteration to less than fifty percent of the impervious surfaces of a previously existing development, and the existing development was not subject to these SUSMP requirements, the Design Standards apply only to the alteration, and not to the entire development. Where redevelopment results in an alteration to more than fifty percent of impervious surfaces of a previously existing development, and the existing development was not subject to the SUSMP requirements, the Design Standards apply to the entire project.

**REDEVELOPMENT:** Redevelopment projects covered under the project/activities categories indicated above may require BMPs under the SUSMP provisions. Your redevelopment project is:

- ❑ **Exempt:** (Impervious surface area replaced, added, or created is < 5,000 square feet)
  Proposed improvements are less than 5,000 square feet or maintain original line and grade and the original purpose of the facility. Project is, therefore, exempt from SUSMP requirements.

- ❑ **BMPs to meet SUSMP requirements must be incorporated into Design Plans:**
  (Impervious surface area replaced, added, or created is > 5,000 square feet.)
  Proposed improvements are greater than or equal to 5,000 square feet or do not maintain original line and grade. Project is, therefore, subject to SUSMP requirements.

**Your redevelopment project requires the following:**

- ❑ **BMPs must be incorporated in project plans for the newly developed area only.**
  Required when an alteration results in an increase of less than 50 percent of the impervious surfaces of the previously existing development, and the existing development was not subject to SUSMP requirements.

- ❑ **BMPs must be incorporated in project plans for the newly developed and existing areas.** Required when an alteration results in an increase of greater than 50 percent of the impervious surfaces of the previously existing development.

## AGENCY REFERRALS

- ❑ Submit and obtain approval from Environmental Programs Division, Industrial Waste Unit, for all structural BMPs selected to treat onsite pollutants for the proposed non-residential project. An annual operating permit may be required. Environmental Programs Division, Industrial Waste Unit - 900 S. Fremont, Alhambra, Annex Building, 3rd floor, (626) 458-3517. Please contact Environmental Programs Division for required fees and minimum submittal requirements. Please note: prior to obtaining approval from Environmental Programs Division the location and the design flows for all BMPs must be shown on plans and approved by Building and Safety.

- ❑ Obtain an encroachment permit for the proposed construction and/or discharge of drainage in the road right of way. Construction Division, Permits Section - 900 S. Fremont, Alhambra, 8th Floor, (626) 458-3129.

- ❑ Obtain a connection permit or approval for the proposed connection to the Los Angeles County Flood Control District Drain_____. Construction Division, Permits Section, 900 S. Fremont, Alhambra, 8th Floor, (626) 458-3129.

- ❑ Obtain an encroachment/connection permit for the proposed construction/connection or discharge of drainage in road right of way. City of_____/Caltrans.
  _____

- ❑ This project is located within the City of _____. Obtain approval from the City for SUSMP requirements. (Required for all Cities that do not contract this service from the Los Angeles County Department of Public Works).

## HYDRAULIC and HYDROLOGY REQUIREMENTS

- ❑ Provide a hydrology analysis to determine the design flow rate ($Q_{PM}$) or Volume (VM) for the first 3/4-inch of rainfall that must be treated. See Appendix 1 for calculation of $Q_{PM}$.

- ❑ Submit site specific hydraulic calculations along with the recommended structural BMP manufacturer's product specifications to verify the BMP will adequately handle the minimum design flow required for treatment. Note: The proposed project improvements must provide the required minimum level of flood protection.

- ❑ Provide Hydraulic analysis for the following:_____
  _____
  _____

- ❑ Outlet velocities from proposed drainage devices must be designed to minimize erosion. Energy dissipation is required for all devices. Calculations for the sizing of dissipaters must be provided. Soils analysis may be required to determine the site conditions and susceptibility to erosion.

## GENERAL COMMENTS

- ❑ For building plans, all SUSMP requirements and associated details for the proprietary or non-proprietary BMPs shall be shown on the building site plan. (Plan scale shall be 1"=40' or better.)

- ❑ For grading plans, all SUSMP requirements and associated details for the proprietary or non-proprietary BMPs shall be shown on the grading plans.

- ❑ The project must mitigate the first 3/4-inch of rainfall for each storm event and be designed to minimize the introduction of pollutants from the site runoff into the stormwater conveyance system. (Reference 1)

In addition to those items required on the site grading and/or building drainage plans, the following SUSMP information shall be incorporated on the plans:

- ❑ Show the location of proposed BMPs on plans. All necessary manufacturer's installation notes and construction requirements and/or details must be included on the plans for all treatment and holding facilities. This includes model, size, material type, dimensions, volumetric capacity, and manufacturer's treatment capacity.
- ❑ For non-proprietary BMPs, in addition to the items indicated above, provide details of all organic materials including plants, filter materials and specifications. Planting and irrigation details for any vegetated BMP must be indicated on the plans.
- ❑ Specify all elevations for proposed BMPs, inverts or flow lines as applicable.
- ❑ Specify on the plans for each drainage device, the total design flow, Qtotal, and the peak mitigation flow rate, $Q_{PM}$ (See Reference 1 for additional information).
- ❑ Clearly show driveway/access road drainage and provide BMPs for treatment of driveway flows. Provide elevations, cross sections, or slopes as applicable.
- ❑ Show proposed drainage in paved areas. Provide spot elevations, slopes, and flow arrows to intended outlet(s). If offsite tributary flows are not included in onsite treatment, show how flows will be directed away from proposed BMPs. Provide topography, elevations, cross sections, slopes, and details as applicable.
- ❑ For commercial properties, all catch basins and inlets that discharge into an existing or proposed storm drain must be labeled to discourage illegal dumping of pollutants. See Appendix 3 for stencil information.
- ❑ Direct rooftop runoff to pervious areas such as yards, vegetated open channels, or areas where practical. Provide BMP solution for treatment of roof runoff.
- ❑ Add the following SUSMP NOTES to the site grading and/or building drainage plans.

