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BMP
Retrofit
PILOT PROGRAM

COMPOSITE SITING STUDY
DISTRICT 7

Prepared For:

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1.0 Executive Summary

As a result of litigation between Caltrans and the National Resources Defense Council (NRDC), a Stipulation was reached outlining the development of a Best Management Practice (BMP) Retrofit Pilot Program in Caltrans District 7. The Retrofit Pilot Program includes the design, construction and monitoring of 38 discrete BMP pilot projects. The District 7 Stipulation permits 10 pilot projects, involving six types of best management practices, to be located within Caltrans District 11, San Diego. The types of devices proposed for possible siting of pilot projects pursuant to the Stipulation include trapping catch basins, drain inlet inserts, biofiltration strips, biofiltration swales, infiltration basins, infiltration trenches, media filters, extended detention basins, and oil/water separators.

The pilot projects have been sited to support the overall objectives of the Retrofit Pilot Program which are to:

1. Determine the feasibility of design, construction and maintenance of the selected BMPs;
2. Evaluate the performance of the selected BMPs in removing constituents of concern in highway stormwater runoff through a benefits assessment program and state-of-the art maintenance and operations; and
3. Evaluate the frequency and magnitude of operational problems associated with maintenance of the structures, including the projected design life of the structure (extrapolated from the operational period) and maintenance and safety concerns specific to transportation facilities and determine solutions to such problems that may be encountered.

The various retrofit pilot projects have been sited so that retrofit options permit observations pertaining to technical feasibility, costs of retrofitting and benefits. Sites were originally selected based on their being common or typical along Caltran's right-of–way, including interchanges, park and rides and maintenance facilities. Each site for a retrofit pilot project has been selected to be appropriate to the type of best management practice to be evaluated and without pre-judgment about the outcome of the associated retrofit pilot study.

Sites have been considered along Caltrans freeways and highways, maintenance stations and park and ride lots within District 7 and selected locations within District 11. The specific retrofit BMPs, and location by Caltrans District per the Stipulation are as shown in Table 1-1. All selected BMP sites can be seen on maps in Exhibits A, B and C at the end of this chapter.

Table 1-1
Stipulation Proposed Sites

Retrofit Pilot Project	Number of Installations District 7	Number of Installations District 11
Trapping Catch Basin	2	0
Catch Basin Insert	6	0
Extended Detention Basin	2	0
Infiltration Basin	1	2
Infiltration Trench	4	2
Biofiltration Swale	4	2
Biofiltration Strip	2	1
Media Filter	4	2
Oil/Water Separator	3	1
Totals	**28**	**10**

The Stipulation also outlined requirements for the development of a more detailed proposal describing the BMP Retrofit Pilot Program. This detailed proposal was developed by Caltrans with review by NRDC in the form of a Scoping Study for the program. The Scoping Study (Draft, RBF, 1997) provides information relative to the BMP Retrofit Pilot Program in sufficient detail so as to serve as a master plan or guide for the entire study. The specific topics discussed in the Scoping Study are:

1. Program research objectives
2. Site selection criteria
3. Sampling frequency
4. Laboratory analysis
5. Site maintenance requirements
6. Reporting procedures
7. Program schedule and estimated cost

The program framework described in the Scoping Study extends over a four-year timeline, with a contingency schedule detailing an optional five-year timeline. The contingency schedule was developed to ensure that the integrity of the study program for individual retrofit pilot projects was not compromised as a result of delays due to unforeseen circumstances.

Some of the maintenance protocol will be site specific and the criteria and procedures will be more effectively prepared during construction of the pilot projects and once construction is complete. The operation and maintenance protocol will be developed according to the guidance provided in *Operation, Maintenance, and Management of Stormwater Management Systems*, USEPA, 1997 and *Stormwater Management Systems Inspection Forms*, 1997. Accordingly, the

discussion relative to operation and maintenance of the Pilot Projects in the Scoping Study is introductory in nature. A detailed maintenance and operation plan, including benefit assessment procedures, will be developed as a separate document. Refinements may also be made to reporting procedures and to the program schedule as the project proceeds.

