Water Quality Technical Report (WQTR)

Project Identification:

Helen Woodward Animal Center
6461 El Apajo Road
Rancho Santa Fe, CA 92067
Project Number: P04-059
Environmental Log Number: ER# 96-08-023B

Project Owner:

Helen Woodward Animal Center
6461 El Apajo Road
Rancho Santa Fe, CA 92067

Project Contractor: TBD

Prepared by:

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NOTE: Engineer's stamp and signature found in Attachment G.

COUNTY OF SAN DIEGO

4th Review – WQTR – Helen Woodward Animal Center (March 19, 2008)

Item	Review Comments	Resolved		Note
		Yes	No	
1.	*Section 1.5 states the project will decrease the runoff coefficient for the site, and later goes on to say the project will introduce 0.3 acres of impervious area representing an increase of 6%. Table 1-1 shows an increase of 7.6 % impervious. Please clarify percent impervious and runoff coefficients used in calculations and correct discrepancies.*	✓		Impervious area numbers updated and discrepancies fixed. Runoff coefficients calculated and included in Drainage Study.
2.	*Section 3.2 states the existing site contains 50% impervious and 50% pervious surfaces, while Table 1-1 shows the existing condition to be 63.9% impervious and 36.1% impervious. Please clarify / correct discrepancies.*	✓		Impervious area numbers updated and discrepancies fixed.
3.	*Table 12-2 total for estimated bmp construction costs is incorrect. Total shown amounts to $34,950 (not $104,896).*	✓		Fixed.
4.	*The Report should be signed and stamped by a registered engineer (Attachment G).*	✓		The document is now signed and stamped by the RCE.

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INTRODUCTION

The County of San Diego Watershed Protection, Storm Water Management, and Discharge Control Ordinance (WPO) (Ordinance No. 9424) requires all applications for a permit or approval associated with a Land Disturbance Activity must be accompanied by a Storm Water Management Plan (SWMP) or Water Quality Technical Report (WQTR) (section 67.804.f). The purpose of a SWMP or WQTR is to describe how the project will minimize the short and long-term impacts on receiving water quality. Projects that meet the criteria for a priority project are required to prepare a Major SWMP or WQTR.

The plans and specifications found in this WQTR are not for construction purposes; the contractor shall refer to the final approved construction documents of plans and specifications.

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1 Project Description

This section describes the project with respect to its location, the planned improvements, and places it within the context of the larger watershed.

1.1 PROJECT LOCATION

Helen Woodward Animal Center is located in Rancho Santa Fe, CA on El Apajo Road about 1000' northwest of the intersection of San Dieguito Road and El Apajo Road. Attachment A provides a location map for the project.

1.2 PROJECT DESCRIPTION AND PURPOSE

1.2.1 Project Description

The project consists of the phased demolition, reconstruction, and renovation of the existing 120,710 square-foot Helen Woodward Animal Center ("HWAC" or "the Center"), on its current Rancho Santa Fe site. The site is approximately 11.9 acres, and the phased rebuilding of the Center anticipates approximately 87,339 square feet of new building space, referred to as Building I, Building III, and the Therapeutic Riding Structure, and approximately 41,013 square feet of renovated space referred to as Building II. In addition, approximately 4,098 square feet of new horse stalls will be located adjacent to Building II and approximately 9,218 square feet of new horse stalls will be located adjacent to the Therapeutic Riding Arena. A variety of exterior site amenities are planned including horse grazing pastures, lunging pen, walking path, corrals, children's activity fields with pre-fabricated shade structure, animal play & exercise fields, mechanical and equipment storage yard, and waste storage. The design has changed from a Campus style plan in our original submittal, consisting of eight separate conditioned structures, to a more compact plan consisting of three conditioned structures, referred to as Building I, Building II, and Building III.

1.2.2 Project Activities

This project is the construction of a new animal center to place the existing center, and activities on the site will be typical of such development. The project is anticipated to generate significant animal waste products and will account for that in design.

1.3 EXISTING IMPROVEMENTS AND DRAINAGE PATTERNS

1.3.1 Existing Drainage Improvements

The existing drainage improvements for this project are not adequate for the current facility therefore will be updated. Currently in the northwest corner of the site, there are drainage issues. An existing storm drain pump is in use but will be upgraded with the new improvements. There are no current vegetated swales or BMP's located on site. There is a large drainage channel on the southern portion of the site that conveys mostly offsite runoff.

1.3.2 Floodplain Mapping

The Federal Emergency Management Agency (FEMA) categorizes the majority of the site (FIRM Panel 06073C-1327F) as Zone A - no base flood elevations determined. The remainder of the site is Zone X - areas determined to be outside the 500-year floodplain.

1.3.3 Downstream Conditions

Drainage generally flows from the northwestern corner of the site to the South, with the Northwestern portions of the site having the highest elevations. There are no existing catch basins on site.
The site **does not** discharge directly into a water body that has been listed under Section 303(d) of the Federal Clean Water Act as impaired for sediment, silt, or turbidity.

1.4 PROPOSED IMPROVEMENTS AND DRAINAGE PATTERNS

The proposed facilities managing runoff from the site include:

- Appropriate pad elevations of all proposed building structures will help prevent flooding as well as increase drainage flows.
- Area will feature vegetated swales to connect impervious areas to proposed storm drain systems to provide for water quality treatment.
- Sand filters will be places in locations where needed such as retaining wall drainage.
- Storm drain gravity pipes, storm drain force mains as well as a new pump will incorporate most of the storm drain system.
- All runoff from impervious areas on site will be routed through a sand filter, a vegetated swale or pervious pavement with sand underdrain before entering the storm drain system.
- All onsite drainage systems will drain into the existing onsite channel.

1.5 HYDROLOGIC EFFECT OF PROJECT

The proposed project will not substantially alter flow patterns on the site. Development on the site will concentrate flows in street gutters, vegetated swales, and storm drains, but will not divert runoff from its original outlet points

While there is a change in land use, it will actually decrease the Rational Method coefficient for the site. Because the "C" values for before and after development are near the same within the calculation accuracy of the Rational Method, the project will maintain peak flows equal to or less than the pre-developed peak flows. Given the small size of the project site relative to the watershed, and consistency with adjacent land use, development of the project site will have little effect on the water resources of the area.

Table 1-1 summarizes the impervious cover under existing and proposed condition. The proposed project will decrease the impervious area from pre-development to postdevelopment by approximately 0.4 acres representing a decrease of approximately 3.4 percent of the project site.

Table 1-1 Summary of Impervious Cover Analysis

Coverage	Existing Condition		Proposed Condition		Change	
	(acre)	(%)	(acre)	(%)	(acre)	(%)
Impervious Area						
Compacted DG	1.0	8.5%	0	0%	-1.0	-8.4%
Building/Paved Area (Streets)	6.1	51.7%	6.7	56.3%	0.6	5.0%
Subtotal Impervious Area	*7.1*	*60.2%*	*6.7*	*56.3%*	*-0.4*	*-3.4%*
Pervious Area						
Subtotal Pervious Area	*4.8*	*39.8%*	*5.2*	*43.7%*	*0.4*	*3.4%*
Total	**11.9**	**100%**	**11.9**	**100%**	**0**	**0%**

1.6 HYDROLOGIC CONTEXT (WATERSHED CONTRIBUTION)

The project site is located in the 22,602-acre (35.32- square mile) Rancho Santa Fe Hydrologic Area (HSA 905.11), which is part of the San Dieguito Hydrologic Unit (HS 905.00). The 11.9-acre property accounts for less than 0.06 percent of the local watershed area. **Attachment B** illustrates the project site in the context of the watershed.

Table 1-2 Comparison of Watershed Areas

	Area (acres)	22,602	11.9	11.9
Richland Area HSA 905.11	22,602	100%	-	-
Property	11.9	< 0.06%	100%	-
Impervious Area (Estimate)	6.8	< 0.04%	57%	100%

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2 Priority Project Determination

The following table determines whether the project is priority according to guidelines laid out in the Municipal Permit. There is a limited exclusion for trenching and re-surfacing work associated with utility projects, which are NOT considered priority projects. Parking lots, buildings, and other structures associated with utility projects are subject to SUSMP requirements if one or more of the criteria described in the table are met. Answering NO to all the projects indicates that the project is NOT a priority project and it is not necessary to complete a Major SWMP or WQTR. Rather, a SWMP for Minor Activities must be completed.

PRIORITY PROJECT	YES	NO
Redevelopment within the County Urban Area that creates or adds at least 5,000 of net square feet of additional impervious surface area.	✓	
Residential development of more than 10 units.		✓
Commercial developments with a land area for development of greater than 100,000 square feet	✓	
Automotive repair shops.		✓
Restaurants, where the land area for development is greater than 5,000 square feet.		✓
Hillside development, in an area with known erosive soil conditions, where there will be grading on any natural slope that is twenty-five percent or greater, if the development creates 5,000 square feet or more of impervious surface		✓
Environmentally Sensitive Areas: All development and redevelopment located within or directly adjacent to or discharging directly to an environmentally sensitive area (where discharges from the development or redevelopment will enter receiving waters within the environmentally sensitive area), which either creates 2,500 square feet of impervious surface on a proposed project site or increases the area of imperviousness of a proposed project site to 10% or more of its naturally occurring condition.		✓
Parking Lots 5,000 square feet or more or with 15 parking spaces or more and potentially exposed to urban runoff.	✓	
Streets, roads, highways, and freeways which would create a new paved surface that is 5,000 square feet or greater.	✓	

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3 Summary of Water Quality Issues

This section provides a summary of relevant storm water quality issues pertaining to the project site.

QUESTIONS	Section	Completed	N/A
Describe the topography of the project area.	3.1	✓	
Describe the local land use within the project area and adjacent areas.	3.2	✓	
Evaluate the presence of dry weather flow.	3.3	✓	
Determine the receiving waters that may be affected by the project throughout the project life cycle (i.e., construction, maintenance and operation).	3.4	✓	
For the project limits, list the 303(d) impaired receiving water bodies and their constituents of concern.	3.5	✓	
Determine if there are any High Risk Areas (municipal or domestic water supply reservoirs or groundwater percolation facilities) within the project limits.	3.6	✓	
Determine the Regional Board special requirements, including TMDLs, effluent limits, etc.	3.7	✓	
Determine the general climate of the project area. Identify annual rainfall and rainfall intensity curves.	3.8	✓	
If considering Treatment BMPs, determine the soil classification, permeability, erodibility, and depth to groundwater.	0	✓	
Determine contaminated or hazardous soils within the project area.	3.10		✓

3.1 TOPOGRAPHY

The property is characterized as predominantly flat. Site elevations vary from a high of approximately 38 feet Mean Sea Level (MSL) at the northwest corner near El Apajo Road, to a low of approximately 30 feet (MSL) in the southeast corner near the main drainage culvert

3.2 LAND USE AND VEGETATION

The entire 11.9 acre site is currently developed with about 60.2% impervious and 39.8% pervious areas. The pervious areas consist of landscaped areas, open animal stables as well as some un-vegetated open space. The impervious areas consist mostly of buildings, storage units, asphalt-paved parking lots and access driveways with associated curb, gutter and lighting.

3.3 DRY WEATHER FLOW

RBF Consulting conducted a field visit to the project site on June 31, 2007 to evaluate site conditions. On the site, there is a significant earthen channel that crosses the south portion of the site. The channel area is vegetated with dense weeds and shrubs, and is relatively stable without visible erosion problems (see Figure 3-1). It is possible that very minute low flows are present within the confines of the dense brush, but no dry weather flow was observed during the field visit.

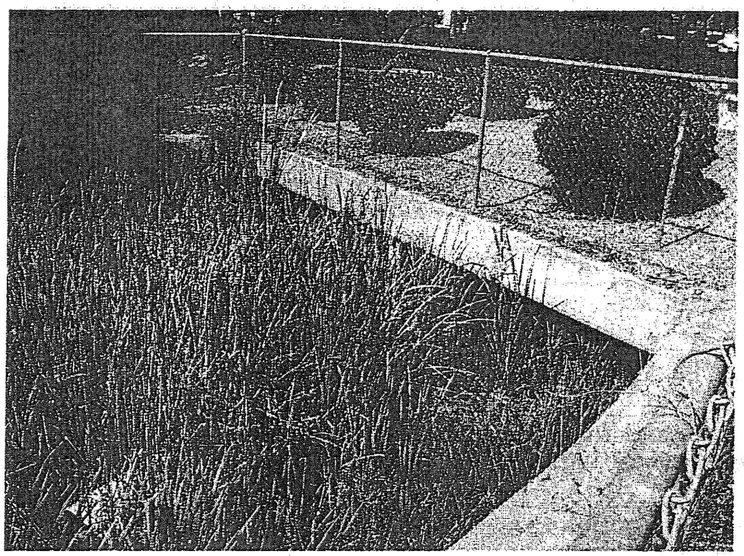

Figure 3-1 **Taken from approximate southeast corner of project site facing north.**

3.4 RECEIVING WATERS

Construction, operation, and maintenance of the project will affect receiving waters throughout the project lifetime. The most immediate receiving waters for the project site is an unnamed tributary of the San Dieguito River.

According to the California 2002 303(d) list published by the San Diego Regional Water Quality Control Board (RWQCB Region 9), none of the immediate receiving waters for the site are impaired for any pollutants.

Table 3-1 Summary of Receiving Surface Waters

Receiving Water	Hydrologic Unit Code	Approximate Distance From Site	303(d) Impairment(s)
San Dieguito Hydrologic Unit (905.00)			
Solano Beach Hydrologic Area (905.10)			
Unnamed Tributary of the San Dieguito River	905.11	-	NONE
San Dieguito River	905.11	1.25 mi	NONE
Pacific Ocean (San Dieguito Lagoon Mouth)	905.11	5 mi	Indicator Bacteria

The most immediate receiving water for the project site is an unnamed tributary of the San Dieguito River. The Pacific Ocean, approximately 5 miles downstream of the project site, is listed for indicator bacteria. It is highly unlikely that the potential pollutants from the project site would have a significant detrimental effect on the listed impairments so far downstream, but the distant impairments should kept in mind when determining appropriate program of BMPs. Table 3-1 summarizes the receiving waters and their classification by the RWQCB Region 9.

3.5 303(D) IMPAIRMENTS

The Environmental Protection Agency (EPA) is the primary federal agency responsible for management of water quality in the United States. The Clean Water Act (CWA) is the federal law that governs water quality control activities initiated by the EPA and others. Section 303 of the CWA requires the adoption of water quality standards for all surface water in the United States. Under Section 303(d), individual states are required to develop lists of water bodies that do not meet water quality objectives after required levels of treatment by point source dischargers. Total maximum daily loads (TMDLs) for all pollutants for which these water bodies are listed must be developed in order to bring them into compliance with water quality objectives.

3.6 RISK ASSESSMENT

There are no high-risk drinking water supply or other sensitive resources within the project limits. Because of the small size of the project in the context of the watershed, the low-intensity nature of the development, and the absence of any downstream reservoirs, the project is unlikely to have a significant effect on drinking water supply. Therefore, the *project presents negligible risk to drinking water supply or other sensitive resources.*

3.7 TOTAL MAXIMUM DAILY LOAD (TMDL)

There are currently no Total Maximum Daily Load (TMDL) restrictions for the project receiving waters.

3.8 GENERAL CLIMATE

San Diego climate is classified as Mediterranean, with warm, dry summers and mild, wet winters. Annual precipitation averages range from 10 inches along the coast to 18 inches the eastern mountains, with low to high intensity storms occurring mostly in the winter and spring.

The average annual precipitation for the watershed area is approximately 12 inches. The 6-hour, 100-year design precipitation for the project site is approximately 2.8 inches.