**SUSMP NOTES:**

1. Determine and provide the pre and post development pervious and impervious areas created by the proposed development. Show the following table on Plans:

| | |
|---|---|
| **POST DEVELOPMENT** | |
| Impervious Area | _____ Acres, |
| Pervious Area | _____ Acres, |
| **PRE DEVELOPMENT** | |
| Impervious Area | _____ Acres, |
| Pervious Area | _____ Acres, |

2. All structural BMPs shall be accessible for inspection and maintenance and shall bear a "No Dumping – Drains to Ocean" symbol in traffic rated paint per detail herein. Stencils are available at the local Building and Safety District office.
3. Prior to commencement of any work within the road right of way and/or connection to a County-maintained storm drain an encroachment permit from Construction Division is required. For more information call (626) 458-3129.
4. Prior to commencement of any work and/or discharge of drainage to a watercourse, a permit from both the California Department of Fish and Game and U.S. Army Corps of Engineers may be required.

5. STATEMENTS OF UNDERSTANDING

As the Architect/Engineer of the project, I have reviewed the Development Planning for Storm Water Management–A manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), and have proposed the implementation of the permanent Best Management Practices (BMPs) applicable to effectively minimize the negative impacts of the project's stormwater runoff. The selected BMPs will be installed per the approved plans and as recommended by the product manufacturer as applicable.

_____

Signature - Architect/Engineer of Record Date

## CERTIFICATIONS AND PROOF OF ONGOING MAINTENANCE

- ❑ Project Civil Engineer/Architect must complete the **STATEMENTS OF UNDERSTANDING**, see SUSMP general note number 5 which must be signed and added to proposed plans.
- ❑ Project Civil Engineer/Architect must submit the **OPERATION AND MAINTENANCE GUIDELINES** for review and approval prior to recordation. The Operation and Maintenance Guidelines shall include the designated responsible party to manage the SUSMP devices, employee's training program and duties, operating schedule, maintenance frequency, routine service schedule, specific maintenance activities, copies of resource agency permits, and any other necessary activities. At a minimum, maintenance shall require inspection and servicing of all SUSMP devices on an annual basis.
- ❑ Provide recorded and certified copies of the **MAINTENANCE COVENANT FOR SUSMP DEVICES** and **OPERATION AND MAINTENANCE GUIDELINES** to provide for ongoing operation and maintenance of SUSMP devices. Refer to Appendix 4 for Covenant.
- ❑ _____
  _____
  _____

## DESIGN SUGGESTIONS

- Examples of BMPs can be found in Appendix 2.
- Wherever practical, use natural drainage areas/systems to convey flows.
- Utilize permeable materials for sidewalks, driveways, and parking lots where practicable.
- Employ the use of detention basins, infiltration basins, and infiltration trenches where applicable.
- Concentrate or cluster proposed developments on portions of site while leaving the greatest area of land in a natural undisturbed condition.
- Conserve natural areas by minimizing the amount of site clearing and grading of native vegetation required for development.
- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.
- Promote natural vegetation by using parking lot islands and other landscaped areas.
- Preserve riparian areas and wetlands.

## AREAS OF SPECIAL ATTENTION

For commercial developments, the items indicated below are reviewed by Environmental Programs Division, Industrial Waste Unit. The following requirements are provided for reference only:

Properly Design Material Storage Areas:

- Provide a roof above the material storage area. If the roof structure does not include side walls, then the roof's overhang must extend a minimum of 20 percent of the roof's height. Elimination of roof cover will be reviewed on a case-by-case basis.
- The storage area must be paved and sufficiently impervious to contain leaks and spills. Provide and show on plans all storage areas for chemicals and/or waste materials stored at the subject facility, with a tank/drum schedule indicating tank capacities, materials of construction, and contents. Provision for spill containment is required where such materials may potentially enter the sewer system, storm drain, or contaminate the soil. Spill containment should be designed for the volume of the largest tank or 10 percent of the drum total (whichever is greater), plus 6 inches of rainfall over the containment area (if outdoors). Submit a typical detail of the containment curb and specify the materials of construction.
- All tanks containing incompatible materials such as acids, bases, reactive or flammable materials must have separate spill containment systems.
- Interior wall and floors within all spill containment areas shall be cleaned, repaired and sealed with an epoxy or equivalent type sealant which is compatible with the materials located within said areas. Provide manufacturer's literature of selected sealant and indicate on drawings areas to be sealed.
- The contact joint for spill containment walls or dikes constructed on existing concrete, masonry or asphalt shall be bonded to the existing surface. Provide manufacturer's literature of the selected bonding agent and indicate on drawings areas to be bonded.
- Materials collected in the spill containment area must be controlled until a determination is made regarding their quality and legal disposal method.

Properly Design Loading/Unloading Areas:

- Provide a roof above the loading dock area. If the roof structure doesn't include side walls, then the roof's overhang must extend a minimum of 20 percent of the roof's height. Elimination of the roof cover will be reviewed on a case-by-case basis.
- Design drainage to minimize stormwater runoff onto loading/unloading area.
- Direct connections to storm drains from depressed loading docks (truck wells) are prohibited.

Properly Design Repair/Maintenance Bays:

- Repair/maintenance bays must be indoors or designed in such a way that does not allow stormwater runoff onto the wash bay.
- Design repair/maintenance bay drainage system to capture all wash water, leaks and spills. Show on plans all proposed drain connections for collection and disposal. Direct connection of the repair/maintenance bay outlet drain to the storm drain system is prohibited.
- If wastewater is generated, the person responsible for the discharge must file for an Industrial Waste Disposal Permit.

Properly Design Vehicle/Equipment Wash Areas:

- Vehicle/equipment wash areas are subject to Industrial Waste Discharge Permit plan review.
- Vehicle/equipment wash areas shall be provided with a clarifier and a sample box. The discharge must be routed to the sanitary sewer line. Details, as applicable, must be indicated on plans.
- Provide a roof above the vehicle/equipment wash area. If the roof structure does not include side walls, then the roof's overhang must extend a minimum of 20 percent of the roof's height. Elimination of the roof cover will be reviewed on a case-by-case basis.
- If a cover is not feasible, provide an approved rainwater diversion system along with a clarifier and a sample box (County Standard Plan 2043-0, enclosed). Diverted flow may require pretreatment, verification of pollutant removal and/or storage prior to discharge to the storm drain.