This report documents the siting process and the selection of final sites pursuant to the conditions and criteria given in the Stipulation and guidelines described in the Scoping Study. The chapters of this report were previously published as individual documents, but have been revised to reflect review comments from the Plaintiffs as well as information obtained during the final elements of the site selection process. The siting studies contained as Chapters 2 through 10 of this report are:

- Chapter 2 - Trapping Catch Basins
- Chapter 3 – Catch Basin Inserts
- Chapter 4 – Extended Detention Basins
- Chapter 5 – Infiltration Basins
- Chapter 6 – Infiltration Trenches
- Chapter 7 – Biofiltration Swales and Strips
- Chapter 8 – Media Filters
- Chapter 9 – Oil/Water Separators
- Chapter 10- Multi-Chambered Treatment Train (MCTT)

The infiltration type Pilot Projects have been the subject of some modification relative to the program originally outlined in the Stipulation. Due to the limited availability of suitable sites for locating this type of BMP, it was mutually agreed between Caltrans and the Plaintiff that an additional BMP Pilot Project(s) would be included in the Retrofit Program. Two such projects are proposed to replace the four un-sited infiltration trenches: a compost media filter and Multi-Chambered Treatment Train (MCTT) devices. Discussion of the compost filter project is provided in Chapter 8. The MCTT is a relatively new structural stormwater BMP developed by the USEPA at the University of Alabama. Siting studies for the MCTT are provided in Chapter 10.

One of the infiltration basins was also not sited due to the lack of a site with a suitable infiltration rate. Three infiltration basin pilot studies are required by the Stipulation, two of which may be implemented in District 11. One infiltration basin was successfully sited in District 7 and another was successfully sited in District 11. An additional extended detention basin will be substituted in District 11 for the un-sited infiltration basin. This substitution is further discussed in Section 1.3 and Chapter 4.

1.1 General Siting Approach

The criteria used to select sites have varied depending on the nature and specific requirements of the type of best management practice to be evaluated. However, there have been four general criteria that have controlled the selection of all retrofit pilot project sites. First, the sites must be appropriate for the capabilities of the best management practice being evaluated. Second, the sites must present a realistic opportunity to install, operate and observe the devices being evaluated. Third, the sites must be owned and operated by Caltrans. Lastly, the sites must be projected to be operational as of December 1, 1998 and for at least two years after that date.

Most information on the design requirements and pollutant removal capabilities for each of the BMPs was obtained from two reference manuals. These manuals are:

> *Evaluation and Management of Highway Runoff Water Quality,* Federal Highway Administration, U.S. Department of Transportation, Publication No. FHWA-PD-96-032, June 1996; and
>
> *Current Regulatory Best Management Practices for Urban Runoff*, Bruce Phillips, Senior Director of Water Resources Engineering, Robert Bein, William Frost and Associates, Irvine, California, 1998.

Specific location criteria related to each type of best management practice are presented in Chapters 2 through 10 in which the siting for the various best management practices included within the Retrofit Pilot Program for Caltrans District 7 are summarized. The siting criteria have been considered based on a review of Caltrans highway runoff data, highway runoff literature, desktop and field reconnaissance of Caltrans facilities and professional judgment.

After initial selection of candidate sites, RBF conducted site reviews with representatives of Caltrans and NRDC and received comments from them concerning the recommended sites. As the site selection process evolved, siting recommendations were refined to insure consistency with the original intent of the Stipulation.

1.1.1 Siting Process

Sites were selected using a weighted decision matrix process. Criteria significant in the selection of the retrofit project were assembled and then assigned a weighting factor to emphasize the more important selection criteria as compared to less critical selection criteria. All candidate sites were reviewed and ranked according to the weighted criteria established for the subject BMP. This criteria is defined and discussed in detail in Appendix C. Some of the primary criteria used in site selection (in no particular order) was:

- Maintenance Access
- Presence of Vehicles and Heavy Equipment
- Space Availability
- Proximity to structures
- Drainage pattern

The 'best' sites were selected as those accumulating the highest composite score for all criteria established in the decision matrix. In many cases, multiple BMPs were suitable for a proposed site. Sites previously selected for other BMP pilot projects were generally given priority to those selected later in the siting process, consistent with the program methodology of siting the pilot projects with the most stringent criteria first. BMPs that are more difficult to site (such as infiltration devices) were sited earlier in the process as compared to those that had less stringent siting requirements. This method of prioritized siting ensured that the BMP best suited to a particular site was selected. The site selection for the various types of BMPs generally proceeded in the following order:

1. Oil/Water Separators
2. Catchbasin Inserts
3. Infiltration Basins
4. Infiltration Trenches
5. Media Filters/MCTTs
6. Extended Detention Basins
7. Biofilters
8. Trapping Catchbasins

Oil/water separators were sited first since a prescreening sampling program was required at the selected sites (see Chapter 4). Catchbasin inserts were selected next as the research program for this pilot study required multiple drainage inlets at a maintenance station. The infiltration BMPs are difficult to site since they must meet space, safety, distance to existing structures and maintenance access requirements as well as soil infiltration criteria. Media filters and MCTTs require an existing storm drain system. Detention basins have most of the criteria associated with infiltration basins relative to space and maintenance access requirements. Biofilters and trapping catchbasins have the fewest space and access criteria providing relatively greater opportunities for siting.