3.9 SOIL CHARACTERISTICS

According to the San Diego Soil Survey of 1973 the site lies on Soil Map Units DaE2, SbA, and TuB. These soil types are moderately well to excessively drained, and are slightly to severely erodible. **Table 3-2** summarizes the soils on the project site.

3.10 CONTAMINATED SOIL AND HAZARDOUS WASTE ASSESSMENT

There are no known contaminated soils, fills, or hazardous wastes at the project site.

Table 3-2 Summary of Site Soil Types

Soil Name	Symbol	Hydrologic Soil Type	Erodibility	Area (acres)	Fraction
DiabloClay	DaE2	D	Moderate	0.46	0.04
Salinas clay loam	SbA	B	Slight	8.74	0.74
Tujunga sand	TuB	A	Slight	2.68	0.22
TOTAL				**11.88**	**1.00**

4 Treatment Best Management Practice Plan Requirements

CRITERIA	YES	NO	INSTRUCTIONS
1. Is this an emergency project?		✓	If YES, go to 6. If NO, continue to 2.
2. Are there established TMDLs for surface waters within the project limits?		✓	If YES, go to 5. If NO, continue to 3.
3. Will the project directly discharge to a 303(d) impaired receiving water body?		✓	If YES, go to 5. If NO, continue to 4.
4. Is this project within the urban and environmentally sensitive areas? (see SUSMP Appendix B)	✓		If YES, continue to 5. If NO, go to 6.
5. Consider approved treatment control BMPs for the project.	✓		If YES, continue to 7. *Treatment control BMPs selection and design are discussed further in Section 11.*
6. Project is not required to consider treatment BMPs			If project is not required to consider treatment control BMPs, document for the project file by referencing this checklist.
7. END			

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5 Watershed Identification

- ☐ San Juan (901)
- ☐ Santa Margarita (902)
- ☐ Carlsbad (904)
- ☒ San Dieguito (905)
- ☐ Penasquitos (906)
- ☐ Pueblo San Diego (908)
- ☐ Sweetwater (909)
- ☐ Otay (910)
- ☐ Tijuana (911)

		303(d) Impairments
Receiving Water	Unnamed Tributary of the San Dieguito River	NONE
Hydrologic Unit	San Dieguito (HU 905.00)	Indicator Bacteria
Hydrologic Area	Solano Beach (HA 905.1)	Indicator Bacteria

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6 Beneficial Uses

This section summarizes the beneficial uses of surface water and ground water resources downstream of the project.

6.1 DEFINITIONS

The Porter-Cologne Act establishes a comprehensive program for the protection of beneficial uses of the waters of the state. California Water Code Section 13050(f) describes the beneficial uses of surface and ground waters that may be designated by the State or Regional Board for protection as follows:

"Beneficial uses of the waters of the state that may be protected against quality degradation include, but are not necessarily limited to, domestic, municipal, agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves."

Beneficial uses for surface waters are designated under the Clean Water Act Section 303 in accordance with regulations contained in 40 CFR 131. The State is required to specify appropriate water uses to be achieved and protected. The beneficial use designation of surface waters of the state must take into consideration the use and value of water for public water supplies, protection and propagation of fish, shellfish and wildlife, recreation in and on the water, agricultural, industrial and other purposes including navigation.

In 1972, the State Board adopted a uniform list and description of beneficial uses to be applied throughout all basins of the State. During the 1994 Basin Plan update, beneficial use definitions were revised and some new beneficial uses were added. The following beneficial uses are defined statewide and are designated within the San Diego Region:

Municipal and Domestic Supply. Includes uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

Agricultural Supply. Includes uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

Industrial Process Supply. Includes uses of water for industrial activities that depend primarily on water quality.

Industrial Service Supply. Includes uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.

Ground Water Recharge. Includes uses of water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.

Freshwater Replenishment. Includes uses of water for natural or artificial maintenance of surface water quantity or quality (e.g., salinity).

Navigation. Includes uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

Hydropower Generation. Includes uses of water for hydropower generation.

Contact Water Recreation. Includes uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and SCUBA diving, surfing, white water activities, fishing, or use of natural hot springs.

Non-Contact Water Recreation. Includes the uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

Commercial and Sport Fishing. Includes the uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

Aquaculture. Includes the uses of water for aquaculture or mariculture operations including, but not limited to, propagation, cultivation, maintenance, or harvesting of aquatic plants and animals for human consumption or bait purposes.

Warm Freshwater Habitat. Includes uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish or wildlife, including invertebrates.

Cold Freshwater Habitat. Includes uses of water that support cold-water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish or wildlife, including invertebrates.

Inland Saline Water Habitat. Includes uses of water that support inland saline water ecosystems including, but not limited to, preservation or enhancement of aquatic saline habitats, vegetation, fish, or wildlife, including invertebrates.

Estuarine Habitat. Includes uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).

Marine Habitat. Includes uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).

Wildlife Habitat. Includes uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Preservation of Biological Habitats of Special Significance. Includes uses of water that support designated areas or habitats, such as established refuges, parks, sanctuaries, ecological reserves, or Areas of Special Biological Significance (ASBS), where the preservation or enhancement of natural resources requires special protection.

6.1.1 Beneficial Uses: Inland Surface Waters

The RWQCB San Diego Basin Plan identifies several beneficial uses of receiving inland surface waters. Table 6-1 summarizes the beneficial uses identified for downstream inland surface waters.

6.1.2 Beneficial Uses: Coastal Waters

The Pacific Ocean (906.10), approximately 5 miles downstream of the project site, is listed for bacterial indicators. Due to the relatively small project site, it is highly unlikely that the potential pollutants from the project site would have a detrimental effect on the listed impairments downstream, but the distant impairments should be kept in mind when determining appropriate program of BMPs. Table 6-2 summarizes the beneficial uses identified for downstream coastal waters.

6.1.3 Beneficial Uses: Lake and Reservoirs

The RWQCB San Diego Basin Plan identifies several beneficial uses of receiving lakes and reservoirs. In this particular case, there are no lakes or reservoirs locater downstream of the site. Table 6-3 summarizes the beneficial uses identified for downstream lakes and reservoirs.

6.1.4 Beneficial Uses: Groundwater Resources

The RWQCB Basin Plan identifies the beneficial uses of groundwater resources. Table 6-4 summarizes the beneficial uses of downstream groundwater resources.

Table 6-1 Beneficial Uses of Downstream Inland Surface Waters (RWQCB, 1998).

● Existing Beneficial Use ○ Potential Beneficial Use + Exempt from Municipal Use	**Beneficial Use**														
Receiving Water (Hydrologic Unit Code)	Municipal/Domestic Supply	Agricultural Supply	Industrial Service Supply	Industrial Process Supply	Groundwater Recharge	Freshwater Replenishment	Hydropower Generation	Contact Water Recreation	Non-Contact Water Recreation	Significant Biological Habitats	Warm Freshwater Habitat	Cold Freshwater Habitat	Wildlife Habitat	Rare Species	Fish Spawning and Development
San Dieguito River (HSA 905.11)	+	○	○					●	●		●		●		

Table 6-2 Beneficial Uses of Downstream Coastal Waters (RWQCB, 1998).

● Existing Beneficial Use ○ Potential Beneficial Use	**Beneficial Use**														
Receiving Water (Hydrologic Unit Code)	Industrial	Navigation	Contact Water Recreation	Non-Contact Water Recreation	Commercial/Sport Fishing	Significant Biological Habitats	Estuarine Habitat	Wildlife Habitat	Rare Species	Marine Habitat	Aquaculture	Aquatic Organism Migration	Spawning	Warm Freshwater Habitat	Shellfish
San Dieguito Lagoon (905.11)			●	●		●	●	●	●	●		●			
Pacific Ocean (905.11)	●	●	●	●	●	●		●	●	●	●	●	●		●

Table 6-3 Beneficial Uses of Downstream Lakes and Reservoirs (RWQCB, 1998).

● Existing Beneficial Use ○ Potential Beneficial Use	Beneficial Use												
Receiving Water (Hydrologic Unit Code)	Municipal/Domestic Supply	Agricultural Supply	Industrial Process Supply	Industrial Service Supply	Groundwater Recharge	Freshwater Replenishment	Contact Water Recreation[1]	Non-Contact Water Recreation	Warm Freshwater Habitat	Cold Freshwater Habitat	Wildlife Habitat	Rare Species	Hydropower Generation
N/A													

(1) Fishing from shore or boat is permitted, but other water contact recreation uses are prohibited.

Table 6-4 Beneficial Use of Downstream Ground Waters (RWQCB, 1998).

● Existing Beneficial Use ○ Potential Beneficial Use	Beneficial Use					
Receiving Water (Hydrologic Unit Code)	Municipal/Domestic Supply	Agricultural Supply	Industrial Service Supply	Industrial Process Supply	Freshwater Replenishment	Groundwater Recharge
N/A						

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7 Pollutants of Concern

7.1 POTENTIAL POLLUTANTS

The proposed project is not expected to generate significant amounts of pollutants, but many constituents are generally anticipated for projects in this category. Table 7-1 identifies anticipated pollutants that might be generated from priority project categories.

Table 7-1 Anticipated and Potential Pollutants by Project Type (San Diego County, 2002a)

✓ Anticipated Pollutants **P** Potential Pollutants	General Pollutant Categories								
Priority Project Categories	Sediments	Nutrients	Heavy Metals	Organic Substances	Trash and Debris	Oxygen-Demanding Substances	Oils and Grease	Bacteria and Viruses	Pesticides
Detached Residential	✓	✓			✓	✓	✓	✓	✓
Attached Residential	✓	✓			✓	P(1)	P(2)	P	✓
Commercial (>100,000 sf)	P(1)	P(1)		P(2)	✓	P(5)	✓	P(3)	P(5)
Auto Repair Shops			✓	✓	✓		✓		
Restaurants					✓	✓	✓	✓	
Hillside Development (>5,000 sf)	✓				✓	✓	✓		✓
Parking Lots	P(1)	P(1)	✓		✓	P(1)	✓		P(1)
Streets, Highways, and Freeways	✓	P(1)	✓	P(4)	✓	P(5)	✓		
Retail Gasoline Outlets			✓	P(4)	✓		✓		

(1) A potential pollutant if landscaping exists on-site; (2) A potential pollutant if the project includes uncovered parking areas; (3) A potential pollutant if land use involved food or animal waste products; (4) Including petroleum hydrocarbons; (5) Including solvents.

7.2 POLLUTANTS

The following discussion briefly describes the pollutants listed in Table 7-1.

7.2.1 Sediment

Sediments are soils or other surface materials eroded and then transported or deposited by the action of wind, water, ice, or gravity. Sediments can increase turbidity, clog fish gills, reduce spawning habitat, lower young aquatic organisms survival rates, smother bottom dwelling organisms, and suppress aquatic vegetation growth.

7.2.2 Nutrients

Nutrients are inorganic substances, such as nitrogen and phosphorus. They commonly exist in the form of mineral salts that are either dissolved or suspended in water. Primary sources of nutrients in urban runoff are fertilizers and eroded soils. Excessive discharge of nutrients to water bodies and streams can cause excessive aquatic algae and plant growth. Such excessive production, referred to as cultural eutrophication, may lead to excessive decay of organic matter in the water body, loss of oxygen in the water, release of toxins in sediment, and the eventual death of aquatic organisms.

7.2.3 Heavy Metals

Metals are raw material components in non-metal products such as fuels, adhesives, paints, and other coatings. The primary sources of metal pollution in storm water are typically commercially available metals and metal products. Metals of concern include cadmium, chromium, copper, lead, mercury, and zinc. Lead and chromium have been used as corrosion inhibitors in primer coatings and cooling tower systems. At low concentrations naturally occurring in soil, metals are not toxic. However, at higher concentrations, certain metals can be toxic to aquatic life. Humans can be impacted from contaminated groundwater resources, and bioaccumulation of metals in fish and shellfish. Environmental concerns, regarding the potential for release of metals to the environment, have already led to restricted metal usage in certain applications.

7.2.4 Organic Compounds

Organic compounds are carbon-based (commercially available or naturally occurring) substances found in pesticides, solvents, and hydrocarbons. Organic compounds can, at certain concentrations, indirectly or directly constitute a hazard to life or health. When rinsing off objects, toxic levels of solvents and cleaning compounds can be discharged to storm drains. Dirt, grease, and grime retained in the cleaning fluid or rinse water may also adsorb levels of organic compounds that are harmful or hazardous to aquatic life.

7.2.5 Trash and Debris

Trash (such as paper, plastic, polystyrene packing foam, and aluminum materials) and biodegradable organic matter (such as leaves, grass cuttings, and food waste) are general waste products on the landscape. The presence of trash and debris may have a significant impact on the recreational value of a water body and aquatic habitat. Excess organic matter can create a high biochemical oxygen demand in a stream and thereby lower its water quality. Also, in areas where stagnant water exists, the presence of excess organic matter can promote septic conditions resulting in the growth of undesirable organisms and the release of odorous and hazardous compounds such as hydrogen sulfide.

7.2.6 Oxygen-Demanding Substances

This category includes biodegradable organic material as well as chemicals that react with dissolved oxygen in water to form other compounds. Proteins, carbohydrates, and fats are examples of biodegradable organic compounds. Compounds such as ammonia and hydrogen sulfide are examples of oxygen-demanding compounds. The oxygen demand of a substance can lead to depletion of dissolved oxygen in a water body and possibly the development of septic conditions.

7.2.7 Oil and Grease

Oil and grease are characterized as high-molecular weight organic compounds. The primary sources of oil and grease are petroleum hydrocarbon products, motor products from leaking vehicles, esters, oils, fats, waxes, and high molecular-weight fatty acids. Introduction of these pollutants to the water bodies are very possible due to the wide uses and applications of some of these products in municipal, residential, commercial, industrial, and construction areas. Elevated oil and grease content can decrease the aesthetic value of the water body, as well as the water quality.

7.2.8 Bacteria and Viruses

Bacteria and viruses are ubiquitous microorganisms that thrive under certain environmental conditions. Their proliferation is typically caused by the transport of animal or human fecal wastes from the watershed. Water containing excessive bacteria and viruses can alter the aquatic habitat and create a harmful environment for humans and aquatic life. Also, the decomposition of excess organic waste causes increased growth of undesirable organisms in the water.

7.2.9 Pesticides

Pesticides (including herbicides) are chemical compounds commonly used to control nuisance growth of organisms. Excessive application of a pesticide may result in runoff containing toxic levels of its active component.

7.3 PRIMARY POLLUTANTS OF CONCERN

Primary pollutants of concern are pollutants that correspond to Clean Water Act section 303(d) impairment of the receiving waters of the project and may aggravate the identified impairment(s). Table 7-2 summarizes these primary pollutants of concern and the treatment control BMPs applied to the project site that target them (see Section 11 for more information).

Table 7-2 Primary Pollutants of Concern versus BMP Matrix

Condition of Concern (Impairments)	Primary Pollutants of Concern (Potential Aggravating Pollutant Sources)	Permanent Best Management Practice(s)
None		

According to the California 2002 303(d) list published by the San Diego Regional Water Quality Control Board (RWQCB Region 9), none of the immediate receiving waters are impaired for any pollutants. However, the fact that the San Dieguito Lagoon and Pacific Ocean are listed should be given consideration in the water quality effect analysis. Table 3-1 summarizes the receiving waters and their classification by the RWQCB Region 9.

7.4 SECONDARY POLLUTANTS OF CONCERN

Pollutants that are anticipated from the project, but are not correlated to receiving water impairments are considered secondary pollutants of concern. Table 7-3 summarizes the secondary pollutants of concern and the treatment control BMPs applied to the project site that target them (see Section 11 for more information).