Properly Design Fueling Areas:

- The fuel dispensing area must be covered with a roof structure or canopy. The canopy's minimum dimensions must be equal to or greater than the area within the grade break. The canopy must not drain onto the fuel dispensing area, and the canopy downspouts must be routed to prevent drainage across the fueling area.
- Fuel dispensing areas must be paved with Portland cement concrete (or equivalent smooth impervious surface), and the use of asphalt concrete shall be prohibited.
- Propose a spill collection and cleanup maintenance plan for the fueling area. Flows from washing-down of the fueling area entering the storm drain system are prohibited.

Properly Design Refuse Collection Areas:

- If drains are proposed in the refuse collection area, these shall be connected to the sanitary sewer with proper pretreatment facilities. Surrounding areas shall be graded to drain away from the refuse collection area.
- Drainage from adjoining roofs must be diverted away from the refuse collection area.
- Refuse collection areas must be screened or walled to prevent off-site transport of refuse.

Properly Design Parking Areas:

- Infiltration runoff that may potentially contaminate soil is not acceptable.
- Provide a pretreatment facility to treat stormwater flows prior to entering the storm drain system.

## REFERENCES


1. Development Planning for Storm Water Management, A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works
2. California Stormwater Best Management Practices Handbook
3. Caltrans Stormwater Quality Handbook: Planning and Design Staff Guide
4. Manual for Stormwater Management in Washington State
5. The Maryland Stormwater Design Manual
6. Florida Development Manual: A Guide to Sound Land and Water Management
7. Denver Urban Storm Drainage Criteria Manual
8. USEPA Report No. EPA-840-B-92-002

# APPENDICES

**APPENDIX 1** **3/4" PEAK MITIGATED FLOW RATE ($Q_{PM}$)**

This Appendix provides a step-by-step approach for calculating the 3/4" peak mitigated flow rate, $Q_{PM}$.

**APPENDIX 2** **EXAMPLES OF BMPs**

This Appendix contains example BMPs and design suggestions that may be incorporated into the project to satisfy the requirement for minimizing the release of pollutants from each new development. Additional examples may be found in reference one on the enclosed list.

**APPENDIX 3** **STENCIL FOR LABELING OF INLETS INTO DRAINAGE SYSTEM**

Inlets to closed storm drains must be clearly labeled to indicate dumping of improper materials into stormwater conveyance system is prohibited. The attached “No Dumping-This Drains to Ocean” graphical icon is acceptable for stenciling or labeling of drain inlets. Stencils may be purchased at the local Building and Safety District Office. Refer to fee code “CB” when purchasing the stencil.

**APPENDIX 4** **SUSMP MAINTENANCE COVENANT**

The purpose of the SUSMP Maintenance Covenant and the Operation and Maintenance Guidelines is to ensure that all current and future owners of a development are made aware that the site contains SUSMP BMPs that must remain operational and be maintained. These documents shall be recorded against the subject property. THE SUSMP MAINTENANCE COVENANT AND OPERATION AND MAINTENANCE GUIDELINES MUST BE SIGNED, NOTARIZED, AND RECORDED. Applicant must provide copy of the recorded documents stamped by the County Recorder’s office.

RECORDATION is the responsibility of the applicant. The main Recorder’s office is located at 12400 Imperial Highway in the City of Norwalk. Additional branch offices for recording documents are available.

Information for the County Recorder’s offices can be obtained on the Internet at http://regrec.co.la.ca.us/main.htm or by calling (562) 462-2125 for more information.

# APPENDIX 1

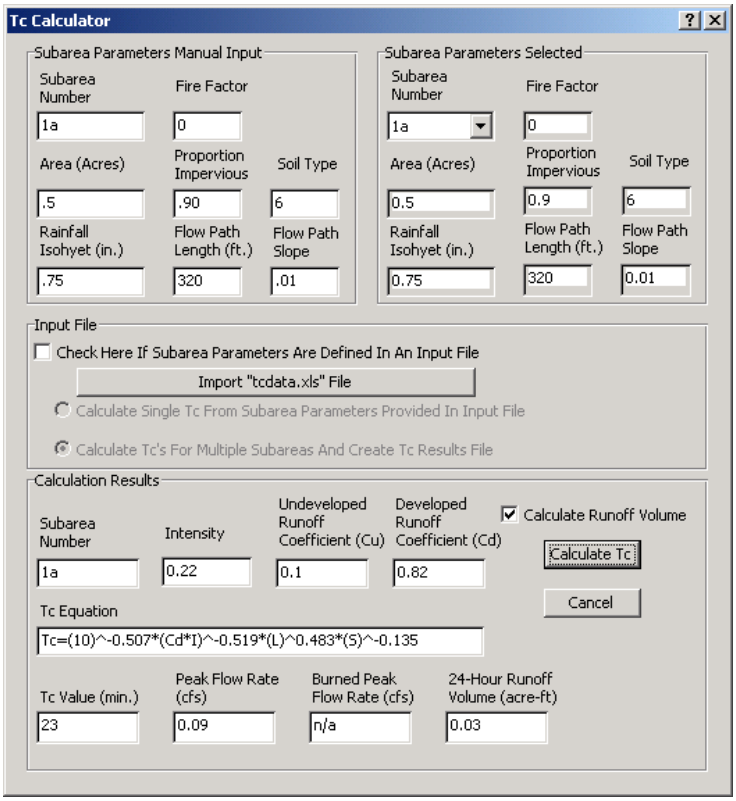
## DETERMINING THE 3/4 INCH PEAK MITIGATED FLOW RATE ($Q_{PM}$):

For compliance with SUSMP requirements, use the Modified Rational Method to calculate the peak mitigated flow rate ($Q_{PM}$). The $Q_{PM}$ may be calculated by hand or by using the County of Los Angeles Department of Public Works' $T_C$ Calculator. Both methods are described below.

### $T_C$ Calculator Method

The $T_C$ Calculator may be downloaded from the following website: dpw.lacounty.gov/wrd/publication/

The $T_c$ Calculator calculates the full modified rational runoff method yielding peak runoff rates and volumes. The figure to the right shows the interface for the $T_c$ calculator. To calculate the $Q_{PM}$, fill out the boxes in the upper left hand corner of the calculator under "Subarea Parameters Manual Input" and use 0.75 as the Rainfall Isohyet. Click on the "Calculate $T_c$" button in the lower right to display the results. To calculate multiple subareas simultaneously, the $T_c$ calculator can also accept Excel spreadsheets as input files containing a number of subareas. Please refer to the Hydrology Manual for more information.