1.1.2 Siting Constraints

Several constraints have been encountered in selecting appropriate sites for the Retrofit Pilot Projects. First, there is a limited amount of suitable, available surplus area within the right-of-way owned and operated by Caltrans. The Department generally maximizes use of its land and has very little land available for the land-intensive best management practices. For the purposes of the Retrofit Pilot Program land purchase or leasing was not deemed realistic because of the

cumbersome and time-consuming procedures that must be followed if Caltrans were to purchase or lease additional property.

It should be noted however, that the opportunity existed to site pilot retrofit extended detention basins and infiltration basins within existing Caltrans right-of-way. Safety concerns dictate several siting criteria, including the reservation of a 30 foot clear recovery zone (for motorist safety) around the perimeter of the basin. In addition, the basin must be protected by 'k'-rail at the periphery of the 30 foot clear zone. Other criteria, such as maintenance access and suitable site topography must also be satisfied. A section of the California Highway Design Manual documenting the basis for this setback, and a Memorandum from District 7 clarifying this issue, is contained in Appendix D.

The placement of infiltration BMPs adjacent to bridge structures must be carefully evaluated since saturation of the area around a bridge column or abutment could reduce the foundation load capacity. A 100 foot setback criteria was developed for the purpose of siting infiltration BMPs in the vicinity of bridge structures. Use of this setback distance is considered the minimum safe distance for which a more detailed site structural and geotechnical investigation would not be required. A memorandum documenting the basis for this setback is contained in Appendix D.

A second significant constraint has been the lack of infiltration capacity of the soils at sites that otherwise would be appropriate for conducting pilot studies of infiltration basin or infiltration trenches. Siting of the infiltration BMPs was carried out by first identifying sites suitable from a use, space and maintenance perspective. This was followed by a preliminary assessment by the geotechnical engineer as to the likelihood of suitable soils (infiltration rates) at the site. Following this analysis, in-field permeability tests were completed for sites that met this preliminary screening criteria. A total of 15 in-field borings and permeability tests were conducted at pre-screened sites in District 7 and District 11. Of these 14 sites, a total of four viable infiltration sites were found.

The widespread occurrence of clay soils within the Metropolitan Los Angeles portion of District 7 results in unsuitable infiltration rates for BMP devices. Following a review of District 7 soils, the geotechnical engineer recommended that more emphasis be placed on infiltration sites in District 11, in the coastal areas where sandy soils are predominate. However, high groundwater reduced the number of viable sites in District 11. Given the fairly comprehensive investigation effort put forth to site the infiltration BMPs and the limited results, it would appear that infiltration BMPs have limited application as a mainstream retrofit application.

The design and use of Caltrans facilities also influences the suitability of sites for installation of particular best management practices. For instance, several maintenance stations were designed to sheet flow their runoff to nearby public streets. These facilities lack on-site drain inlets and storm drain systems which might be retrofitted with such devices as media filters. In addition, several Caltrans facilities have been designed and constructed with multiple drainage areas and discharge points. This reduces flows and concentrations of potential pollutants to any particular

discharge point. Furthermore, several maintenance stations are small and lack the heavy equipment associated with road crews. The lack of heavy equipment reduces the likelihood of sufficient oil and grease to justify installation of specific devices such as oil/water separators. The probability of appropriate sites for these devices is further reduced by site configurations with multiple drainage areas and multiple discharge points which reduce concentrations of oil and grease at any given discharge point.

1.2 Selected BMP Retrofit Sites

Siting of the BMP Retrofit Pilot Projects occurred in District 7 and District 11 as allowed by the Stipulation. Sites in District 7 and District 11 were considered on a consistent basis, with criteria for the selection of a pilot project site in District 11 identical to and made concurrently with site selection in District 7. In District 7, 21 sites were selected containing a total of 23 BMP Pilot Projects. Table 1-2 indicates the District 7 BMP Retrofit Pilot Project sites. In District 11, seven sites were selected with a total of eight BMP Pilot Projects. Table 1-3 describes the District 7 Retrofit Pilot Project sites located in District 11. Note that some locations were selected for more than one BMP. All selected BMP sites can be seen on maps in Exhibits A, B and C at the end of this chapter.