Table 7-3 Secondary Pollutants of Concern versus BMP Matrix

Anticipated Pollutants	Potential Aggravating Pollutant Source(s)	Permanent Best Management Practice(s)
Sediment	Roadways	Vegetated Swales
Nutrients	Sediment-Adsorbed Pollutants from Residential Development	On Lot Measures (Vegetated Swales or Bioretention)
Trash and Debris		Riprap Aprons
O2-Demanding Substances		Homeowner Outreach (CC&R)
Oils and Grease		
Bacteria and Viruses		
Pesticides		

The most important secondary pollutants of concern from this residential development will be (1) an increase in sediment discharge from the site due to concentration of flows (which may carry adsorbed pollutants of concern); (2) trash (such as paper, plastic, polystyrene packing foam, and aluminum materials) and biodegradable organic matter (such as leaves, grass cuttings, and food waste), which may create a "habitat" for harmful bacteria; and (3) pesticides, oils, grease, and other hydrocarbons from landscaped areas, parking lots, and driveways.

Sediment discharge and eroded soil are of most concern during construction phase of the project. A complete program of construction Best Management Practices (BMPs) will be developed for the project site, and will be described in a Storm Water Pollution Prevention Program (SWPPP) for Construction Activities as part of the approval of the final grading plans. The construction BMPs will address this condition of concern during the construction phase.

Sediment discharge and eroded soil will also be a condition of concern after construction is complete. On one hand, leveling and stabilizing the site might actually reduce the sediment yield from the site. However, concentration of flows at the culverts will potentially generate erosive conditions on hillsides. Riprap protection, landscape planting, and other measures will be taken to ensure that the constructed slopes and areas downstream of culverts are adequately protected from concentrated storm water flows.

Other common pollutants from detached residential housing have the potential to aggravate downstream impairments. Eroded soils may increase total dissolved solids, and may carry nutrients like phosphorous into downstream receiving waters. Biodegradable materials in trash can lower dissolved oxygen. It is possible that pet waste would help aggravate downstream coliform and bacterial impairments, but given the low magnitude and the distance of the site from the impairment, this condition of concern in not probable and therefore should be given a low priority. Source control and treatment control (for example, vegetated swales) BMPs will mitigate potential pollutants like soil-borne nutrients and chemicals, trash, and hydrocarbons, to the maximum extent practical after

8 Construction BMPs

Best management practices to prevent, reduce, or treat storm water pollution will be implemented during the construction phase of the project. Table 8-1 and Table 8-2 (next pages) summarize the Construction BMPs that will be used for the project. The applicant is responsible for the placement and maintenance of the BMPs selected.

Because the project site is larger than one acre in size, a full Storm Water Pollution Prevention Plan for Construction Activities (SWPPP) will be developed for the project under separate cover from this WQTR. Please reference the SWPPP and erosion control plans for additional construction-phase BMP information.

Table 8-1 Minimum Required Construction BMPs

Minimum Required Best Management Practices (BMPs)	Caltrans Stormwater Handbook Reference Detail	BMP Selected	Explanation (If No BMP Selected)
Step 1 Select Erosion Control method for graded Slopes (choose at least one)			
Vegetation Stabilization Planting (see note 1)	SS-2 SS-4	☒	
Hydraulic Stabilization Hydroseeding (see note 1)	SS-3 SS-4	☒	
Bonded Fiber Matrix (see note 2)	SS-4	☐	
Physical Stabilization / Erosion Control Blanket (see note 2)	SS-7	☐	
Step 2 Select Erosion Control Method for Graded Flat Areas (Slope < 5%) (Choose at Least One)			
Will use above Slope Control measures on flat areas also	SS-2,3,4,7	☒	
Mulch, straw, wood chips, soil application	SS-6 SS-8	☐	
De-silting Basin (must treat all site runoff)	SC-2	☐	
Step 3 If runoff is concentrated, velocity must be controlled using energy dissipater			
Energy Dissipater Outlet Protection (see note 3)	SS-10	☐	
Step 4 Select Sediment Control method for all disturbed areas (choose at least one)			
Silt Fence	SC-1	☐	
Straw Wattles	SC-5	☒	
Gravel Bags	SC-6 & 8	☒	
Storm Drain Inlet Protection	SC-10	☒	
De-silting Basin (sized for Construction)	SC-2	☐	
Step 5 Select method for preventing offsite tracking of sediment (choose at least one)			
Stabilized Construction Entrance	TC-1	☒	
Construction Road Stabilization	TC-2	☐	
Entrance/Exit Tire Wash	TC-3	☐	
Entrance/Exit Inspection & Cleaning Facility	-	☐	

Step 6 Select the General Site Management BMPs for each waste that will be on site			
Materials Management / Material Delivery & Storage	WM-1	☒	
Waste Management / Concrete Waste Management	WM-8	☒	
Solid Waste Management	WM-5	☒	
Sanitary Waste Management	WM-9	☒	
Hazardous Waste Management	WM-6	☐	

Notes:

1. When Planting or Hydroseeding are selected for erosion control, the vegetative cover must be planted by August 15th and established by October 1st. If in the opinion of the County Official the vegetative cover is not established by October 1st, additional hydraulic or physical erosion control BMPs will be required.

2. These BMPs are temporary measures only when used without planting or hydroseeding. All slopes must have established vegetative cover prior to final grading approval.

3. Regional Standard Drawing D-40 - Rip Rap Energy Dissipater is also acceptable for velocity reduction.

4. Not all grading projects will have every waste identified. The applicant is responsible for identifying wastes that will be on-site and applying the appropriate BMP. For example, if concrete will be used, BMP WM-8 should be selected.

Table 8-2 Additional Construction BMPs

Best Management Practices (BMPs)	**Caltrans Stormwater Handbook Detail**	**BMP Selected**
EROSION CONTROL		
Site Development Considerations		
Scheduling	SS-1	☒
Preservation of Existing Vegetation	SS-2	☒
Other (submit description for approval)		☐
Vegetation Stabilization		
Vegetation Buffer Strips	SS-2	☐
Physical Stabilization		
Dust Control	WE-1	☒
Soil Stabilizers	SS-5	☐
DIVERSION OF RUNOFF		
Earthen Dikes	SS-9	☐
Ditches and Berms	SS-9	☐
Slope Drains	SS-11	☐
Temporary Drains & Swales	SS-9	☒
VELOCITY REDUCTION		
Check Dams	SS-4	☐
Slope Terracing	-	☐
SEDIMENT CONTROL		
Brush or Rock Filter	-	☐
Sediment Trap	SC-3	☒
Sediment Basin	SC-2	☐
GENERAL SITE MANAGEMENT		
Employee & Subcontractor Training	-	☒
Materials Management		
Spill Prevention & Control	WM-4	☒
Waste Management		
Contaminated Soil Management	WM-7	☐
Vehicle and Equipment Management		
Vehicle & Equipment Cleaning	NS-8	☒
Vehicle & Equipment Fueling	NS-9	☒
Vehicle & Equipment Maintenance	NS-10	☒
Construction Practices		
Water Conservation	NS-1	☒
Structure Construction & Painting	-	☒
Paving Operations	NS-3	☒
Dewatering Operations	NS-2	☐

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9 Site Design BMPs

Site design BMPs aim to conserve natural areas and minimize impervious cover, especially impervious areas 'directly connected' to receiving waters, in order to maintain or reduce increases in peak flow velocities from the project site. The project has incorporated site design BMPs to the maximum extent possible. This section summarizes the selection and application of site design BMPs on the project site.

9.1 SITE DESIGN BMP SELECTION MATRIX

	SITE DESIGN BMP OPTION	YES	NO	N/A	EXPLANATION[1]
1.	Can the project be relocated or realigned to avoid/reduce impacts to receiving waters or to increase the preservation of critical (or problematic) areas such as floodplains, steep slopes, wetlands, and areas with erosive or unstable soil conditions?	✓			
2.	Can the project be designed to minimize impervious footprint?	✓			
3.	Conserve natural areas where feasible?	✓			
4.	Where landscape is proposed, can rooftops, impervious sidewalks, walkways, trails and patios be drained into adjacent landscaping?	✓			
5.	For roadway projects, can structures and bridges be designed or located to reduce work in live streams and minimize construction impacts?			✓	The project does not involve roadway structures..
6.	Can any of the following methods be utilized to minimize erosion from slopes:				

[1] *Explanation is only required if "NO" or "N/A" is indicated; if YES is checked, it is assumed that the measure was used for this project.*

	SITE DESIGN BMP OPTION	YES	NO	N/A	EXPLANATION[1]
	6.a. Disturbing existing slopes only when necessary?	✓			
	6.b. Minimize cut and fill areas to reduce slope lengths?	✓			
	6.c. Incorporating retaining walls to reduce steepness of slopes or to shorten slopes?		✓		There are no significant slopes on the site.
	6.d. Providing benches or terraces on high cut and fill slopes to reduce concentration of flows?		✓		There are no significant slopes on the site.
	6.e. Rounding and shaping slopes to reduce concentrated flow?		✓		There are no significant slopes on the site.
	6.f. Collecting concentrated flows in stabilized drains and channels?	✓			
	OTHER SITE DESIGN BMPS				
	Riprap Energy Dissipaters	✓			

9.2 PROJECTS WITHIN CHANNELS

The following decision matrix must be completed for projects that include work within channels. The information is obtained from the project drainage report.

ITEM	CRITERIA	YES	NO	N/A	INSTRUCTIONS	EXPLANATION
	The project includes work within drainage channels.	✓			If YES, START at 1.	The project extends culverts in secondary channel
1.	Will the project increase velocity or volume of downstream flow?		✓		If YES go to 5.	
2.	Will the project discharge to unlined channels?	✓			If YES go to 5.	
3.	Will the project increase potential sediment load of downstream flow?		✓		If YES go to 5.	
4.	Will the project encroach, cross, realign, or cause other hydraulic changes to a stream that may affect upstream and/or downstream channel stability?		✓		If YES go to 7.	
5.	Review channel lining materials and design for stream bank erosion.			✓	Continue to 6.	Bank erosion to be verified during design.
6.	Consider channel erosion control measures within the project limits as well as downstream. Consider scour velocity.	✓			Continue to 7.	
7.	Include, where appropriate, energy dissipation devices at culverts.	✓			Continue to 8.	
8.	Ensure all transitions between culvert outlets/headwalls/wingwalls and channels are smooth to reduce turbulence and scour.	✓			Continue to 9.	
9.	Include, if appropriate, detention facilities to reduce peak discharges.			✓		Peak discharge is reduced with proposed development.
10.	"Hardening" natural downstream areas to prevent erosion is not an acceptable technique for protecting channel slopes, unless pre-development conditions are determined to be so erosive that hardening would be required even in the absence of the proposed development.		✓		Continue to 11.	
11.	Provide other design principles that are comparable and equally effective.			✓	Continue to 12.	
12.	End					

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10 Source Control BMPs

Source-control BMPs are activities, practices, and procedures (primarily non-structural) that are designed to prevent urban runoff pollution. These measures either reduce the amount of runoff from the site or prevent contact between potential pollutants and storm water. Also, source-control BMPs are often the best method to address non-storm (dry-weather) flows. The following table lists source-control BMP alternatives and indicates the practices that will be applied at the project site.

10.1.1 Source Control BMP Selection Matrix

	SOURCE CONTROL BMP OPTION	YES	NO	N/A	EXPLANATION[1]
1.	**Storm Drain System Stenciling and Signage**				
	1.a. All storm drain inlets and catch basins within the project area shall have a stencil or tile placed with prohibitive language and/or graphical icons to discourage illegal dumping.	✓			
	1.b. Signs and prohibitive language and/or graphical icons, which prohibit illegal dumping, must be posted at public access points along channels and creeks within the project area.	✓			
2.	**Outdoor Material Storage Areas**				

[1] *Explanation is only required if "NO" or "N/A" is indicated; if YES is checked, it is assumed that the measure was used for this project.*

	SOURCE CONTROL BMP OPTION	YES	NO	N/A	EXPLANATION[1]
	2.b. Hazardous materials with the potential to contaminate urban runoff shall either be: (1) placed in an enclosure such as, but not limited to, a cabinet, shed, or similar structure that prevents contact with runoff or spillage to the storm water conveyance system; or (2) protected by secondary containment structures such as berms, dikes, or curbs.	✓			
	2.c. The storage area shall be paved and sufficiently impervious to contain leaks and spills.	✓			
	2.d. The storage area shall have a roof or awning to minimize direct precipitation within the secondary containment area.	✓			
3.	**Trash Storage Areas**				
	3.a Paved with an impervious surface, designed not to allow run-on from adjoining areas, screened or walled to prevent off-site transport of trash; or,	✓			
	3.b. Provide attached lids on all trash containers that exclude rain, or roof or awning to minimize direct precipitation.	✓			
4.	**Efficient Irrigation Systems and Landscape Design** The following methods to reduce excessive irrigation runoff shall be considered, and incorporated and implemented where determined applicable and feasible.				
	4.a Employing rain shutoff devices to prevent irrigation after precipitation.	✓			
	4.b. Designing irrigation systems to each landscape area's specific water requirements.	✓			
	4.c. Using flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.	✓			
	4.d. Employing other comparable, equally effective, methods to reduce irrigation water runoff.	✓			

	SOURCE CONTROL BMP OPTION	YES	NO	N/A	EXPLANATION[1]
5.	**Private Roads** The design of private roadway drainage shall use at least one of the following:				
	5.a. Rural swale system: street sheet flows to vegetated swale or gravel shoulder, curbs at street corners, culverts under driveways and street crossings.			✓	
	5.b Urban curb/swale system: street slopes to curb, periodic swale inlets drain to vegetated swale/biofilter.	✓			
	5.c. Dual drainage system: First flush captured in street catch basins and discharged to adjacent vegetated swale or gravel shoulder, high flows connect directly to storm water conveyance system.		✓		
	5.d. Other methods that are comparable and equally effective within the project.			✓	
6.	**Residential Driveways & Guest Parking** The design of driveways and private residential parking areas shall use one at least of the following features.				
	6.a. Design driveways with shared access, flared (single lane at street) or wheelstrips (paving only under tires); or, drain into landscaping prior to discharging to the storm water conveyance system.			✓	The project is not residential.
	6.b. 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 storm water conveyance system.			✓	
	6.c. Other features which are comparable and equally effective.			✓	
7.	**Dock Areas** Loading/unloading dock areas shall include the following.				
	7.a. Cover loading dock areas, or design drainage to preclude urban run-on and runoff.				
	7.b. Direct connections to storm drains from depressed loading docks (truck wells) are prohibited.	✓			

	SOURCE CONTROL BMP OPTION	YES	NO	N/A	EXPLANATION[1]
	7.c. Other features which are comparable and equally effective.			✓	
8.	**Maintenance Bays**				
	8.a. Repair/maintenance bays shall be indoors; or, designed to preclude urban run-on and runoff.			✓	The project does not include any maintenance bays.
	8.b. Design a repair/maintenance bay drainage system to capture all wash water, leaks and spills. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.			✓	
	8.c. Other features which are comparable and equally effective.			✓	
9.	**Vehicle Wash Areas** Priority projects that include areas for washing/steam cleaning of vehicles shall use the following.				
	9.a. Self-contained; or covered with a roof or overhang.			✓	The project does not include any vehicle wash areas.
	9.b. Equipped with a clarifier or other pretreatment facility.			✓	
	9.c. Properly connected to a sanitary sewer.			✓	
	9.d. Other features which are comparable and equally effective.			✓	
10.	**Outdoor Processing Areas** Outdoor process equipment operations, such as rock grinding or crushing, painting or coating, grinding or sanding, degreasing or parts cleaning, waste piles, and wastewater and solid waste treatment and disposal, and other operations determined to be a potential threat to water quality by the County shall adhere to the following requirements.				