### Hand Calculation Method

The Hydrology Manual may be downloaded from the following website: dpw.lacounty.gov/wrd/publication/

By trial and error, determine the time of concentration ($T_c$), as shown below:

CALCULATION STEPS:

1. **Determine subarea boundaries and then calculate flow path length, flow path slope, and area.**
   L = _____ feet
   S = _____ feet / feet
   A = _____ acres

2. **Assume an initial value for $T_c$**
   $T_c$ = _____ minutes

3. **Using Table 1, look up the assumed $T_c$ value and select the corresponding intensity, $I_t$**
   $I_t$ = _____ in/hr

**4. Determine the undeveloped runoff coefficient, $C_u$, using the runoff coefficient curve corresponding to the predominant soil type** in Appendix C of the County of Los Angeles Department of Public Works Hydrology Manual.

$C_u$ = _____

**5. Determine the developed runoff coefficient, $C_d$**

$C_d = (0.9 \times IMP) + [(1.0 - IMP)\ C_u]$

where, $C_d$ = Developed area runoff coefficient
IMP = Percent impervious
$C_u$ = Undeveloped area runoff coefficient

$C_d$ = _____

**6. Calculate the time of concentration, $T_c$**

$$T_c = \frac{0.31L^{0.483}}{(C_d * I_t)^{0.519} * S^{0.135}}$$ , $T_c$ = _____ minutes

**7. Compare the initial $T_c$ assumption with the calculated $T_c$. If the difference is not within 0.5 minutes, use the new $T_c$ value and begin at Step 3 to complete another iteration. If the difference is within 0.5 minutes, round the $T_c$ value to the nearest minute.**

The acceptable $T_c$ range is from 5 to 30 minutes. If a Tc of less than 5 minutes is calculated, use 5 minutes. If a $T_c$ greater than 30 minutes is calculated, the subarea must be divided into two or more subareas.

Acceptable $T_c$ value = _____ minutes

**TABLE FOR ITERATIONS:**

| Iteration No. | Initial $T_c$ (min) | $I_t$ (in/hr) | $C_u$ | $C_d$ | Calculated $T_c$ (min) | Difference (min) |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |

**8. Calculate the peak mitigated flow rate, $Q_{PM}$**

$Q_{PM} = C_d * I_t * A$, $Q_{PM}$ = _____ cfs

## TABLE 1

## INTENSITY – DURATION DATA FOR 0.75-INCH OF RAINFALL

| Duration, $T_c$ (min) | Rainfall Intensity, $I_t$ (in/hr) |
|---|---|
| 5 | 0.447 |
| 6 | 0.411 |
| 7 | 0.382 |
| 8 | 0.359 |
| 9 | 0.339 |
| 10 | 0.323 |
| 11 | 0.309 |
| 12 | 0.297 |
| 13 | 0.286 |
| 14 | 0.276 |
| 15 | 0.267 |
| 16 | 0.259 |
| 17 | 0.252 |
| 18 | 0.245 |
| 19 | 0.239 |
| 20 | 0.233 |
| 21 | 0.228 |
| 22 | 0.223 |
| 23 | 0.218 |
| 24 | 0.214 |
| 25 | 0.210 |
| 26 | 0.206 |
| 27 | 0.203 |
| 28 | 0.199 |
| 29 | 0.196 |
| 30 | 0.193 |

## PEAK MITIGATED FLOW RATE, $Q_{PM}$, EXAMPLE

Proposed Project Characteristics:

Drainage area ___1.2____ acres
Type of development Commercial_
Predominant soil type # ___006____
% of project impervious ___90%___

**By trial and error, determine the time of concentration ($T_c$), as shown below:**

1. **Determine subarea boundaries and then calculate flow path length, flow path slope, and area**

   L = ___320___ feet
   S = __0.035__ feet / feet
   A = ___1.2____ acres

**2. Assume an initial value for $T_c$**

$T_c$ = ___10___ minutes

**3. Using Table 1 on page IV, look up the assumed $T_c$ value and select the corresponding intensity, $I_t$**

$I_t$ = ___0.323____ in/hr

**4. Using the runoff coefficient curves in Appendix C of the County of Los Angeles Department of Public Works Hydrology Manual, determine the undeveloped runoff coefficient, $C_u$, corresponding to the predominant soil type**

$C_u$ = ___0.10___

**5. Determine the developed runoff coefficient, $C_d$**

$C_d = (0.9*IMP) + [(1.0 - IMP)*C_u]$

where, $C_d$ = Developed area runoff coefficient

IMP = Percent impervious

$C_u$ = Undeveloped area runoff coefficient

$C_d = (0.9*0.9) + [(1.0 - 0.9)*0.1]$ = ___0.82____

**6. Calculate the time of concentration, $T_c$**

$$T_c = \frac{0.31*L^{0.483}}{(C_d*I_t)^{0.519}*S^{0.135}} \quad , \quad T_c = \frac{0.31 * (320)^{0.483}}{(0.82*0.323)^{0.519}*(0.035)^{0.135}} = \text{__15.75___ minutes}$$

**7. Compare the initial $T_c$ assumption with the calculated $T_c$. If the difference is not within 0.5 minutes, use the new $T_c$ value and begin at Step 3 to complete another iteration. If the difference is within 0.5 minutes, round the $T_c$ value to the nearest minute.**

Initial $T_c$ = 10 minutes, Calculated $T_c$ = 15.75 minutes, Difference = 5.75 minutes

Since the difference is greater than 0.5 minutes, 15.75 minutes is rounded to 16 minutes and used as the new $T_c$ value. Beginning at Step 3, additional iterations are performed until the initial and calculated $T_c$ values are within 0.5 minutes. See results below.

| Iteration No. | Initial $T_c$ (min) | $I_t$ (in/hr) | $C_u$ | $C_d$ | Calculated $T_c$ (min) | Difference (min) |
|---|---|---|---|---|---|---|
| 1 | 10 | 0.323 | 0.10 | 0.82 | 15.75 | 5.75 |
| 2 | 16 | 0.259 | 0.10 | 0.82 | 17.67 | 1.67 |
| 3 | 18 | 0.245 | 0.10 | 0.82 | 18.18 | 0.18 |