BMP RETROFIT PILOT PROGRAM SITES – DISTRICT 7, LOS ANGELES

Table 1-2

BMP Location	BMP Project Type	Location
Trapping Catch Basins		
210-13 (1) (TC)	Trapping Catch Basin (TC)	Drainage system located along the I-210, approx. 850' west of Orcas Ave, in Lake View Terrace(LVT). (4 inlets)
210-13 (2) (TC)	Trapping Catch Basin (TC)	Drainage system located along the I-210, approx. 150' east of Orcas Ave., LVT. (4 inlets)
210-5 (3) (TC)	Trapping Catch Basin (TC)	Drainage system located along the I-210, approx. 600'west of Van Nuys Blvd. LVT (5 inlets)
210-6 (1) (TC)	Trapping Catch Basin (TC)	Drainage system located along the I-210, just north of Carl Street , LVT (7 inlets)
Catch Basin Inserts		
Las Flores Maintenance Station	Catch Basin Insert (CI)	2503 Las Flores Canyon Road, approx. one half mile north off PCH.
Rosemead Maintenance Station	Catch Basin Insert (CI)	9153 Lower Azusa Road, I-10 Fwy. Rosemead offramp
Foothill Maintenance Station	Catch Basin Insert (CI)	850 East Huntington Drive, I-210 Fwy. Mountain Ave. offramp.
Extended Detention Basin		
S605.91(S)	Extended Detention Basin (EDB)	Basin between southbound I-605 and SR91e-I605s connector
S5/S605	Extended Detention Basin (EDB)	Basin between southbound I-5 and I605s-I5s connector
Infiltration Basin		
N605/91(S) Interchange	Infiltration Basin (IB)	Basin in the middle of the I605n-SR91w cloverleaf connector

BMP RETROFIT PILOT PROGRAM SITES – DISTRICT 7, LOS ANGELES

Table 1-2

BMP Location	BMP Project Type	Location
Infiltration Trench		
Altadena Maintenance Station	Infiltration Trench (IT)	2122 North Windsor Avenue,I-210 Fwy. North Windsor Ave. offramp
Biofiltration Swale		
Cerritos Maintenance Station	Biofiltration Swale (BSw)	At end of Studabaker offramp, SR91westbound runoff (behind Cerritos MS).
I-605(N)/SR-91(N) Interchange	Biofiltration Swale (BSw)	Between I-605 northbound, SR91w-I605s connector, and I605n-SR91w connector
I-5(S)/I-605(N) Interchange	Biofiltration Swale (BSw)	Between southbound I-5 and I5s-I605s connector
I-605(N)/Carson &Del Amo Interchange	Biofiltration Swale (BSw)	Strip along shoulder of I-605 southbound between Carson & Del Amo offramps
Biofiltration Strip		
Altadena Maintenance Station	Biofiltration Strip (BSt)	2122 North Windsor Avenue,I-210 Fwy. North Windsor Ave. offramp
I-605(N)/SR-91(N) Interchange	Biofiltration Strip (BSt)	Between I-605 northbound, SR91w-I605s connector, and I605n-SR91w connector
Media Filter		
East Regional Maintenance Station	Media Filter (MF)	19405 Workman Mill Rd. Just off SR-60 Fwy.
Foothill Maintenance Station	Media Filter (MF)	850 East Huntington Drive, I-210 Fwy. Mountain Ave. offramp.
Termination Park and Ride	Media Filter (MF)	I-105/I-605 interchange
Paxton Park and Ride	Media Filter (MF)	I-210 and Paxton Street

BMP RETROFIT PILOT PROGRAM SITES – DISTRICT 7, LOS ANGELES
Table 1-2

BMP Location	BMP Project Type	Location
MCTT		
Lakewood Park and Ride	MCTT	SR-105/Lakewood Blvd. interchange in the City of Downey
Metro Maintenance Station	MCTT	2187 Riverside Drive, off SR 2
Via Verde Park and Ride	MCTT	I-210/Via Verde intersection inside the I-210 Southbound onramp in the City of San Dimas
Oil/Water Separator		
Alameda Maintenance Station	Oil/Water Separator (O/W S)	1740 East 15th Street, I-10 Fwy. Alameda Street offramp

BMP RETROFIT PILOT PROGRAM SITES – DISTRICT 11, SAN DIEGO
Table 1-3

BMP Locations	BMP Retrofit Facility	Location Description
Infiltration Basin		
I-5 and La Costa Ave (w)	Infiltration Basin (IB)	The basin is located on the west side of I-5 just north of the I-5 southbound offramp. It is bounded on the east by the I-5. It is bounded on the north by a gas station at the La Costa exit going west. The basin is bounded on the south by the Bataquitos Lagoon.