	SOURCE CONTROL BMP OPTION	YES	NO	N/A	EXPLANATION[1]
	10.a. Cover or enclose areas that would be the most significant source of pollutants; or, slope the area toward a dead-end sump; or, discharge to the sanitary sewer system following appropriate treatment in accordance with conditions established by the applicable sewer agency.			✓	The project does not include any outdoor processing areas.
	10.b. Grade or berm area to prevent run-on from surrounding areas.			✓	
	10.c. Installation of storm drains in areas of equipment repair is prohibited.			✓	
	10.d. Other features which are comparable or equally effective.			✓	
11.	**Equipment Wash Areas** Outdoor equipment/accessory washing and steam cleaning activities shall be:				
	11.a. Be self-contained; or covered with a roof or overhang.			✓	The project does not include any equipment wash areas.
	11.b. Be equipped with a clarifier, grease trap or other pretreatment facility, as Appropriate			✓	
	11.c. Be properly connected to a sanitary sewer.			✓	
	11.d Other features which are comparable or equally effective.			✓	
12.	**Parking Areas** The following design concepts shall be considered, and incorporated and implemented where determined applicable and feasible by the County.				
	12.a. Where landscaping is proposed in parking areas, incorporate landscape areas into the drainage design.	✓			
	12.b. Overflow parking (parking stalls provided in excess of the County's minimum parking requirements) may be constructed with permeable paving.			✓	
13.	**Fueling Areas** Non-retail fuel dispensing areas shall contain the following:				

	SOURCE CONTROL BMP OPTION	YES	NO	N/A	EXPLANATION[1]
	13.a. Overhanging roof structure or canopy. The cover's minimum dimensions must be equal to or greater than the area within the grade break. The cover must not drain onto the fuel dispensing area and the downspouts must be routed to prevent drainage across the fueling area. The fueling area shall drain to the project's treatment control BMP(s) prior to discharging to the storm water conveyance system.			✓	The project does not include any fueling areas.
	13.b. Paved with Portland cement concrete (or equivalent smooth impervious surface). The use of asphalt concrete shall be prohibited.			✓	
	13.c. Have an appropriate slope to prevent ponding, and must be separated from the rest of the site by a grade break that prevents run-on of urban runoff.			✓	
	13.d. At a minimum, the concrete fuel dispensing area must extend 6.5 feet (2.0 meters) from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 foot (0.3 meter), whichever is less.			✓	

11 Treatment Control BMPs

Post-construction "treatment control" storm water management BMPs provide treatment for storm water emanating from the project site. Implementation of NPDES General Permit requirements entails the use of post-construction BMPs that will remain in service to protect water quality throughout the life of the project. Structural BMPs are an integral element of post-construction storm water management and include storage, filtration, and infiltration practices. BMPs have varying degrees of effectiveness versus different pollutants of concern as identified in Table 11-1.

11.1 SELECTION OF TREATMENT CONTROL BMPS

The selection, design and sitting of structural BMPs within a project depend largely on the project-wide drainage plan. BMP alternatives were evaluated for their relative effectiveness for treating potential pollutants from the project site (Table 7-1); technical feasibility; relative costs and benefits; and applicable legal, institutional, and other constraints. lists treatment-control BMP alternatives and identifies the BMPs selected for the project site.

The Treatment Control BMPs have been chosen based on this Selection Matrix, comparing the list of pollutants for which the downstream receiving waters are impaired (if any) (Table 3-1), with the pollutants anticipated to be generated by the project (as identified in Table 7-1).

Any pollutants identified by Table 7-1 that correspond to a Clean Water Act section 303(d) impairment of the receiving waters of the project, are considered primary pollutants of concern. Table 7-2 summarizes these primary pollutants of concern.

11.1.1 When There are Primary Pollutants of Concern

Priority projects that are anticipated to generate primary pollutants of concern shall select a single or combination of stormwater BMPs from Table 11-1, which **maximizes pollutant removal** for the particular primary pollutant(s) of concern. Maximizing pollutant removal generally implies the selection of a BMP with a high removal efficiency for the pollutant(s) of concern, or a "treatment train" of BMPs with low or medium removal efficiencies for the pollutant(s) of concern that will maximize the removal of primary pollutant(s) of concern.

11.1.2 When There are No Primary Pollutants of Concern

Priority projects that are **not** anticipated to generate a pollutant for which the receiving water is Clean Water Act Section 303(d) impaired (i.e., with no primary pollutants of

Table 11-1 Treatment Control BMP Selection Matrix (San Diego County, 2002a).

○ High Removal Efficiency
◒ Medium Removal Efficiency
● Low Removal Efficiency
? Unknown Removal Efficiency

	Treatment Control BMP Categories						
Pollutant of Concern	Biofilters	Detention Basins	Infiltration Basins[1]	Wet Ponds or Wetlands	Drainage Inserts	Filtration	Continuous Flow Deflection Systems[2]
Sediment	◒	○	○	○	◒	○	◒
Nutrients	●	◒	◒	◒	◒	◒	●
Heavy Metals	◒	◒	◒	○	◒	○	●
Organic Compounds	?	?	?	?	●	◒	●
Trash & Debris	●	○	?	?	◒	○	◒
Oxygen Demanding Substances	●	◒	◒	◒	●	◒	●
Bacteria	?	?	○	?	●	◒	●
Oils and Grease	◒	◒	?	?	●	○	●
Pesticides	?	?	?	?	●	?	●

(1) Including trenches and porous pavement.(2) Also known as hydrodynamic devices and baffle boxes.
Original Sources: *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (1993), National Stormwater Best Management Practices Database (2001), and Guide for BMP Selection in Urban Developed Areas (2001).*

concern, see Section 7.4) shall select a single or combination of stormwater BMPs from Table 11-1, which are effective for pollutant removal of the identified secondary pollutants of concern, consistent with the "maximum extent practicable" standard.

11.2 TREATMENT CONTROL BMP PROGRAM

Treatment control BMPs address runoff from all developed areas on the project site. Treatment BMP Location Map In Attachment D describes the treatment control BMPs for the project and where they are located. The BMP program consists of the following elements: three vegetated swales, a sand filter basin, 2 sand filter trenches and an area of pervious pavers with a sand underdrain. All impervious areas of the site will be routed through (disconnected and treated) one of the above before discharging to the storm drain system. Attachment D illustrates the location of the BMPs.

11.3 TREATMENT CONTROL BMP SELECTION

Table 11-2 describes the treatment control BMPs for the project and explains why they were (or were not) selected. A detailed explanation and justification is provided if a low performing BMP was selected (see Table 11-1).

Table 11-2 Treatment Control BMP Selection Summary

	TREATMENT CONTROL BMP OPTION	YES	NO	N/A	EXPLANATION
1.	**Biofilters**				
	1.a. Grass Swale(s)	✓			Vegetated swales will be installed at roadsides and other locations around the project site.
	1.b. Grass Strip(s)		✓		Site configuration lends itself to grass swale rather than strips.
	1.c. Wetland Vegetation Swale(s)		✓		Not feasible to implement wetland vegetation swale given site constraints absence of perennial low flow, and general arid climate.
	1.d. Bio-retention Area(s)		✓		There will be no Bio-retention areas on site.
2.	**Detention Basins**				
	2.a. Extended Dry Detention w/ Grass Lining		✓		Site configuration lends itself better to grass swale and sand filter basin.
	2.b. Extended Dry Detention Basin(s) w/ Impervious Lining		✓		See above.
3.	**Infiltration Measures**				
	3.a Infiltration Basin(s)		✓		Site configuration lends itself better to grass swale and sand filter basin.
	3.b. Infiltration Trench(es)		✓		See above.

	TREATMENT CONTROL BMP OPTION	YES	NO	N/A	EXPLANATION
	3.c Porous Asphalt		✓		Site configuration lends itself better to use of porous pavers.
	3.d. Porous Concrete		✓		See above.
	3.e Porous Modular Concrete Block	✓			Porous pavers with a sand underdrain will be used in the central driveway to disconnect impervious area from the storm drain system.
4.	Wet Ponds or Wetlands				
	4.a Wet Detention Pond or Basin w/ Permanent Pool		✓		Not feasible to implement wetland with permanent pool due to site constraints, absence of perennial low flow, and general arid climate conditions. Wetlands would likely require public maintenance funding and might generate attractive nuisance and safety issues.
	4.b. Constructed Wetland		✓		See above.
5.	Drainage Inserts*				
	5.a. Oil/Water Separator(s)		✓		The project's proposed storm drain system will not convey enough runoff to justify the use of a storm water separator.
	5.b Catch Basin Insert(s)		✓		See above.
	5.c. Storm Drain Inserts		✓		See above.
	5.d. Catch Basin Screens		✓		See above.
6.	Filtration Practices				
	6.a. Media Filtration		✓		Site configuration lends itself better to grass swale and sand filter basin.
	6.b. Sand Filtration	✓			See above.
7.	Hydrodynamic Separator(s)				

TREATMENT CONTROL BMP OPTION		YES	NO	N/A	EXPLANATION
7.a.	Swirl Concentrator(s)		✓		Site configuration lends itself better to grass swale and sand filter basin.
7.b.	Cyclone Separator(s)		✓		See above.
7.c.	Baffle Separators		✓		See above.
7.d.	Gross Solids Removal Devices (GSRDs)		✓		See above.
7.e.	Linear Radial Device		✓		See above.

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11.4 TREATMENT CONTROL BMP DESIGN

Treatment control BMPs have been designed following criteria and methodology from the County of San Diego Hydrology Manual (2003), Drainage Design Manual (2005), and Storm Water Standards (2002) as appropriate for the project site. Attachment E provides detailed descriptions and design calculations of the water quality treatment control BMPs applied to the project site.

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12 Maintenance

The San Diego Watershed Protection Ordinance requires that mechanism be in place to ensure maintenance of post-construction BMPs. The maintenance mechanisms listed by the Ordinance include: County maintenance; maintenance by another public entity; maintenance by subsequent owner(s); a County Service Area or Special Assessment District; provisions of a lease; provisions of a conditional use permit; or other mechanisms as acceptable to the County.

12.1 MAINTENANCE CATEGORIES

Treatment control stormwater BMPs fall into four primary maintenance categories: (1) minimal maintenance BMPs; (2) BMPs requiring ongoing maintenance; (3) BMPs requiring maintenance by Flood Control District, with funding tied to the specific project, and (4) BMPs where there is a broader public responsibility for maintenance, with funding mechanisms beyond the project. Table 12-1 summarizes the treatment control BMPs selected for the project site and the maintenance category they fall under.

Table 12-1 Summary of Maintenance Category for Selected BMPs

BMP Type / Location	Category 1	Category 2	Category 3	Category 4
Vegetated Swales	✓			
On-Lot Measures (Source Control)	✓			
Sand Filtration (Treatment Control)	✓			
Pervious Pavement	✓			

Vegetated swales, sand filtration and pervious pavement require minimal maintenance and in this case are located on private property, and they are best designated as Category 1 facilities, and therefore will not require a funding mechanism.

12.2 FISCAL RESOURCES

The section briefly describes the long-term fiscal resources for the selected maintenance mechanisms.

- Vegetated swales, sand filtration and pervious pavement require minimal maintenance and in this case are located on private property, and they are best designated as Category 1 facilities, and therefore will not require a funding mechanism.

Table 12-2 Summary of Estimated Annual BMP Operation and Maintenance Costs – Private Maintenance

BMP Type / Location	Estimated Construction Cost	Estimated Annual O&M Cost
Vegetated Swales (365 lf)	$ 1,650	$ 250
Sand Filter Basin N.E. Corner (650 sf)	$ 11,100	$ 555
Sand Filter Trench Western Boundary North Portion (2380 sf)	$ 11,100	$ 555
Sand Filter Trench Western Boundary South Portion (2380 sf)	$ 11,100	$ 555
TOTAL	**$34,950**	**$1,915**

12.3 MAINTENANCE PROGRAM

The effectiveness of this WQTR relies on the maintenance of the storm water Best Management Practices (BMPs) proposed for the project. **Attachment F** summarizes the maintenance plan for the care and upkeep of BMPs on the project site, including frequency or maintenance indicators, and the type of maintenance required.

12.4 CONSTRUCTION, OPERATION, AND MAINTENANCE COST

This section provides a cost estimate for the construction and maintenance of the post-construction BMPs proposed for the project site. Table 12-2 summarizes the estimated annual BMP operation and maintenance costs for the project based upon guidance provided in the CASQA Stormwater Best Management Practices Handbook.

12.5 OTHER MAINTENANCE CONSIDERATIONS

Aside from the maintenance program resources required to fulfill maintenance requirements, there are several other maintenance aspects and activities to consider.

12.5.1 BMP Inspection

Property owners shall allow County staff access for inspection of BMPs maintenance plans by County staff.

12.5.2 Waste Disposal

Sediment and other pollutants shall be properly disposed of in a landfill or by another appropriate disposal method in accordance with local, state, and federal regulations. All construction waste shall be disposed of off-site in accordance with local, state, and Federal regulations. Interim storage and disposal of these wastes shall also be in accordance with the best management practices outlined in the Storm Water Pollution Prevention Plan for Construction Activities developed for the site.

12.5.3 Best Management Practices for Maintenance Activities

Maintenance of the BMPs often requires activities like grading and the use of equipment that in themselves present a potential pollutant source. The BMPs required to address these potential pollutant sources are similar to those found in Stormwater Pollution Prevention Plans for Construction Activities (SWPPPs). Table 12-3 summarizes the BMPs that may be implemented during typical BMP maintenance activities, which usually include minor grading and other construction activities over a short duration of time outside of the rainy season. Additional BMPs may be added for major repairs of longer duration or as appropriate to particular site conditions at the time of maintenance. For instance, if a particular BMP required repair of a concrete inlet structure, BMP measures for Paving and Grinding Operations (NS-3) and Concrete Waste Management (WM-8) may become applicable. If BMP repair must take place during the rainy season, sediment control BMPs would be mandatory.

Table 12-3 Typical BMPs for BMP Maintenance Activities

Soil Stabilization BMPs	**Waste Management BMPs**
Scheduling (SS-1)	Material Delivery and Storage (WM-1)
Preservation of Existing Vegetation (SS-2)	Material Use (WM-2)
Tracking Control BMPs	Stockpile Management (WM-3)
Stabilized Construction Access (TC-1)	Spill Prevention and Control (WM-4)
Non-Storm Water Management BMPs	Solid Waste Management (WM-5)
Illicit Connection/Discharge Detection/Reporting (NS-6)	Hazardous Waste Management (WM-6)
Vehicle and Equipment Cleaning (NS-8)	Contaminated Soil Management (WM-7)
Vehicle and Equipment Fueling (NS-9)	Sanitary Waste Management (WM-9)
Vehicle and Equipment Maintenance (NS-10)	Liquid Waste Management (WM-10)

12.5.4 Qualifications of Maintenance Personnel

Maintenance personnel must be trained in the proper procedures to inspect treatment and source control BMPs, to determine if maintenance on the BMPs is required, and to perform such maintenance. Subsequent property owners will ensure that all personnel retained to perform BMP maintenance will have the proper training for such duties. This would entail requiring that they provide certification that they have attended training sessions.

12.5.5 Record-Keeping

The County Watershed Protection Ordinance requires that maintenance and inspection records for BMPs be kept for a minimum of three years.