Acceptable $T_c$ value = ___18____ minutes

**8. Calculate the peak mitigated flow rate, $Q_{PM}$**

$Q_{PM} = C_d * I_t * A$, , $Q_{PM}$ = 0.82 * 0.245 * 1.2 = __0.24___ cfs

# APPENDIX 2

## EXAMPLE BEST MANAGEMENT PRACTICES (BMPs)

The following are examples of BMPs that can be used for minimizing the introduction of pollutants of concern that may result in significant impacts, generated from site runoff to the storm water conveyance system. (See Reference 1: Suggested resources for additional sources of information):

- Provide reduced width sidewalks and incorporate landscaped buffer areas between sidewalks and streets. However, sidewalk widths must still comply with regulations for the Americans with Disabilities Act and other life safety requirements.
- Design residential streets for the minimum required pavement widths needed to comply with all zoning and applicable ordinances to support travel lanes; on-street parking; emergency, maintenance, and service vehicle access; sidewalks; and vegetated open channels.
- Comply with all zoning and applicable ordinances to minimize the number of residential street cul-de-sacs and incorporate landscaped areas to reduce their impervious cover. The radius of cul-de-sacs should be the minimum required to accommodate emergency and maintenance vehicles. Alternative turnarounds should be considered.
- Use permeable materials for private sidewalks, driveways, parking lots, or interior roadway surfaces (examples: hybrid lots, parking groves, permeable overflow parking, etc.).
- Use open space development that incorporates smaller lot sizes.
- Reduce building density.
- Comply with all zoning and applicable ordinances to reduce overall lot imperviousness by promoting alternative driveway surfaces and shared driveways that connect two or more homes together.
- Comply with all zoning and applicable ordinances to reduce the overall imperviousness associated with parking lots by providing compact car spaces, minimizing stall dimensions, incorporating efficient parking lanes, and using pervious materials in spillover parking areas.
- Direct rooftop runoff to pervious areas such as yards, open channels, or vegetated areas, and avoid routing rooftop runoff to the roadway or the stormwater conveyance system.
- Vegetated swales and strips
- Extended/dry detention basins
- Infiltration basin
- Infiltration trenches
- Wet ponds
- Constructed wetlands
- Oil/Water separators
- Catch basin inserts
- Continuous flow deflection/separation systems
- Storm drain inserts
- Media filtration
- Bioretention facility
- Dry-wells
- Cisterns
- Foundation planting
- Catch basin screens
- Normal flow storage/separation systems
- Clarifiers
- Filtration systems
- Primary waste water treatment systems

# APPENDIX 3

RECORDING REQUESTED BY AND MAIL TO:

COUNTY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
BUILDING AND SAFETY DIVISION
900 S. FREMONT AVENUE, 3RD FLOOR
ALHAMBRA, CA 91803-1331

Space above this line is for Recorder's use

# MAINTENANCE COVENANT FOR STANDARD URBAN STORMWATER MITIGATION PLAN (SUSMP) REQUIREMENTS

Pursuant to Section 106.4.3 of the County of Los Angeles Building Code and Title 12, Chapter 12.80 of the Los Angeles County Code relating to the control of pollutants carried by stormwater runoff, structural and/or treatment control Best Management Practices (BMPs) have been installed on the following property:

LEGAL DESCRIPTION

ASSESSOR'S ID #_____TRACT NO._____LOT NO._____

ADDRESS: _____

_____

REFERENCE

PLAN CHECK NO.: _____ DISTRICT OFFICE NO.: _____

I (we)_____, hereby certify that I (we) am (are) the legal owner(s) of
(Legal Name of Property Owners)
property indicated above, and as such owners for the mutual benefit of future purchasers, their heirs, successors, and assigns, do hereby fix the following protective conditions to which their property, or portions thereof, shall be held, sold and/or conveyed.

That owner(s) shall maintain the drainage devices such as paved swales, bench drains, inlets, catch basins, downdrains, pipes, and water quality devices on the property indicated above and as shown on plans permitted by the Los Angeles County Department of Public Works and as outlined in the attached "OPERATION AND MAINTENANCE GUIDELINES", in a good and functional condition to safeguard the property owners and adjoining properties from damage and pollution.

That owner(s) shall conduct maintenance inspection of all Structural or Treatment Control BMPs on the property at least once a year and retain proof of the inspection. Said maintenance inspection shall verify the legibility of all required stencils and signs and shall repaint and label as necessary.

That owner(s) shall provide printed educational materials with any sale of the property that provide information on what stormwater management facilities are present, the type(s) and location(s) of maintenance signs that are required, and how the necessary maintenance can be performed.

Owner(s):

By:_____ Date:_____

By:_____ Date:_____

(PLEASE ATTACH NOTARY)

# APPENDIX 2

# TREATMENT CONTROL BMP DETAILS

# Extended Detention Basin TC-22

**Design Considerations**

- Tributary Area
- Area Required
- Hydraulic Head

## Description

Dry extended detention ponds (a.k.a. dry ponds, extended detention basins, detention ponds, extended detention ponds) are basins whose outlets have been designed to detain the stormwater runoff from a water quality design storm for some minimum time (e.g., 48 hours) to allow particles and associated pollutants to settle. Unlike wet ponds, these facilities do not have a large permanent pool. They can also be used to provide flood control by including additional flood detention storage.

**Targeted Constituents**

| | | |
|---|---|---|
| ☑ | Sediment | ▲ |
| ☑ | Nutrients | ● |
| ☑ | Trash | ■ |
| ☑ | Metals | ▲ |
| ☑ | Bacteria | ▲ |
| ☑ | Oil and Grease | ▲ |
| ☑ | Organics | ▲ |

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

## California Experience

Caltrans constructed and monitored 5 extended detention basins in southern California with design drain times of 72 hours. Four of the basins were earthen, less costly and had substantially better load reduction because of infiltration that occurred, than the concrete basin. The Caltrans study reaffirmed the flexibility and performance of this conventional technology. The small headloss and few siting constraints suggest that these devices are one of the most applicable technologies for stormwater treatment.

## Advantages

- Due to the simplicity of design, extended detention basins are relatively easy and inexpensive to construct and operate.
- Extended detention basins can provide substantial capture of sediment and the toxics fraction associated with particulates.
- Widespread application with sufficient capture volume can provide significant control of channel erosion and enlargement caused by changes to flow frequency

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relationships resulting from the increase of impervious cover in a watershed.