BMP RETROFIT PILOT PROGRAM SITES – DISTRICT 11, SAN DIEGO **Table 1-3**		
BMP Locations	**BMP Retrofit Facility**	**Location Description**
Extended Detention Basin		
SR 78 and I-15	Extended Detention Basin (EDB)	The basin is located along the SR 78 eastbound/I-15 northbound connector, west if I-15.
Infiltration Trench		
Carlsbad Maintenance Station	Infiltration Trench (IT)	In the City of Carlsbad, one block south of Palomar Airport Road at 6050 Paseo Del Norte. Bounded by Paseo del Norte to the west and commercial and industrial uses to the south, east and north.
Biofiltration Swale		
Melrose Dr./SR 78	Biofiltration Swale (BSw)	Site location begins along the SR78 eastbound shoulder about 30 yards prior to the start of the Melrose Avenue offramp. Site continues along the shoulder of the offramp to Melrose Avenue but ends about 50 yards before Melrose Avenue.
Palomar Airport Rd.	Biofiltration Swale (BSw)	Located along the I-5 (s). Access to the site is from the I-5 southbound shoulder. Site is located approximately 200-300 feet prior to the Palomar Airport Road offramp.
Biofiltration Strip		
Carlsbad Maintenance Station	Biofiltration Strip (BSt)	In the City of Carlsbad, one block south of Palomar Airport Road at 6050 Paseo Del Norte. Bounded by Paseo del Norte to the west and commercial and industrial uses to the south, east and north.

BMP RETROFIT PILOT PROGRAM SITES – DISTRICT 11, SAN DIEGO

Table 1-3

BMP Locations	BMP Retrofit Facility	Location Description
Media Filter		
Kearny Mesa Maintenance Station	Compost Media Filter (MF)	Adjacent to the 805 freeway at 7179 Opportunity Road in San Diego. Bounded by commercial uses to the east, Opportunity Road to the north and the I-805 freeway to the south and west.
Escondido Maintenance Station	Sand Media Filter (MF)	Located at 1780 West Mission Avenue in the City of Escondido, one block west of SR78 at Nordahl Road. Bounded by industrial uses to the east and west, SR78 to the north, Mission Avenue to the south.
SR-78/I-5 Park and Ride	Sand Media Filter (MF)	Park and ride is located just off the I-5 freeway southboud at the intersection with the 78 freeway on the northerly side of hwy 78 and the westerly side of I-5 in Carlsbad.

1.3 Unsited Retrofit Pilot Projects

Table 1-4
BMP Retrofit Pilot Projects Not Sited

BMP Pilot Project	Number of Projects Stipulated	Number of Projects Unsited	Reason Not Sited
Infiltration Trench	6	4	Insufficient sites with adequate infiltration
Infiltration Basin	3	1	Insufficient sites with adequate infiltration
Oil/Water Separators	4	3	Total oil/grease concentration in runoff low

Several of the infiltration devices were not sited due to difficulties in finding sites with suitable infiltration rates as discussed previously. Three of the oil/water separators were not sited pursuant to the option provided in the Stipulation relative to a decision to construct. The oil/water separator testing program revealed that free oil and grease concentrations in the runoff from maintenance stations was in general too low for effective removal through a plate-type separator.

It was mutually agreed between NRDC and Caltrans to substitute MCTT BMPs for the infiltration trench pilot projects since the stipulation did not provide an early termination mechanism for the infiltration trench pilots. The final number of MCTT BMP pilot projects was agreed upon by Caltrans and NRDC as equal in construction cost to the cost of construction of the three infiltration trench pilot projects they replace. A compost media filter will replace the fourth infiltration trench that will not be sited.

An extended detention basin has been substituted for the infiltration basin that was not sited. The substituted extended detention basin is located in District 11 on SR 78 at the I-15 interchange.

2.0 Trapping Catch Basins

As part of the District 7 Pilot Retrofit Program, RBF investigated Caltrans storm drain systems in District 7 with the goal of selecting four sites for the purpose of evaluating the feasibility and effectiveness of installing trapping catch basins. The four sites will include two retrofitted and two non-retrofitted catchments.

Trapping catch basins are defined as inlets to the storm drain located between the curb and the underground storm drain line. They include a small trap or sump area below the outlet lateral pipe invert to allow sediment and debris accumulation and removal. An optional baffle at the outlet helps to prevent floating materials from entering the storm drain pipe.

The trapping catch basin efficiency, in addition to operation and maintenance, will be evaluated based on water quality monitoring for a two-year period. The District 7 Stipulation indicates that retrofit for trapping catch basins should not exceed the replacement of a total of twenty existing drain inlets.

2.1 Study Objectives

The study objectives for the sites include comparing the differences between trapping catch basins and self-cleaning drain inlets for the following characteristics:

1. Estimated rates of material entrance to, accumulation in, and discharge from basins; and
2. Ability to remove the following constituents: settleable solids, total suspended solids, metals and petroleum hydrocarbons.