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13 Design Criteria

This section summarizes the design criteria and methodology applied during drainage analysis of the project site.

13.1 VOLUME-BASED WATER QUALITY NUMERIC SIZING CRITERIA

Volume-based BMPs are designed to capture and treat the most frequent storm events. Volume-based BMPs include extended detention basins, wet detention basins, and water quality treatment wetlands.

The water quality capture volume may be included as part of the configuration of the detention basins (for example, in a forebay or as initial storage in the basin), or as a stand-alone water quality basin. The water quality volumes should be provided in addition to the flood-control detention volume and debris volumes allocated for each basin.

The San Diego Regional Water Quality Control Board (RWQCB Region 9) has defined the sizing criteria for volume-based Best Management Practices as:

> *The volume of runoff produced from each and every storm event up to and including a historical record-based reference 24-hour rainfall criterion for treatment (0.6 inch approximate average for the San Diego County area) that achieves approximately the same reduction in pollutant loads achieved by the 85th percentile 24-hour event.*

A 24-hour, 0.6-inch rainfall has a return frequency of less than one year. The 85th percentile 24-hour event criterion was used for sizing the volume-based water quality treatment controls within the project site.

13.2 FLOW-BASED WATER QUALITY NUMERIC SIZING CRITERIA

Flow-based BMPs are sized to filter or otherwise treat the peak flow of runoff from a stormwater quality storm event. Flow-based BMPs include vegetated filter strips and swales.

The San Diego RWQCB has defined the design discharge for flow-based BMPs as the runoff generated from a storm with a rainfall intensity of 0.2 inch/hour. Flow-based water quality BMPs on the project site have been designed based upon a Rational Method analysis of this design storm, which is slightly larger than the 85th percentile event (0.1 inch/hour).

13.3 HYDROLOGIC DESIGN METHODOLOGY

13.3.1 Rational Method: Peak Flow

Runoff calculations for this study were accomplished using the Rational Method. The Rational Method is a physically-based numerical method where runoff is assumed to be directly proportional to rainfall and area, less losses for infiltration and depression storage. Flows were computed based on the Rational formula:

$$Q = C\,i\,A$$

where ... Q = Peak discharge (cfs);
C = runoff coefficient, based on land use and soil type;
i = rainfall intensity (in/hr);
A = watershed area (acre)

The runoff coefficient represents the ratio of rainfall that runs off the watershed versus the portion that infiltrates to the soil or is held in depression storage. The runoff coefficient is dependent on the land use coverage and soil type. The City of San Diego Drainage Design Manual methodology assumes hydrologic Soil Type D for all soils.

For a typical drainage study, rainfall intensity varies with the watershed time of concentration. The watershed time of concentration at any given point is defined as the time it would theoretically take runoff to travel from the most upstream point in the watershed to a concentration point, as calculated by equations in the San Diego County Hydrology Manual or City of San Diego Drainage Design Manual, as appropriate.

Rational Method calculations were accomplished using either the Advanced Engineering Software Rational Method Analysis (Southern California County Methods) (AES-RATSCx) or CivilCADD Rational Method Hydrology computer software packages. Peak discharges were computed for 100-year, 50-year, and 10-year hypothetical storm return frequencies. Rainfall intensity was calculated using the intensity-duration-frequency curves (IDF curves) found in the City of San Diego Drainage Design Manual.

14 References

14.1 GENERAL REFERENCES

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ATTACHMENT A

Location Map

RBF CONSULTING

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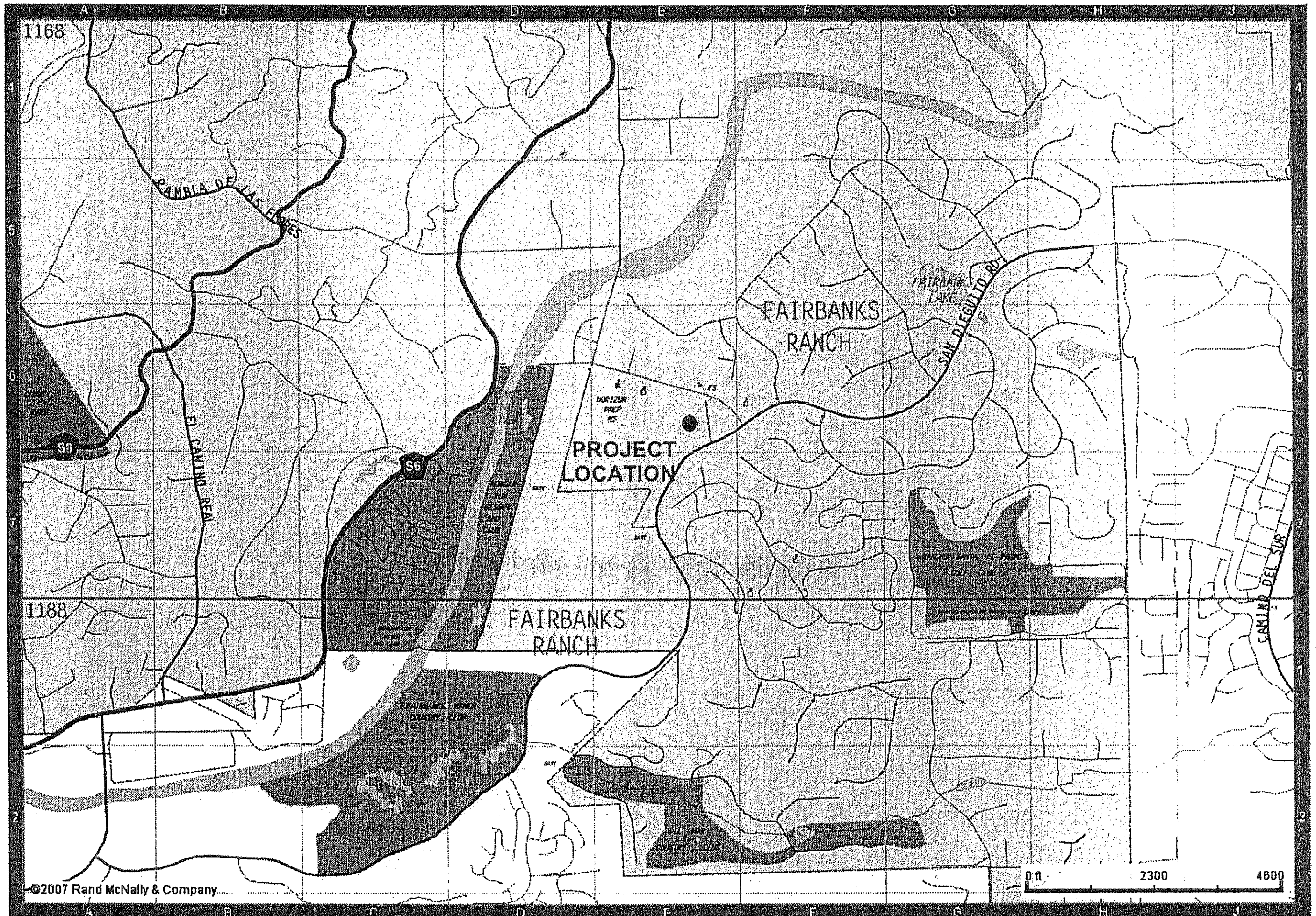

Location Map

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ATTACHMENT B

Project Site Map

RBF CONSULTING

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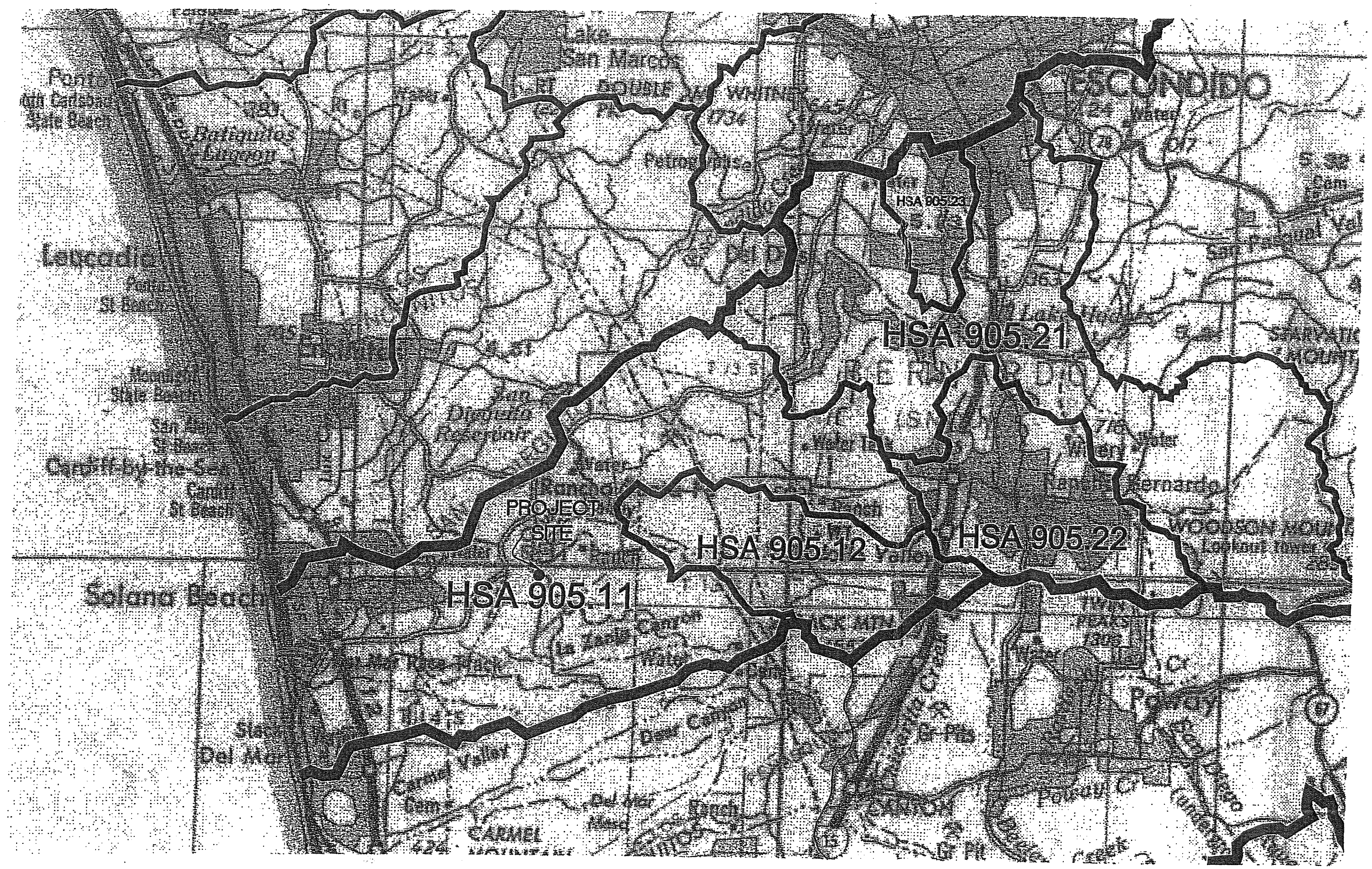

SCALE: 1"=2 mi

WOODWARD ANIMAL CENTER

PROJECT SITE MAP

RBF CONSULTING
PLANNING ■ DESIGN ■ CONSTRUCTION
9755 CLAREMONT MESA BOULEVARD, SUITE 100
SAN DIEGO, CALIFORNIA 92124-1324
858.614.5000 • FAX 858.614.5001 • www.RBF.com

PROJECT LOCATION
SAN DIEGO, CA

DRAFTED BY	DATE	SCALE
ADB	08/07	1"=2 miles

RBF JOB NO.
25-102814

H:\PDATA\25102814\Cadd\Stormwater\EXHIBITS\PSM.dwg 08/02/07 - 7:29pm ABARRY

ATTACHMENT C

Water Quality Monitoring Data

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Water Quality Monitoring Data

There are no relevant water quality monitoring data available for the project site.

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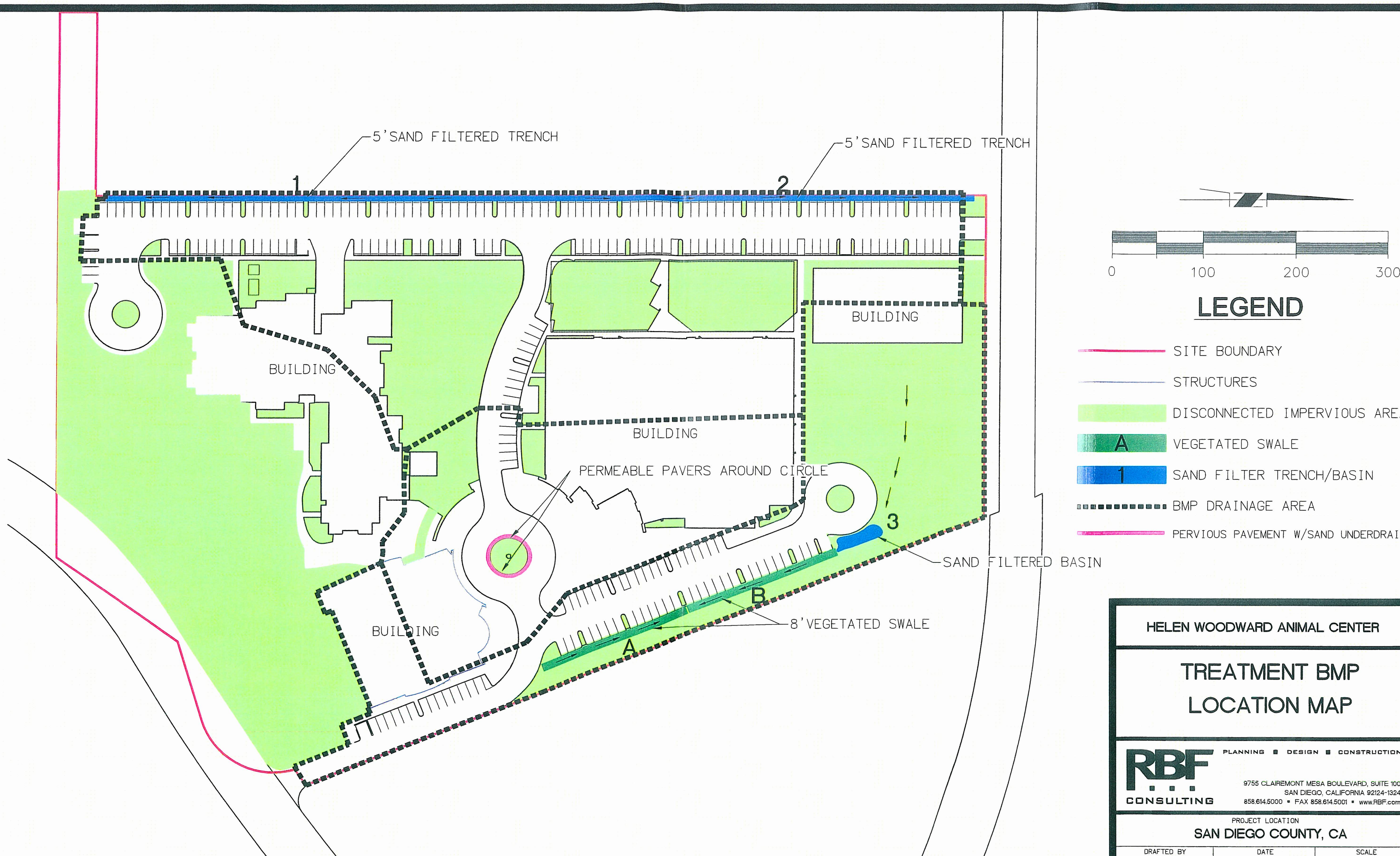
ATTACHMENT D