### Limitations

- Limitation of the diameter of the orifice may not allow use of extended detention in watersheds of less than 5 acres (would require an orifice with a diameter of less than 0.5 inches that would be prone to clogging).
- Dry extended detention ponds have only moderate pollutant removal when compared to some other structural stormwater practices, and they are relatively ineffective at removing soluble pollutants.
- Although wet ponds can increase property values, dry ponds can actually detract from the value of a home due to the adverse aesthetics of dry, bare areas and inlet and outlet structures.

### Design and Sizing Guidelines

- Capture volume determined by local requirements or sized to treat 85% of the annual runoff volume.
- Outlet designed to discharge the capture volume over a period of hours.
- Length to width ratio of at least 1.5:1 where feasible.
- Basin depths optimally range from 2 to 5 feet.
- Include energy dissipation in the inlet design to reduce resuspension of accumulated sediment.
- A maintenance ramp and perimeter access should be included in the design to facilitate access to the basin for maintenance activities and for vector surveillance and control.
- Use a draw down time of 48 hours in most areas of California. Draw down times in excess of 48 hours may result in vector breeding, and should be used only after coordination with local vector control authorities. Draw down times of less than 48 hours should be limited to BMP drainage areas with coarse soils that readily settle and to watersheds where warming may be determined to downstream fisheries.

### Construction/Inspection Considerations

- Inspect facility after first large to storm to determine whether the desired residence time has been achieved.
- When constructed with small tributary area, orifice sizing is critical and inspection should verify that flow through additional openings such as bolt holes does not occur.

### Performance

One objective of stormwater management practices can be to reduce the flood hazard associated with large storm events by reducing the peak flow associated with these storms. Dry extended detention basins can easily be designed for flood control, and this is actually the primary purpose of most detention ponds.

Dry extended detention basins provide moderate pollutant removal, provided that the recommended design features are incorporated. Although they can be effective at removing some pollutants through settling, they are less effective at removing soluble pollutants because of the absence of a permanent pool. Several studies are available on the effectiveness of dry extended detention ponds including one recently concluded by Caltrans (2002).

The load reduction is greater than the concentration reduction because of the substantial infiltration that occurs. Although the infiltration of stormwater is clearly beneficial to surface receiving waters, there is the potential for groundwater contamination. Previous research on the effects of incidental infiltration on groundwater quality indicated that the risk of contamination is minimal.

There were substantial differences in the amount of infiltration that were observed in the earthen basins during the Caltrans study. On average, approximately 40 percent of the runoff entering the unlined basins infiltrated and was not discharged. The percentage ranged from a high of about 60 percent to a low of only about 8 percent for the different facilities. Climatic conditions and local water table elevation are likely the principal causes of this difference. The least infiltration occurred at a site located on the coast where humidity is higher and the basin invert is within a few meters of sea level. Conversely, the most infiltration occurred at a facility located well inland in Los Angeles County where the climate is much warmer and the humidity is less, resulting in lower soil moisture content in the basin floor at the beginning of storms.

Vegetated detention basins appear to have greater pollutant removal than concrete basins. In the Caltrans study, the concrete basin exported sediment and associated pollutants during a number of storms. Export was not as common in the earthen basins, where the vegetation appeared to help stabilize the retained sediment.

### Siting Criteria

Dry extended detention ponds are among the most widely applicable stormwater management practices and are especially useful in retrofit situations where their low hydraulic head requirements allow them to be sited within the constraints of the existing storm drain system. In addition, many communities have detention basins designed for flood control. It is possible to modify these facilities to incorporate features that provide water quality treatment and/or channel protection. Although dry extended detention ponds can be applied rather broadly, designers need to ensure that they are feasible at the site in question. This section provides basic guidelines for siting dry extended detention ponds.

In general, dry extended detention ponds should be used on sites with a minimum area of 5 acres. With this size catchment area, the orifice size can be on the order of 0.5 inches. On smaller sites, it can be challenging to provide channel or water quality control because the orifice diameter at the outlet needed to control relatively small storms becomes very small and thus prone to clogging. In addition, it is generally more cost-effective to control larger drainage areas due to the economies of scale.

Extended detention basins can be used with almost all soils and geology, with minor design adjustments for regions of rapidly percolating soils such as sand. In these areas, extended detention ponds may need an impermeable liner to prevent ground water contamination.

The base of the extended detention facility should not intersect the water table. A permanently wet bottom may become a mosquito breeding ground. Research in Southwest Florida (Santana et al., 1994) demonstrated that intermittently flooded systems, such as dry extended detention ponds, produce more mosquitoes than other pond systems, particularly when the facilities remained wet for more than 3 days following heavy rainfall.

A study in Prince George's County, Maryland, found that stormwater management practices can increase stream temperatures (Galli, 1990). Overall, dry extended detention ponds increased temperature by about 5°F. In cold water streams, dry ponds should be designed to detain stormwater for a relatively short time (i.e., 24 hours) to minimize the amount of warming that occurs in the basin.

### Additional Design Guidelines

In order to enhance the effectiveness of extended detention basins, the dimensions of the basin must be sized appropriately. Merely providing the required storage volume will not ensure maximum constituent removal. By effectively configuring the basin, the designer will create a long flow path, promote the establishment of low velocities, and avoid having stagnant areas of the basin. To promote settling and to attain an appealing environment, the design of the basin should consider the length to width ratio, cross-sectional areas, basin slopes and pond configuration, and aesthetics (Young et al., 1996).

Energy dissipation structures should be included for the basin inlet to prevent resuspension of accumulated sediment. The use of stilling basins for this purpose should be avoided because the standing water provides a breeding area for mosquitoes.

Extended detention facilities should be sized to completely capture the water quality volume. A micropool is often recommended for inclusion in the design and one is shown in the schematic diagram. These small permanent pools greatly increase the potential for mosquito breeding and complicate maintenance activities; consequently, they are not recommended for use in California.

A large aspect ratio may improve the performance of detention basins; consequently, the outlets should be placed to maximize the flowpath through the facility. The ratio of flowpath length to width from the inlet to the outlet should be at least 1.5:1 (L:W) where feasible. Basin depths optimally range from 2 to 5 feet.