Trapping catch basins are intended to trap settleable solids by means of a settling zone or sump below the outlet. They also typically have grates or bars.

The maximum storage volume of sediment in a catch basin generally equals about 60 percent of the sump volume. To operate at their maximum efficiency, trapping catch basins need to be cleaned frequently. Catch basins may be effective at solids removal at very low flow rates.

2.2 Site Selection Process

The site selection process of locating four sites for the Retrofit Pilot Program involved meeting with Camp Dresser and McKee (CDM) to review site plans and related information for catch basins located in Los Angeles County, District 7 along freeways and highways. CDM has previously compiled all ‘as-built’ information for Caltrans

storm drain systems in District 7 as a part of other ongoing investigations. Candidate sites need to contain at least four catch basins while containing no median drains. Median drains can create safety and traffic problems during debris removal and other maintenance operations. Consequently, the number of viable sites was limited by this siting criteria. Field notes for candidate sites can be found in Appendix B.

This information was then evaluated using a weighted decision matrix process. Each site was evaluated and compared with respect to several different criteria and characteristic categories. Each criteria or characteristic category was given a value, or weight (1 – 10), with respect to its importance and relevance to the site selection process. The scoring system used in the matrix can be found in Appendix C.

The characteristics determined to be important were the following:

- Monitoring site feasibility;
- Maintenance feasibility;
- Equipment security; and
- Sampling safety and access.

The site characteristic values were assigned for each category at each site. For example, "monitoring site feasibility" would receive a low score if flow to a monitoring site was supercritical and through corrugated metal piping (CMP) because the resulting flow would be too turbulent to accurately monitor for discharge. Each site was then rated by developing a composite score, representing all of the individual characteristic categories, as shown in Table 2-2. The sites with the highest composite scores were chosen for further consideration.

During the preliminary screening process, RBF was able to utilize the as-built plan data base compiled by CDM. Preliminary research consisted of reviewing CDM's compilation of drainage plans and field review notes for most of the highways and freeways in Los Angeles County. The interstate highways and state routes investigated were as follows: I-5, I-10, I-15, I-405, I-605, I-210, SR 91, SR 60, SR 110, and SR 57. The SR 105 was not considered due to previous drainage problems and possible future repair projects resulting from a high water table.

All sites evaluated in the decision matrix and described in Table 2-1 below are located on the I-210 freeway. There are several reasons why all candidate sites were proposed along the same freeway. First, there were numerous siting criteria for the trapping catch basin Pilot Project including: absence of median drains, a minimum of four and maximum of ten drain inlets, no offsite flow and adequate area for maintenance and monitoring must be present for safety purposes. Some of these criteria may be less important in a post-study retrofit scenario, and such assessments will be a part of this BMP Pilot Retrofit investigation. The criteria described reduces the number of available candidate sites.

Second, similar hydrologic characteristics and average daily traffic counts (ADT), were desired for the trapping catch basins for purposes of comparability between the study sites. Interstate 210 had the most opportunities consisting of isolated storm drain systems discharging within Caltrans right-of-way with access for maintenance and monitoring.

The sites that best fit the criteria developed for this study are as follows:

Table 2-1: Site Descriptions

ID #	Fwy.	Location	CDM Data Base #	# Inlets	Monitoring Point
1	I-210	210(n) @ 210(w)/210(n) interchange	210-24	7	MH in lateral
2	I-210	210(e,w) @Evergreen onramp	210-59	6	Outlet
3	I-210	210(e,w), west of Orcas Ave.	210-13 (1)	4	Outlet
4	I-210	210(w), east of Orcas Ave.	210-13 (2)	4	Outlet
5	I-210	210(w), east of Filmore St.	210-5 (1)	7	MH in lateral
6	I-210	210(e), east of Filmore St.	210-5 (2)	7	MH in lateral
7	I-210	210(e,w) east of Filmore St. and #5,6	210-5 (3)	7	Outlet
8	I-210	210(e,w) west of Van Nuys Blvd.	210-5 (4)	6	Outlet
9	I-210	210(e,w) east of Van Nuys Blvd.	210-6 (1)	7	Outlet
10	I-210	210(e,w) east of Maclay St.	210-1 (1)	5	MH to lateral
11	I-210	210(e,w) east of Maclay St. & #10	210-1 (2)	4	MH to lateral

The selected sites from the preliminary research were reviewed in the field to better understand the outlets, inlets and safety considerations. These sites were analyzed using a decision matrix process to match two sets of two drainage systems for this project as described above.