Treatment BMP Location Map

RBF CONSULTING



HELEN WOODWARD ANIMAL CENTER

TREATMENT BMP LOCATION MAP

RBF CONSULTING

PLANNING ■ DESIGN ■ CONSTRUCTION

9755 CLAIREMONT MESA BOULEVARD, SUITE 100
SAN DIEGO, CALIFORNIA 92124-1324
858.614.5000 • FAX 858.614.5001 • www.RBF.com

PROJECT LOCATION
SAN DIEGO COUNTY, CA

DRAFTED BY	DATE	SCALE
ADB	3/08	1"=100'

RBF JOB NO.
25-102814

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ATTACHMENT E

Treatment BMP Data and Sizing Calculations

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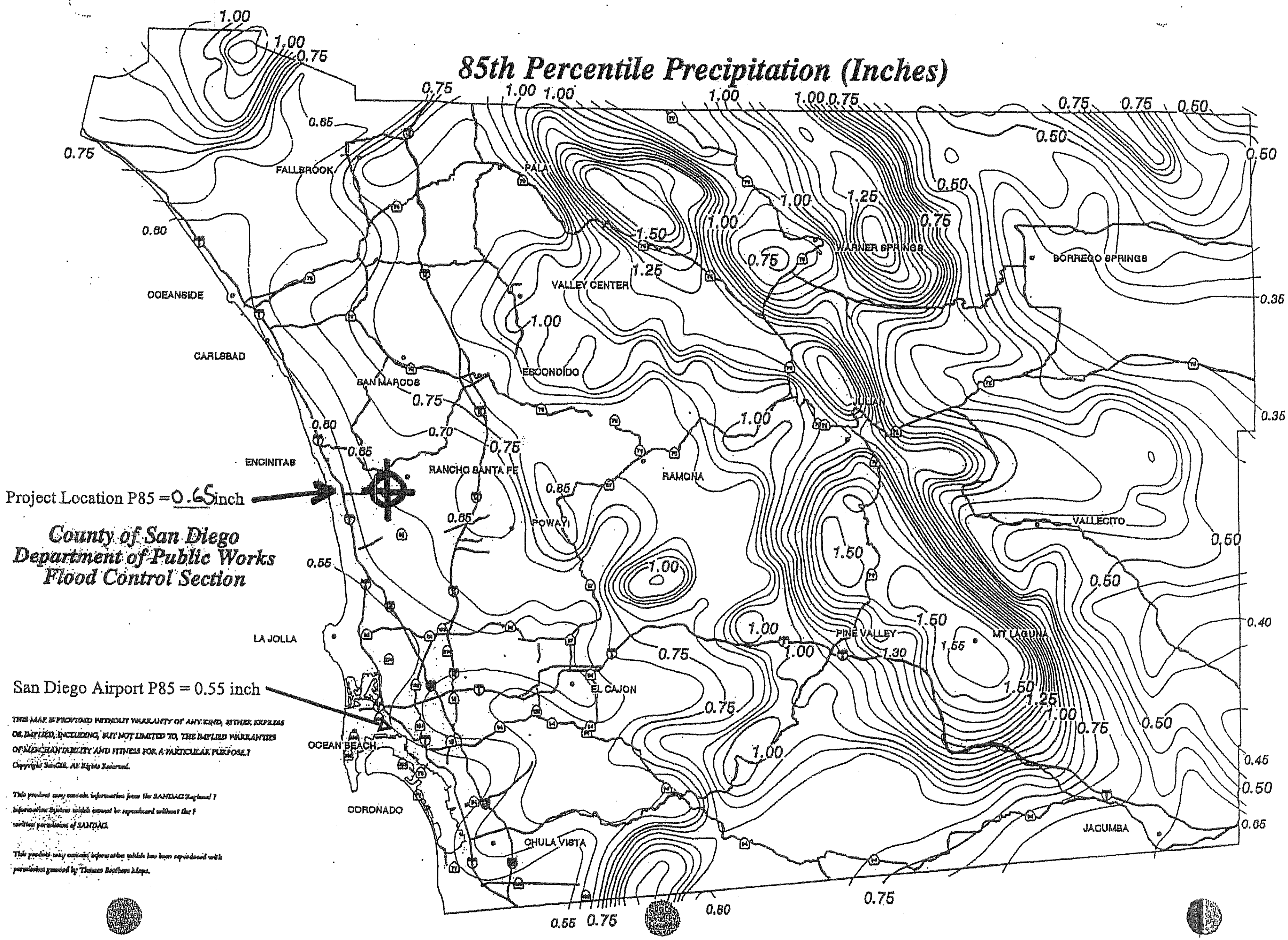
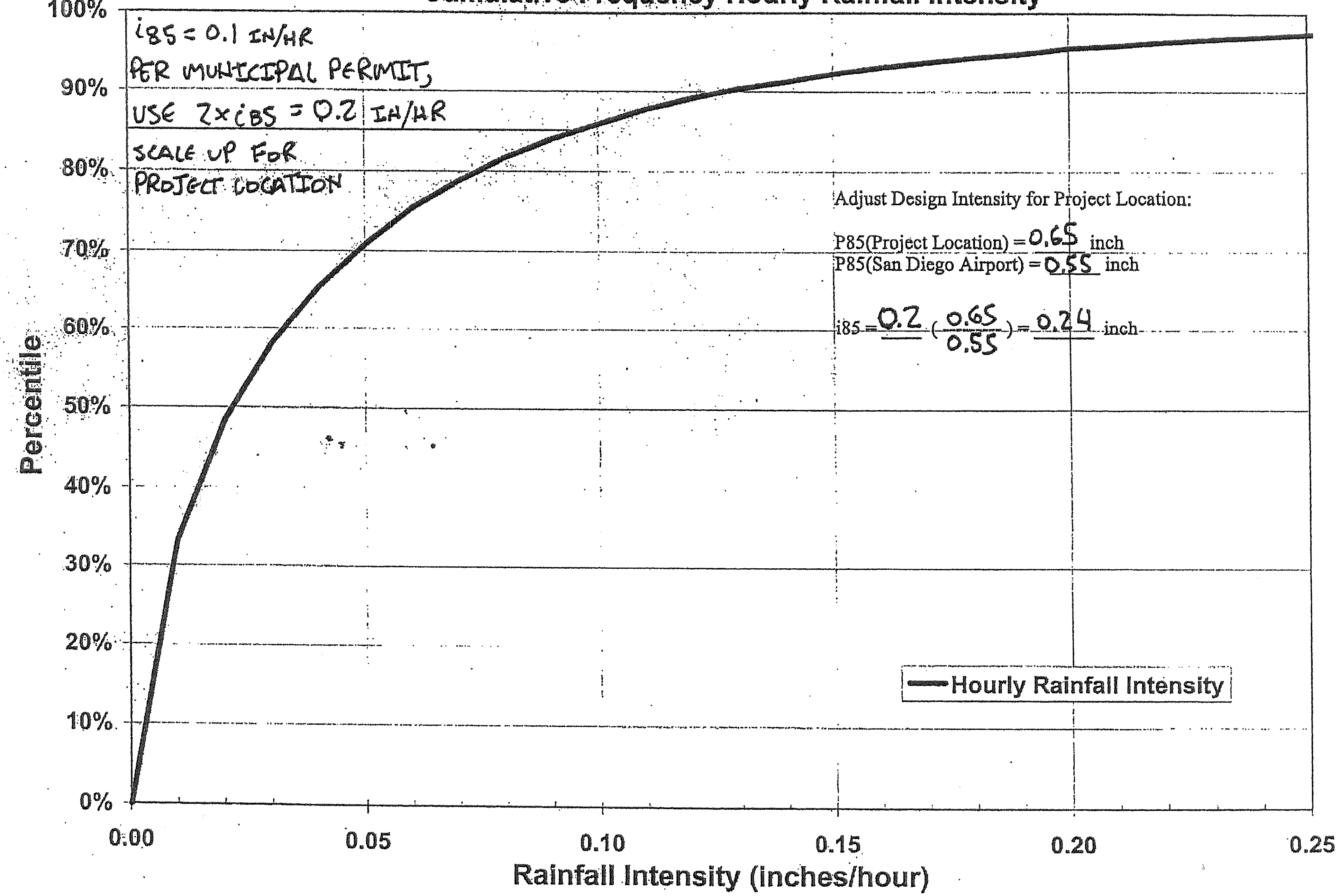
85th Percentile Precipitation (Inches)

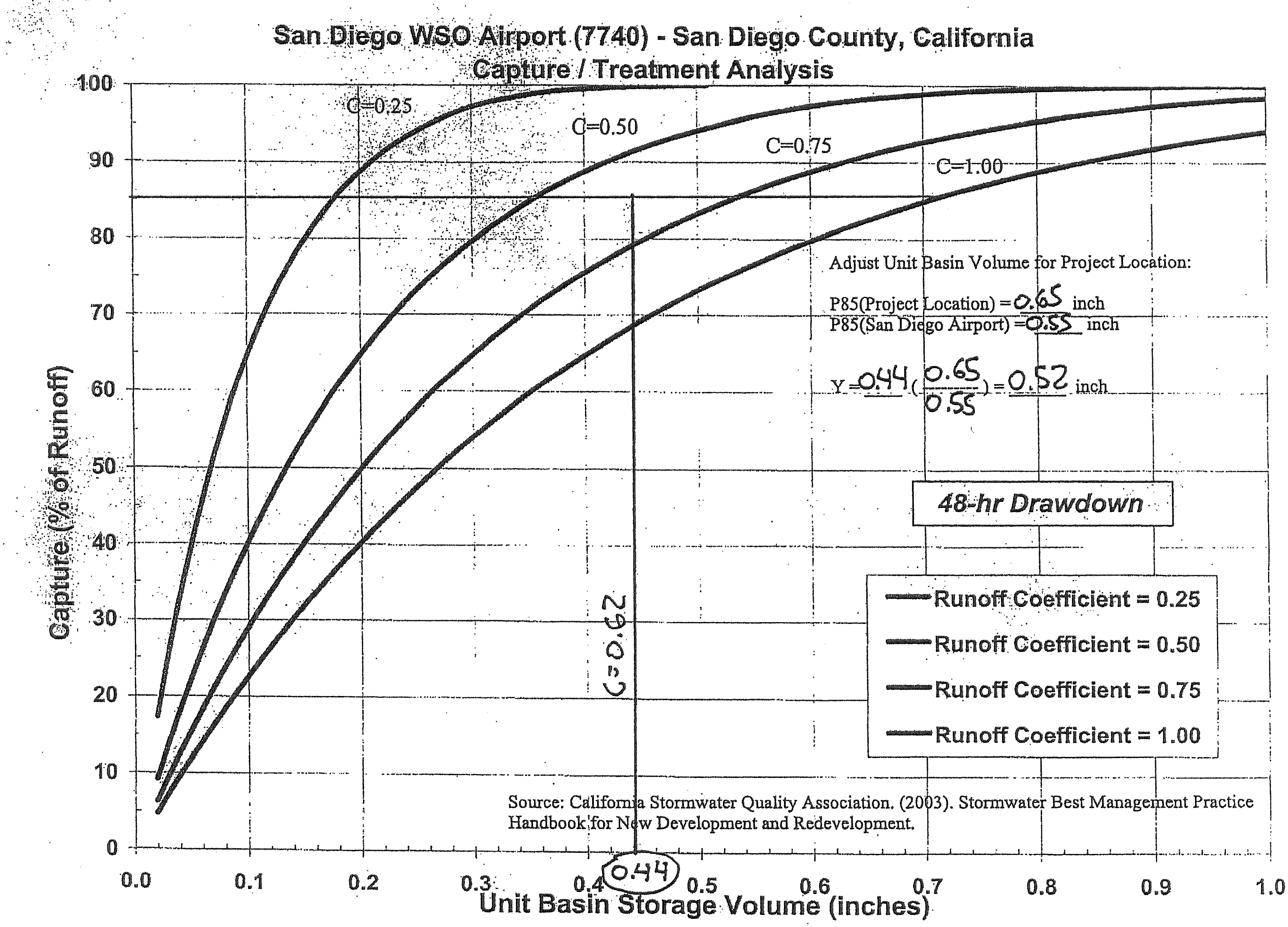


County of San Diego
Department of Public Works
Flood Control Section

THIS MAP IS PROVIDED WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

San Diego WSO Airport (7740) - San Diego County, California
Cumulative Frequency Hourly Rainfall Intensity




San Diego WSO Airport (7740) - San Diego County, California
Capture / Treatment Analysis
Capture (% of Runoff)
Unit Basin Storage Volume (inches)
C=0.25
C=0.50
C=0.75
C=1.00
C=0.62
0.44
Adjust Unit Basin Volume for Project Location:
P85(Project Location) = 0.65 inch
P85(San Diego Airport) = 0.55 inch
Y = 0.44 (0.65 / 0.55) = 0.52 inch
48-hr Drawdown
Runoff Coefficient = 0.25
Runoff Coefficient = 0.50
Runoff Coefficient = 0.75
Runoff Coefficient = 1.00
Source: California Stormwater Quality Association. (2003). Stormwater Best Management Practice Handbook for New Development and Redevelopment.

SAND FILTER DESIGN					
FILTER	DRAINAGE AREA (ac)	Y85 (in)	VWQ (ac-ft)	FILTER AREA REQUIRED (ac)	FILTER AREA PROVIDED (ac)
1	0.79	0.52	0.034	0.0034	0.055
2	0.67	0.52	0.029	0.0029	0.052
3	0.54	0.52	0.023	0.0023	0.015

VEGETATED SWALE DESIGN							
SWALE	DRAINAGE AREA (ac)	i85 (in)	C	Q85 (cfs)	V (fps)	L (ft)	RESIDENCE TIME (min)
A	0.183	0.24	0.62	0.03	0.1	170	28.3
B	0.183	0.24	0.62	0.03	0.1	170	28.3

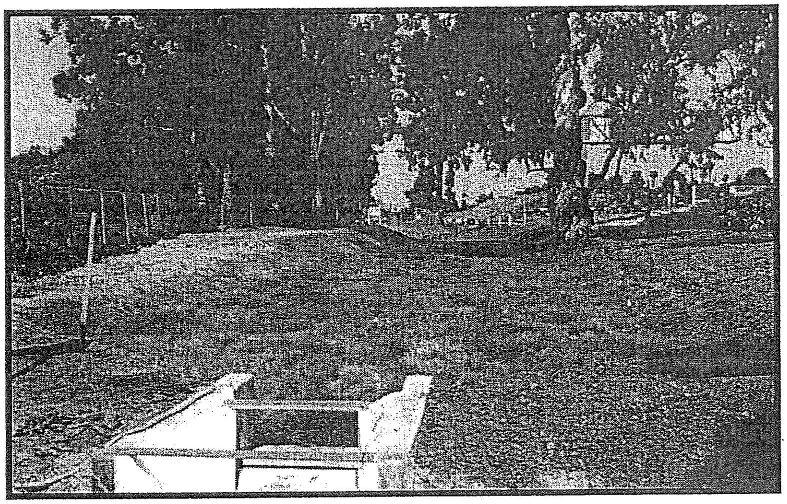
VEGETATED SWALES A AND B VELOCITY CALCULATION
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	VEGETATED SWAL
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.250	
Slope	010000	ft/ft
Left Side Slope	2.00	H : V
Right Side Slope	2.00	H : V
Bottom Width	4.00	ft
Discharge	0.03	cfs

Results		
Depth	0.07	ft
Flow Area	0.3	ft²
Wetted Perim	4.32	ft
Top Width	4.29	ft
Critical Depth	0.01	ft
Critical Slope	3.992781	ft/ft
Velocity	0.10	ft/s
Velocity Head	1.56e-4	ft
Specific Energ	0.07	ft
Froude Numb	0.07	
Flow Type	Subcritical	

Vegetated Swale TC-30



Design Considerations

- Tributary Area
- Area Required
- Slope
- Water Availability

Description

Vegetated swales are open, shallow channels with vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. They are designed to treat runoff through filtering by the vegetation in the channel, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Swales can be natural or manmade. They trap particulate pollutants (suspended solids and trace metals), promote infiltration, and reduce the flow velocity of stormwater runoff. Vegetated swales can serve as part of a stormwater drainage system and can replace curbs, gutters and storm sewer systems.