The facility's drawdown time should be regulated by an orifice or weir. In general, the outflow structure should have a trash rack or other acceptable means of preventing clogging at the entrance to the outflow pipes. The outlet design implemented by Caltrans in the facilities constructed in San Diego County used an outlet riser with orifices

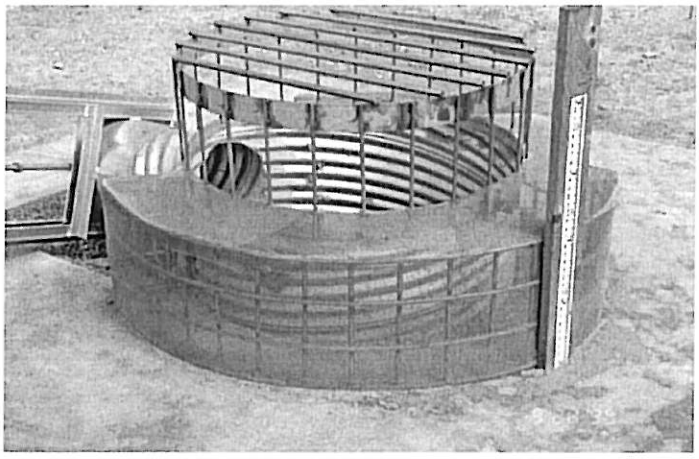

**Figure 1**
**Example of Extended Detention Outlet Structure**

sized to discharge the water quality volume, and the riser overflow height was set to the design storm elevation. A stainless steel screen was placed around the outlet riser to ensure that the orifices would not become clogged with debris. Sites either used a separate riser or broad crested weir for overflow of runoff for the 25 and greater year storms. A picture of a typical outlet is presented in Figure 1.

The outflow structure should be sized to allow for complete drawdown of the water quality volume in 72 hours. No more than 50% of the water quality volume should drain from the facility within the first 24 hours. The outflow structure can be fitted with a valve so that discharge from the basin can be halted in case of an accidental spill in the watershed.

***Summary of Design Recommendations***

(1) Facility Sizing - The required water quality volume is determined by local regulations or the basin should be sized to capture and treat 85% of the annual runoff volume. See Section 5.5.1 of the handbook for a discussion of volume-based design.

Basin Configuration – A high aspect ratio may improve the performance of detention basins; consequently, the outlets should be placed to maximize the flowpath through the facility. The ratio of flowpath length to width from the inlet to the outlet should be at least 1.5:1 (L:W). The flowpath length is defined as the distance from the inlet to the outlet as measured at the surface. The width is defined as the mean width of the basin. Basin depths optimally range from 2 to 5 feet. The basin may include a sediment forebay to provide the opportunity for larger particles to settle out.

A micropool should not be incorporated in the design because of vector concerns. For online facilities, the principal and emergency spillways must be sized to provide 1.0 foot of freeboard during the 25-year event and to safely pass the flow from 100-year storm.

(2) Pond Side Slopes - Side slopes of the pond should be 3:1 (H:V) or flatter for grass stabilized slopes. Slopes steeper than 3:1 (H:V) must be stabilized with an appropriate slope stabilization practice.

(3) Basin Lining – Basins must be constructed to prevent possible contamination of groundwater below the facility.

(4) Basin Inlet – Energy dissipation is required at the basin inlet to reduce resuspension of accumulated sediment and to reduce the tendency for short-circuiting.

(5) Outflow Structure - The facility's drawdown time should be regulated by a gate valve or orifice plate. In general, the outflow structure should have a trash rack or other acceptable means of preventing clogging at the entrance to the outflow pipes.

The outflow structure should be sized to allow for complete drawdown of the water quality volume in 72 hours. No more than 50% of the water quality volume should drain from the facility within the first 24 hours. The outflow structure should be fitted with a valve so that discharge from the basin can be halted in case of an accidental spill in the watershed. This same valve also can be used to regulate the rate of discharge from the basin.

The discharge through a control orifice is calculated from:

$$Q = CA(2g(H-H_o))^{0.5}$$

where: Q = discharge ($ft^3/s$)
C = orifice coefficient
A = area of the orifice ($ft^2$)
g = gravitational constant (32.2)
H = water surface elevation (ft)
$H_o$= orifice elevation (ft)

Recommended values for C are 0.66 for thin materials and 0.80 when the material is thicker than the orifice diameter. This equation can be implemented in spreadsheet form with the pond stage/volume relationship to calculate drain time. To do this, use the initial height of the water above the orifice for the water quality volume. Calculate the discharge and assume that it remains constant for approximately 10 minutes. Based on that discharge, estimate the total discharge during that interval and the new elevation based on the stage volume relationship. Continue to iterate until H is approximately equal to $H_o$. When using multiple orifices the discharge from each is summed.

(6) Splitter Box - When the pond is designed as an offline facility, a splitter structure is used to isolate the water quality volume. The splitter box, or other flow diverting approach, should be designed to convey the 25-year storm event while providing at least 1.0 foot of freeboard along pond side slopes.

(7) Erosion Protection at the Outfall - For online facilities, special consideration should be given to the facility's outfall location. Flared pipe end sections that discharge at or near the stream invert are preferred. The channel immediately below the pond outfall should be modified to conform to natural dimensions, and lined with large stone riprap placed over filter cloth. Energy dissipation may be required to reduce flow velocities from the primary spillway to non-erosive velocities.

(8) Safety Considerations - Safety is provided either by fencing of the facility or by managing the contours of the pond to eliminate dropoffs and other hazards. Earthen side slopes should not exceed 3:1 (H:V) and should terminate on a flat safety bench area. Landscaping can be used to impede access to the facility. The primary spillway opening must not permit access by small children. Outfall pipes above 48 inches in diameter should be fenced.

## Maintenance

Routine maintenance activity is often thought to consist mostly of sediment and trash and debris removal; however, these activities often constitute only a small fraction of the maintenance hours. During a recent study by Caltrans, 72 hours of maintenance was performed annually, but only a little over 7 hours was spent on sediment and trash removal. The largest recurring activity was vegetation management, routine mowing. The largest absolute number of hours was associated with vector control because of mosquito breeding that occurred in the stilling basins (example of standing water to be avoided) installed as energy dissipaters. In most cases, basic housekeeping practices such as removal of debris accumulations and vegetation

management to ensure that the basin dewaters completely in 48-72 hours is sufficient to prevent creating mosquito and other vector habitats.