Table 2-2: Decision Matrix					
Weight	*10*	*9*	*6*	*7*	
Site #	**Monitoring Site Feasibility[1]**	**Maintenance Feasibility[2]**	**Equipment Security[3]**	**Sampling Safety & Access[4]**	**Total**
1	6	5	7	6	189
2	7	7	7	5	210
3	**7**	**7**	**8**	**8**	**237**
4	**8**	**8**	**7**	**7**	**243**
5	5	8	8	5	205
6	2	7	8	4	159
7	**8**	**7**	**8**	**8**	**247**
8	3	7	7	7	184
9	**7**	**6**	**7**	**6**	**208**
10	4	7	6	6	181
11	1	7	6	6	151

1. Feasibility of placing a monitoring station at desired location (construction, energy dissipation, etc.).
2. Feasibility of cleaning catch basins (space for vehicle, location of catch basins, etc.).
3. Security of equipment (damage, theft, etc.).
4. Safety of sampling party (access, dogs, crime, etc.)

The six sites that scored the highest were selected for further analysis. The sites were also grouped in pairs with respect to their locations and tributary area sizes relative to one another. As mentioned previously, sites that are situated near to each other will have more similar average daily traffic counts and hydrologic conditions. In addition, sites that are similar in tributary area will yield more comparable results. Taking these criteria into consideration, sites #3, 4, 7, and 9 were chosen. Site #2 was not chosen due to a tributary area of one acre, which is not consistent with any of the other sites. Site #5 was not chosen because a considerable amount of construction would be needed to locate the monitoring station along the I-210 freeway.

The remaining four sites were situated into two groups, A and B. Sites 3 and 4 were selected for group A, and sites 7 and 9 were selected for group B.

2.3 Site Descriptions

2.3.1 Group A

Group A consists of sites # 3 and 4 from Table 2-1. Site #3 is located approximately 850 feet (259 meters)west of Orcas Avenue in the City of Lake View Terrace. Site #3 has a total of four drain inlets, two on each side of the I-210 freeway. The total tributary area was estimated to be just over three acres (1.2 hectares). The system outlet is an 18-inch (46 cm) corrugated metal pipe that drains into an earthen channel (*Figures 2-1 & 2-2*). The estimated slope of the outlet pipe is 20 percent. The channel width is approximately 25 feet (7.6 meters) wide, which should provide enough space to dissipate the energy of the outlet runoff for purposes of flow monitoring. The proposed monitoring location can be accessed by Foothill Boulevard.

Figure 2-1 (Site area)

Figure 2-2 (Site outlet)

The catch basin inlets are located along the curb on the outside of a eight-foot (2.4 meter) shoulder.

Site #4 is located approximately 150 feet (46 meters) east of Orcas Avenue. Site #4 has a total of four drain inlets, all of which are situated along the westbound side of the I-210 freeway. The estimated tributary area is 2.5 acres (1 ha). The system outlet consists of an 18-inch (45.8 cm) corrugated metal pipe that drains directly into a type 'B' v-ditch drain (*Figures 2-3 & 2-4*). The estimated distance across from the outlet is 25 feet (7.6 meters), which should allow for enough space to dissipate the energy and construct a monitoring station. The proposed monitoring location can be accessed from Orcas Avenue.

Figure 2-3 (Outlet slope)

Figure 2-4 (System outlet)

The catch basin inlets are located along the curb on the outside of an eight-foot (2.4 meter) shoulder. With respect to maintenance of the individual drain inlets, since all four inlets of this site are located on the same side of the freeway, and adequate space is available to construct stairways up to the inlets from the staging area, it is recommended that this site be retrofitted.

2.3.2 Group B

Group B consists of sites #7 and 9 from Table 2-1. Site #7 is located approximately 600 feet (183 meters) west of Van Nuys Boulevard near the I-210/SR 118 interchange in the City of Lake View Terrace. Site #7 has a total of seven drain inlets, five on the I-210 westbound (*Figure 2-5*) and two on the eastbound. The estimated tributary area is just over two acres (0.8 hectares). The system outlet is an 18-inch (46 cm) corrugated metal pipe that drains into a small six-foot (1.8 meter) rectangular concrete channel (*Figure 2-6*). A subsurface break in slope occurs in the outlet pipe, from a 40% to a 5% slope. The outlet structure drains into a 5-foot (1.5 meter) by 1.25-foot (0.4 meter) rectangular concrete channel, which runs parallel to the I-210 freeway until draining into the city storm drain system.

Figure 2-5 (Drain inlets)

Figure 2-6 (System outlet)

From the end of the outlet structure to the Caltrans right-of-way fence, is approximately 35 feet (10.7 meters), which should provide enough space for energy dissipation and implementation of a monitoring station.
Five of the drain inlets are located along the curb of the westbound I-210/southbound SR 118 connector. One inlet is located along the curb of the northbound.