California Experience

Caltrans constructed and monitored six vegetated swales in southern California. These swales were generally effective in reducing the volume and mass of pollutants in runoff. Even in the areas where the annual rainfall was only about 10 inches/yr, the vegetation did not require additional irrigation. One factor that strongly affected performance was the presence of large numbers of gophers at most of the sites. The gophers created earthen mounds, destroyed vegetation, and generally reduced the effectiveness of the controls for TSS reduction.

Advantages

- If properly designed, vegetated, and operated, swales can serve as an aesthetic, potentially inexpensive urban development or roadway drainage conveyance measure with significant collateral water quality benefits.

Targeted Constituents

	Constituent	Removal
☑	Sediment	▲
☑	Nutrients	●
☑	Trash	●
☑	Metals	▲
☑	Bacteria	●
☑	Oil and Grease	▲
☑	Organics	▲

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

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- Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible.

Limitations

- Can be difficult to avoid channelization.
- May not be appropriate for industrial sites or locations where spills may occur
- Grassed swales cannot treat a very large drainage area. Large areas may be divided and treated using multiple swales.
- A thick vegetative cover is needed for these practices to function properly.
- They are impractical in areas with steep topography.
- They are not effective and may even erode when flow velocities are high, if the grass cover is not properly maintained.
- In some places, their use is restricted by law: many local municipalities require curb and gutter systems in residential areas.
- Swales are mores susceptible to failure if not properly maintained than other treatment BMPs.

Design and Sizing Guidelines

- Flow rate based design determined by local requirements or sized so that 85% of the annual runoff volume is discharged at less than the design rainfall intensity.
- Swale should be designed so that the water level does not exceed 2/3rds the height of the grass or 4 inches, which ever is less, at the design treatment rate.
- Longitudinal slopes should not exceed 2.5%
- Trapezoidal channels are normally recommended but other configurations, such as parabolic, can also provide substantial water quality improvement and may be easier to mow than designs with sharp breaks in slope.
- Swales constructed in cut are preferred, or in fill areas that are far enough from an adjacent slope to minimize the potential for gopher damage. Do not use side slopes constructed of fill, which are prone to structural damage by gophers and other burrowing animals.
- A diverse selection of low growing, plants that thrive under the specific site, climatic, and watering conditions should be specified. Vegetation whose growing season corresponds to the wet season are preferred. Drought tolerant vegetation should be considered especially for swales that are not part of a regularly irrigated landscaped area.
- The width of the swale should be determined using Manning's Equation using a value of 0.25 for Manning's n.

Construction/Inspection Considerations

- Include directions in the specifications for use of appropriate fertilizer and soil amendments based on soil properties determined through testing and compared to the needs of the vegetation requirements.
- Install swales at the time of the year when there is a reasonable chance of successful establishment without irrigation; however, it is recognized that rainfall in a given year may not be sufficient and temporary irrigation may be used.
- If sod tiles must be used, they should be placed so that there are no gaps between the tiles; stagger the ends of the tiles to prevent the formation of channels along the swale or strip.
- Use a roller on the sod to ensure that no air pockets form between the sod and the soil.
- Where seeds are used, erosion controls will be necessary to protect seeds for at least 75 days after the first rainfall of the season.

Performance

The literature suggests that vegetated swales represent a practical and potentially effective technique for controlling urban runoff quality. While limited quantitative performance data exists for vegetated swales, it is known that check dams, slight slopes, permeable soils, dense grass cover, increased contact time, and small storm events all contribute to successful pollutant removal by the swale system. Factors decreasing the effectiveness of swales include compacted soils, short runoff contact time, large storm events, frozen ground, short grass heights, steep slopes, and high runoff velocities and discharge rates.

Conventional vegetated swale designs have achieved mixed results in removing particulate pollutants. A study performed by the Nationwide Urban Runoff Program (NURP) monitored three grass swales in the Washington, D.C., area and found no significant improvement in urban runoff quality for the pollutants analyzed. However, the weak performance of these swales was attributed to the high flow velocities in the swales, soil compaction, steep slopes, and short grass height.

Another project in Durham, NC, monitored the performance of a carefully designed artificial swale that received runoff from a commercial parking lot. The project tracked 11 storms and concluded that particulate concentrations of heavy metals (Cu, Pb, Zn, and Cd) were reduced by approximately 50 percent. However, the swale proved largely ineffective for removing soluble nutrients.

The effectiveness of vegetated swales can be enhanced by adding check dams at approximately 17 meter (50 foot) increments along their length (See Figure 1). These dams maximize the retention time within the swale, decrease flow velocities, and promote particulate settling. Finally, the incorporation of vegetated filter strips parallel to the top of the channel banks can help to treat sheet flows entering the swale.

Only 9 studies have been conducted on all grassed channels designed for water quality (Table 1). The data suggest relatively high removal rates for some pollutants, but negative removals for some bacteria, and fair performance for phosphorus.

Table 1 Grassed swale pollutant removal efficiency data

Study	Removal Efficiencies (% Removal)						Type
	TSS	TP	TN	NO_3	Metals	Bacteria	
Caltrans 2002	77	8	67	66	83-90	-33	dry swales
Goldberg 1993	67.8	4.5	-	31.4	42–62	-100	grassed channel
Seattle Metro and Washington Department of Ecology 1992	60	45	-	-25	2–16	-25	grassed channel
Seattle Metro and Washington Department of Ecology, 1992	83	29	-	-25	46–73	-25	grassed channel
Wang et al., 1981	80	-	-	-	70–80	-	dry swale
Dorman et al., 1989	98	18	-	45	37–81	-	dry swale
Harper, 1988	87	83	84	80	88–90	-	dry swale
Kercher et al., 1983	99	99	99	99	99	-	dry swale
Harper, 1988.	81	17	40	52	37–69	-	wet swale
Koon, 1995	67	39	-	9	-35 to 6	-	wet swale

While it is difficult to distinguish between different designs based on the small amount of available data, grassed channels generally have poorer removal rates than wet and dry swales, although some swales appear to export soluble phosphorus (Harper, 1988; Koon, 1995). It is not clear why swales export bacteria. One explanation is that bacteria thrive in the warm swale soils.

Siting Criteria

The suitability of a swale at a site will depend on land use, size of the area serviced, soil type, slope, imperviousness of the contributing watershed, and dimensions and slope of the swale system (Schueler et al., 1992). In general, swales can be used to serve areas of less than 10 acres, with slopes no greater than 5 %. Use of natural topographic lows is encouraged and natural drainage courses should be regarded as significant local resources to be kept in use (Young et al., 1996).

Selection Criteria (NCTCOG, 1993)

- Comparable performance to wet basins
- Limited to treating a few acres
- Availability of water during dry periods to maintain vegetation
- Sufficient available land area

Research in the Austin area indicates that vegetated controls are effective at removing pollutants even when dormant. Therefore, irrigation is not required to maintain growth during dry periods, but may be necessary only to prevent the vegetation from dying.

The topography of the site should permit the design of a channel with appropriate slope and cross-sectional area. Site topography may also dictate a need for additional structural controls. Recommendations for longitudinal slopes range between 2 and 6 percent. Flatter slopes can be used, if sufficient to provide adequate conveyance. Steep slopes increase flow velocity, decrease detention time, and may require energy dissipating and grade check. Steep slopes also can be managed using a series of check dams to terrace the swale and reduce the slope to within acceptable limits. The use of check dams with swales also promotes infiltration.

Additional Design Guidelines

Most of the design guidelines adopted for swale design specify a minimum hydraulic residence time of 9 minutes. This criterion is based on the results of a single study conducted in Seattle, Washington (Seattle Metro and Washington Department of Ecology, 1992), and is not well supported. Analysis of the data collected in that study indicates that pollutant removal at a residence time of 5 minutes was not significantly different, although there is more variability in that data. Therefore, additional research in the design criteria for swales is needed. Substantial pollutant removal has also been observed for vegetated controls designed solely for conveyance (Barrett et al, 1998); consequently, some flexibility in the design is warranted.

Many design guidelines recommend that grass be frequently mowed to maintain dense coverage near the ground surface. Recent research (Colwell et al., 2000) has shown mowing frequency or grass height has little or no effect on pollutant removal.

Summary of Design Recommendations

1) The swale should have a length that provides a minimum hydraulic residence time of at least 10 minutes. The maximum bottom width should not exceed 10 feet unless a dividing berm is provided. The depth of flow should not exceed 2/3rds the height of the grass at the peak of the water quality design storm intensity. The channel slope should not exceed 2.5%.

2) A design grass height of 6 inches is recommended.

3) Regardless of the recommended detention time, the swale should be not less than 100 feet in length.

4) The width of the swale should be determined using Manning's Equation, at the peak of the design storm, using a Manning's n of 0.25.

5) The swale can be sized as both a treatment facility for the design storm and as a conveyance system to pass the peak hydraulic flows of the 100-year storm if it is located "on-line." The side slopes should be no steeper than 3:1 (H:V).

6) Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible. If flow is to be introduced through curb cuts, place pavement slightly above the elevation of the vegetated areas. Curb cuts should be at least 12 inches wide to prevent clogging.

7) Swales must be vegetated in order to provide adequate treatment of runoff. It is important to maximize water contact with vegetation and the soil surface. For general purposes, select fine, close-growing, water-resistant grasses. If possible, divert runoff (other than necessary irrigation) during the period of vegetation

establishment. Where runoff diversion is not possible, cover graded and seeded areas with suitable erosion control materials.

Maintenance

The useful life of a vegetated swale system is directly proportional to its maintenance frequency. If properly designed and regularly maintained, vegetated swales can last indefinitely. The maintenance objectives for vegetated swale systems include keeping up the hydraulic and removal efficiency of the channel and maintaining a dense, healthy grass cover.

Maintenance activities should include periodic mowing (with grass never cut shorter than the design flow depth), weed control, watering during drought conditions, reseeding of bare areas, and clearing of debris and blockages. Cuttings should be removed from the channel and disposed in a local composting facility. Accumulated sediment should also be removed manually to avoid concentrated flows in the swale. The application of fertilizers and pesticides should be minimal.

Another aspect of a good maintenance plan is repairing damaged areas within a channel. For example, if the channel develops ruts or holes, it should be repaired utilizing a suitable soil that is properly tamped and seeded. The grass cover should be thick; if it is not, reseed as necessary. Any standing water removed during the maintenance operation must be disposed to a sanitary sewer at an approved discharge location. Residuals (e.g., silt, grass cuttings) must be disposed in accordance with local or State requirements. Maintenance of grassed swales mostly involves maintenance of the grass or wetland plant cover. Typical maintenance activities are summarized below:

- Inspect swales at least twice annually for erosion, damage to vegetation, and sediment and debris accumulation preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the swale is ready for winter. However, additional inspection after periods of heavy runoff is desirable. The swale should be checked for debris and litter, and areas of sediment accumulation.

- Grass height and mowing frequency may not have a large impact on pollutant removal. Consequently, mowing may only be necessary once or twice a year for safety or aesthetics or to suppress weeds and woody vegetation.

- Trash tends to accumulate in swale areas, particularly along highways. The need for litter removal is determined through periodic inspection, but litter should always be removed prior to mowing.

- Sediment accumulating near culverts and in channels should be removed when it builds up to 75 mm (3 in.) at any spot, or covers vegetation.

- Regularly inspect swales for pools of standing water. Swales can become a nuisance due to mosquito breeding in standing water if obstructions develop (e.g. debris accumulation, invasive vegetation) and/or if proper drainage slopes are not implemented and maintained.

Cost

Construction Cost

Little data is available to estimate the difference in cost between various swale designs. One study (SWRPC, 1991) estimated the construction cost of grassed channels at approximately \$0.25 per ft^2. This price does not include design costs or contingencies. Brown and Schueler (1997) estimate these costs at approximately 32 percent of construction costs for most stormwater management practices. For swales, however, these costs would probably be significantly higher since the construction costs are so low compared with other practices. A more realistic estimate would be a total cost of approximately \$0.50 per ft^2, which compares favorably with other stormwater management practices.

Table 2 Swale Cost Estimate (SEWRPC, 1991)

Component	Unit	Extent	Unit Cost			Total Cost		
			Low	Moderate	High	Low	Moderate	High
Mobilization / Demobilization-Light	Swale	1	$107	$274	$441	$107	$274	$441
Site Preparation								
Clearing[b]...............	Acre	0.5	$2,200	$3,800	$5,400	$1,100	$1,900	$2,700
Grubbing[c].............	Acre	0.25	$3,800	$5,200	$6,600	$950	$1,300	$1,650
General Excavation[d]...........	Yd^3	372	$2.10	$3.70	$5.30	$781	$1,376	$1,972
Level and Till[e].......	Yd^2	1,210	$0.20	$0.35	$0.50	$242	$424	$605
Sites Development								
Salvaged Topsoil Seed, and Mulch[f]..	Yd^2	1,210	$0.40	$1.00	$1.60	$484	$1,210	$1,936
Sod[g].....................	Yd^2	1,210	$1.20	$2.40	$3.60	$1,452	$2,904	$4,356
Subtotal	--	--	--	--	--	$5,116	$9,388	$13,660
Contingencies	Swale	1	25%	25%	25%	$1,279	$2,347	$3,415
Total	--	--	--	--	--	$6,395	$11,735	$17,075

Source: (SEWRPC, 1991)

Note: Mobilization/demobilization refers to the organization and planning involved in establishing a vegetative swale.

[a] Swale has a bottom width of 1.0 foot, a top width of 10 feet with 1:3 side slopes, and a 1,000-foot length.

[b] Area cleared = (top width + 10 feet) x swale length.

[c] Area grubbed = (top width x swale length).

[d] Volume excavated = (0.67 x top width x swale depth) x swale length (parabolic cross-section).

[e] Area tilled = $\left(\text{top width} + \frac{8(\text{swale depth}^2)}{3(\text{top width})}\right)$ x swale length (parabolic cross-section).

[f] Area seeded = area cleared x 0.5.

[g] Area sodded = area cleared x 0.5.