Consequently, maintenance costs should be estimated based primarily on the mowing frequency and the time required. Mowing should be done at least annually to avoid establishment of woody vegetation, but may need to be performed much more frequently if aesthetics are an important consideration.

Typical activities and frequencies include:

- Schedule semiannual inspection for the beginning and end of the wet season for standing water, slope stability, sediment accumulation, trash and debris, and presence of burrows.
- Remove accumulated trash and debris in the basin and around the riser pipe during the semiannual inspections. The frequency of this activity may be altered to meet specific site conditions.
- Trim vegetation at the beginning and end of the wet season and inspect monthly to prevent establishment of woody vegetation and for aesthetic and vector reasons.
- Remove accumulated sediment and re-grade about every 10 years or when the accumulated sediment volume exceeds 10 percent of the basin volume. Inspect the basin each year for accumulated sediment volume.

## Cost

### *Construction Cost*

The construction costs associated with extended detention basins vary considerably. One recent study evaluated the cost of all pond systems (Brown and Schueler, 1997). Adjusting for inflation, the cost of dry extended detention ponds can be estimated with the equation:

$$C = 12.4V^{0.760}$$

where: C = Construction, design, and permitting cost, and
V = Volume ($ft^3$).

Using this equation, typical construction costs are:

$ 41,600 for a 1 acre-foot pond

$ 239,000 for a 10 acre-foot pond

$ 1,380,000 for a 100 acre-foot pond

Interestingly, these costs are generally slightly higher than the predicted cost of wet ponds (according to Brown and Schueler, 1997) on a cost per total volume basis, which highlights the difficulty of developing reasonably accurate construction estimates. In addition, a typical facility constructed by Caltrans cost about $160,000 with a capture volume of only 0.3 ac-ft.

An economic concern associated with dry ponds is that they might detract slightly from the value of adjacent properties. One study found that dry ponds can actually detract from the

perceived value of homes adjacent to a dry pond by between 3 and 10 percent (Emmerling-Dinovo, 1995).

### *Maintenance Cost*

For ponds, the annual cost of routine maintenance is typically estimated at about 3 to 5 percent of the construction cost (EPA website). Alternatively, a community can estimate the cost of the maintenance activities outlined in the maintenance section. Table 1 presents the maintenance costs estimated by Caltrans based on their experience with five basins located in southern California. Again, it should be emphasized that the vast majority of hours are related to vegetation management (mowing).

**Table 1 Estimated Average Annual Maintenance Effort**

| Activity | Labor Hours | Equipment & Material ($) | Cost |
|---|---|---|---|
| Inspections | 4 | 7 | 183 |
| Maintenance | 49 | 126 | 2282 |
| Vector Control | 0 | 0 | 0 |
| Administration | 3 | 0 | 132 |
| Materials | - | 535 | 535 |
| **Total** | **56** | **$668** | **$3,132** |

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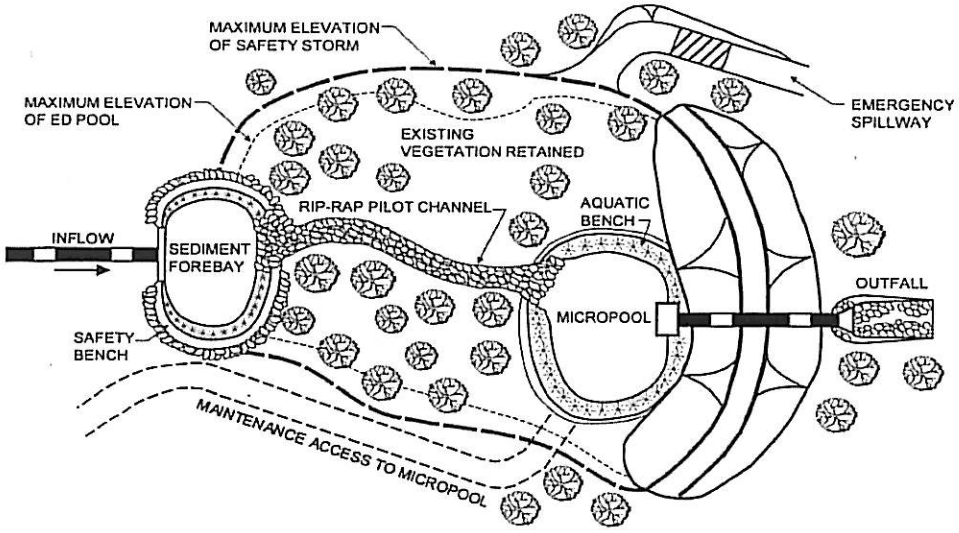
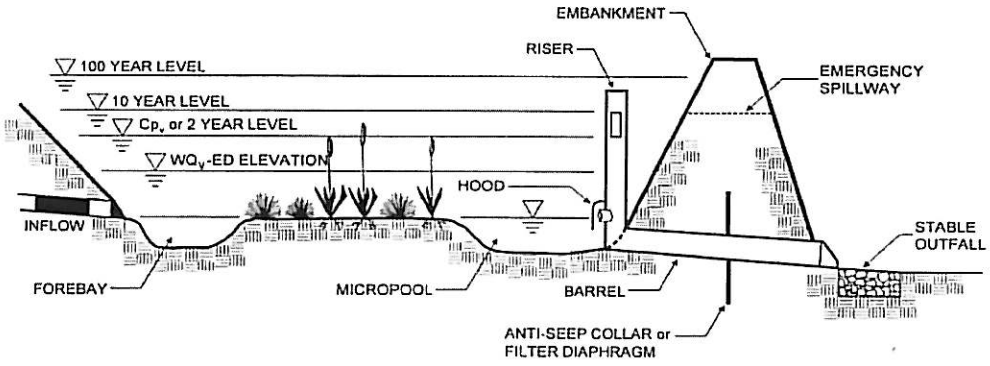



PLAN VIEW




PROFILE

**Schematic of an Extended Detention Basin (MDE, 2000)**