Table 3 Estimated Maintenance Costs (SEWRPC, 1991)

Component	Unit Cost	Swale Size (Depth and Top Width)		Comment
		1.5 Foot Depth, One-Foot Bottom Width, 10-Foot Top Width	3-Foot Depth, 3-Foot Bottom Width, 21-Foot Top Width	
Lawn Mowing	\$0.85 / 1,000 ft²/ mowing	\$0.14 / linear foot	\$0.21 / linear foot	Lawn maintenance area=(top width + 10 feet) x length. Mow eight times per year
General Lawn Care	\$9.00 / 1,000 ft²/ year	\$0.18 / linear foot	\$0.28 / linear foot	Lawn maintenance area = (top width + 10 feet) x length
Swale Debris and Litter Removal	\$0.10 / linear foot / year	\$0.10 / linear foot	\$0.10 / linear foot	–
Grass Reseeding with Mulch and Fertilizer	\$0.30 / yd²	\$0.01 / linear foot	\$0.01 / linear foot	Area revegetated equals 1% of lawn maintenance area per year
Program Administration and Swale Inspection	\$0.15 / linear foot / year, plus \$25 / inspection	\$0.15 / linear foot	\$0.15 / linear foot	Inspect four times per year
Total	--	**\$0.58 / linear foot**	**\$ 0.75 / linear foot**	–

Maintenance Cost

Caltrans (2002) estimated the expected annual maintenance cost for a swale with a tributary area of approximately 2 ha at approximately $2,700. Since almost all maintenance consists of mowing, the cost is fundamentally a function of the mowing frequency. Unit costs developed by SEWRPC are shown in Table 3. In many cases vegetated channels would be used to convey runoff and would require periodic mowing as well, so there may be little additional cost for the water quality component. Since essentially all the activities are related to vegetation management, no special training is required for maintenance personnel.

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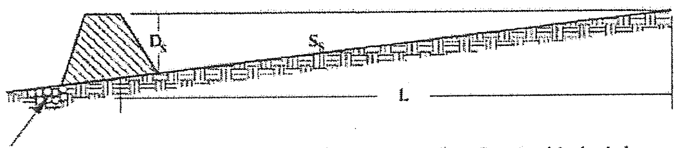
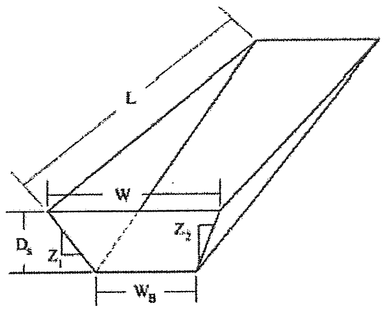


(a) Cross section of swale with check dam.



(b) Dimensional view of swale impoundment area.

Notation:

L = Length of swale impoundment area per check dam (ft)
D_s = Depth of check dam (ft)
S_s = Bottom slpe of swale (ft/ft)
W = Top width of check dam (ft)
W_B = Bottom width of check dam (ft)
$Z_{1\&2}$ = Ratio of horizontal to vertical change in swale side slope (ft/ft)

Design Considerations

- Design Storm
- Media Type
- Maintenance Requirement

Targeted Constituents

- ☑ Sediment
- ☑ Nutrients
- ☑ Trash
- ☑ Metals
- Bacteria
- ☑ Oil and Grease
- ☑ Organics

Removal Effectiveness

See New Development and Redevelopment Handbook-Section 5.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Description

Stormwater media filters are usually two-chambered including a pretreatment settling basin and a filter bed filled with sand or other absorptive filtering media. As stormwater flows into the first chamber, large particles settle out, and then finer particles and other pollutants are removed as stormwater flows through the filtering media in the second chamber.

There are currently three manufacturers of stormwater filter systems. Two are similar in that they use cartridges of a standard size. The cartridges are placed in vaults; the number of cartridges a function of the design flow rate. The water flows laterally (horizontally) into the cartridge to a centerwell, then downward to an underdrain system. The third product is a flatbed filter, similar in appearance to sand filters.

California Experience

There are currently about 75 facilities in California that use manufactured filters.

Advantages

- Requires a smaller area than standard flatbed sand filters, wet ponds, and constructed wetlands.
- There is no standing water in the units between storms, minimizing but does not entirely eliminate the opportunity for mosquito breeding.
- Media capable of removing dissolved pollutants can be selected.
- One system utilizes media in layers, allowing for selective removal of pollutants.
- The modular concept allows the design engineer to more closely match the size of the facility to the design storm.

Limitations

- As some of the manufactured filter systems function at higher flow rates and/or have larger media than found in flatbed filters, the former may not provide the same level of performance as standard sand filters. However, the level of treatment may still be satisfactory.
- As with all filtration systems, use in catchments that have significant areas of non-stabilized soils can lead to premature clogging.

Design and Sizing Guidelines

There are currently three manufacturers of stormwater filter systems.

Filter System A: This system is similar in appearance to a slow-rate sand filter. However, the media is cellulose material treated to enhance its ability to remove hydrocarbons and other organic compounds. The media depth is 12 inches (30 cm). It operates at a very high rate, 20 gpm/ft2 at peak flows. Normal operating rates are much lower assuming that the stormwater covers the entire bed at flows less than the peak rate. The system uses vortex separation for pretreatment. As the media is intended to remove sediments (with attached pollutants) and organic compounds, it would not be expected to remove dissolved pollutants such as nutrients and metals unless they are complexed with the organic compounds that are removed.

Filter System B: It uses a simple vertical filter consisting of 3 inch diameter, 30 inch high slotted plastic pipe wrapped with fabric. The standard fabric has nominal openings of 10 microns. The stormwater flows into the vertical filter pipes and out through an underdrain system. Several units are placed vertically at 1 foot intervals to give the desired capacity. Pretreatment is typically a dry extended detention basin, with a detention time of about 30 hours. Stormwater is retained in the basin by a bladder that is automatically inflated when rainfall begins. This action starts a timer which opens the bladder 30 hours later. The filter bay has an emptying time of 12 to 24 hours, or about 1 to 2 gpm/ft2 of filter area. This provides a total elapsed time of 42 to 54 hours. Given that the media is fabric, the system does not remove dissolved pollutants. It does remove pollutants attached to the sediment that is removed.

Filter System C: The system use vertical cartridges in which stormwater enters radially to a center well within the filter unit, flowing downward to an underdrain system. Flow is controlled by a passive float valve system, which prevents water from passing through the cartridge until the water level in the vault rises to the top of the cartridge. Full use of the entire filter surface area and the volume of the cartridge is assured by a passive siphon mechanism as the water surface recedes below the top of the cartridge. A balance between hydrostatic forces assures a more or less equal flow potential across the vertical face of the filter surface. Hence, the filter surface receives suspended solids evenly. Absent the float valve and siphon systems, the amount of water treated over time per unit area in a vertical filter is not constant, decreasing with the filter height; furthermore, a filter would clog unevenly. Restriction of the flow using orifices ensures consistent hydraulic conductivity of the cartridge as a whole by allowing the orifice, rather than the media, whose hydraulic conductivity decreases over time, to control flow.

The manufacturer offers several media used singly or in combination (dual- or multi-media). Total media thickness is about 7 inches. Some media, such as fabric and perlite, remove only suspended solids (with attached pollutants). Media that also remove dissolved include compost, zeolite, and iron-infused polymer. Pretreatment occurs in an upstream unit and/or the vault within which the cartridges are located.

Water quality volume or flow rate (depending on the particular product) is determined by local governments or sized so that 85% of the annual runoff volume is treated.

Construction/Inspection Considerations

- Inspect one or more times as necessary during the first wet season of operation to be certain that it is draining properly.

Performance

The mechanisms of pollutant removal are essentially the same as with public domain filters (TC -40) if of a similar design. Whether removal of dissolved pollutants occurs depends on the media. Perlite and fabric do not remove dissolved pollutants, whereas for examples, zeolites, compost, activated carbon, and peat have this capability.

As most manufactured filter systems function at higher flow rates and have larger media than found in flatbed filters, they may not provide the same level of performance as standard sand filters. However, the level of treatment may still be satisfactory.

Siting Criteria

There are no unique siting criteria.

Additional Design Guidelines

Follow guidelines provided by the manufacturer.

Maintenance

- Maintenance activities and frequencies are specific to each product. Annual maintenance is typical.
- Manufactured filters, like standard filters (TC-40), require more frequent maintenance than most standard treatment systems like wet ponds and constructed wetlands, typically annually for most sites.
- Pretreatment systems that may precede the filter unit should be maintained at a frequency specified for the particular process.

Cost

Manufacturers provide costs for the units including delivery. Installation costs are generally on the order of 50 to 100 % of the manufacturer's costs.

Cost Considerations

- Filters are generally more expensive to maintain than swales, ponds, and basins.
- The modularity of the manufactured systems allows the design engineer to closely match the capacity of the facility to the design storm, more so than with most other manufactured products.

References and Sources of Additional Information

Minton, G.R., 2002, Stormwater Treatment: Biological, Chemical, and Engineering Principles, RPA Press, 416 pages.

ATTACHMENT F

Treatment BMP Maintenance Program

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EXHIBIT B
BMP Maintenance Program

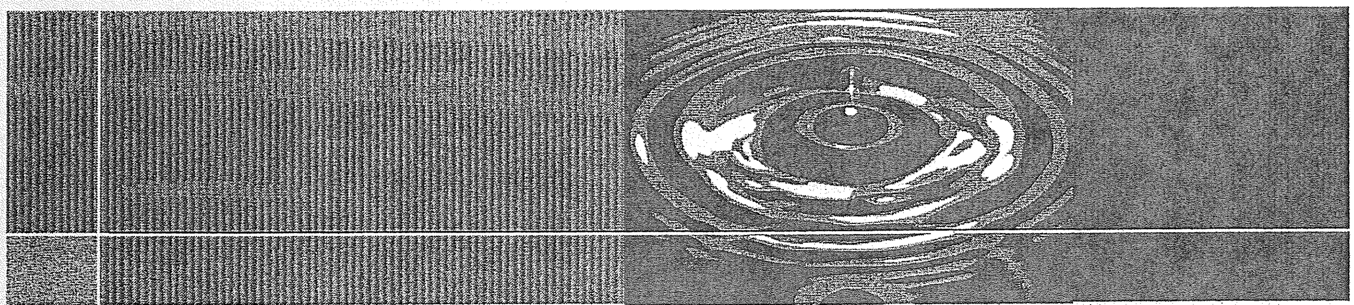
The following inspection and maintenance activities shall be performed and completed as indicated. Questions should be directed to the San Diego County Department of Public Works at (858) 694-3810.

Maintenance Program for Vegetated Swales

Inspection Frequency/Indications:	Regular Inspections ❑ Before wet season begins (September); ❑ After wet season (April). Performance Inspections ❑ After rainfall events greater than 0.5 inch
Maintenance Indications	**Maintenance Activities**
❑ Damage to slopes, inlet, outlet, or other structures	❑ Repair slopes, inlet, outlet, or other structures
❑ Barren areas or badly established vegetation	❑ Re-plant or re-seed barren areas or badly established vegetation, use erosion control mats if necessary
❑ Over-grown vegetation, emergent woody vegetation and/or weeds	❑ Trim vegetation to 6 inches, remove emergent woody vegetation and weeds
❑ Sediment accumulation over 3 inches	❑ Remove sediment accumulation
❑ Trash and litter present in swale	❑ Remove trash and debris
❑ Rodent burrows that inhibit function of facility	❑ Abate rodents and other vectors as necessary
❑ Standing water in facility	❑ Drain standing water
Waste Disposal	Sediment, other pollutants, and all other waste shall be properly disposed of in a licensed landfill or by another appropriate disposal method in accordance with local, state, and federal regulations.

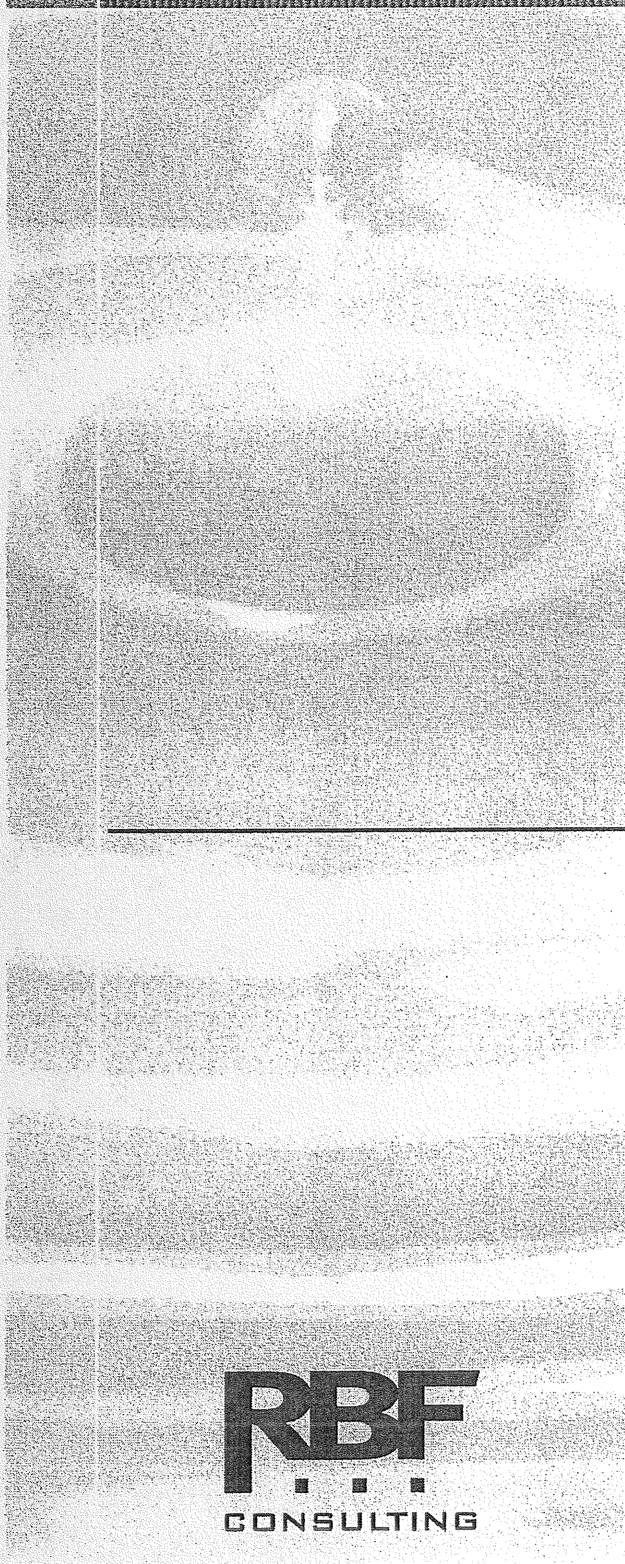
Maintenance Program for Sand Filter

Inspection Frequency/Indications:	Regular Inspections ❑ Before wet season begins (September); ❑ Every 60 days during wet season (September-April); ❑ After wet season (April). Performance Inspections ❑ After rainfall events greater than 0.5 inch
Maintenance Indications Connections	**Maintenance Activities Connections**
❑ Damage to inlet/outlet, sideslopes, headwall, or other structures	❑ Repair inlet/outlet structures, side slopes, fences, or other structural elements as needed to maintain performance of the facility.
❑ Sediment accumulation over 3 inches	❑ Remove sediment accumulation at or near filter height
❑ Trash, debris, and vegetative litter	❑ Remove trash, debris, and vegetative litter
❑ Rodents or other vectors	❑ Abate and control rodents as necessary to maintain performance of the facility ❑ Drain standing water
Waste Disposal	Sediment, other pollutants, and all other waste shall be properly disposed of in a licensed landfill or by another appropriate disposal method in accordance with local, state, and federal regulations.



ATTACHMENT G

Engineer's Certification



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Certification

This Water Quality Technical Report (WQTR) has been prepared under the direction of the following Registered Civil Engineer. The Registered Civil Engineer attests to the technical information contained herein and the engineering data upon which recommendations, conclusions, and decisions are based. The plans and specifications in this WQTR are not for construction purposes; the contractor shall refer to final approved construction documents for plans and specifications.

REGISTERED PROFESSIONAL ENGINEER
KEVIN G. VOGELSANG
NO. C041213
EXP. 3.31.09
CIVIL
STATE OF CALIFORNIA

Kevin G Vogelsang — 3/26/08

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Date