SR 118/eastbound I-210 connector and one drain inlet is located on the median between the eastbound I-210 and the SR 118 northbound/I-210 eastbound connector. All drain inlets are situated on the curb side of their respective eight-foot (2.4 meter) shoulders.

Site #9 is located just north of Carl Street in the City of Lake View Terrace. It has a total of seven drain inlets and one inlet from the adjacent slope along the westbound I-210 freeway. The inlet located along the slope was considered not to pose a problem for this study due to the fact that freeway inlets usually accept runoff from adjacent freeway slopes.

Of the seven drain inlets, three are located along the I-210 westbound side and four along the eastbound side. The estimated tributary area is about 3.5 acres (1.4 hectares). The system outlet consists of a 24-inch (61 cm) reinforced concrete pipe that drains into a small concrete rectangular channel (*Figure 2-7*). The channel drains into a concrete swale, which runs


Figure 2-7 (System Outlet)


Figure 2-8 (Outlet Access)

through a private lot out to Foothill Boulevard. The slope of the outlet pipe is approximately 2%. The amount of space at the outlet should provide ample area for construction of a monitoring station and energy dissipation if needed.

The proposed monitoring area can be by the Pierce Street entrance to the Caltrans right-of-way area south of the I-210 eastbound (*Figure 2-8*).

Due to the existence of the one non-grate drain inlet, it is recommended that this site be the control site.

3.0 Introduction

As part of the District 7 Pilot Retrofit Program, RBF has selected three Caltrans maintenance stations as sites for the purpose of evaluating the feasibility and effectiveness of installing catch basin inserts.

Catch basin inserts are defined as containers with some filtering and/or sorbing medium to be installed in existing inlets. The catch basin inserts manufactured to date typically have been configured to remove sediment, pollutants adsorbed to sediment, and oil and grease.

Two different designs of commercially available catch basin inserts will be installed at each site selected. Storm water runoff constituent removal efficiencies, in addition to operation and maintenance, will be monitored for a two year period for the following constituents: total suspended solids, metals, and total recoverable petroleum hydrocarbons.

3.1 Site Evaluations

The process of locating three sites for the Pilot Program involved extensive field reviews of the maintenance stations. The proposed sites needed to contain at least two drain inlet structures, consequently, the number of viable sites was limited. Field notes on the sites can be found in Appendix B.

The criteria for selection involves not only the number of existing drainage inlets, but also the type of maintenance activities and equipment storage at the yard. Since petroleum hydrocarbons are the primary runoff constituents of concern, areas chosen included heavy vehicles and/or equipment. In other words, areas with two inlets but no vehicular storage would not be considered. Other criteria considered during the selection process included tributary area and sediment and/or debris accumulation possibilities. Selection criteria are discussed in Appendix C.

The site selection process began with meetings with Caltrans officials and maintenance yard superintendents to request site plans and related information. Caltrans assisted with field investigations including tours of the grounds, photos, and observations of drainage patterns and general housekeeping practices.

Initially, the Alameda, Altadena, Central, East Region, Foothill, Las Flores, Metro and Rosemead Maintenance Stations were considered for the catch basin insert retrofit because they contained drain inlet structures with heavy equipment type uses on site. Reasons for rejection of some sites included:

- the absence of two onsite catch basins,
- the high cost of site improvements required to direct water to a second inlet,

- the cost and feasibility associated with extensive offsite improvements for those sites not containing adequate onsite drainage facilities.

Table 3-1 shows the selected sites and their drainage inlet characteristics. The grate inlets found in these maintenance stations were G1 type inlets using type 450-9X & 600-12X grates.

After preliminary selection of the sites, RBF met with representatives of Caltrans and the NRDC for a final site review. On November 18th and 19th, 1997 inspections of these sites concluded with a verbal agreement between all parties on the selection of these sites for construction of the Pilot projects.

After extensive office and field review, only three sites met the site selection criteria. They were: Foothill, Las Flores, and Rosemead Maintenance Stations. These sites are the few that contain muliple drainage inlets and site activities consistant with the criteria for the study.

Table 3-1: Selected Catch Basin Insert

Site Location	**# of Grate Drain Inlets**	Selected Catch Basin Runoff Characteristics	
		Approximate Tributary Area in Acres (Hectares)	
		Inlet 1	**Inlet 2**
Foothill MS	4	0.5 (0.20)	1.5 (0.61)
Las Flores MS	3	0.3 (0.12)	0.6 (0.24)
Rosemead MS	2	0.4 (0.16)	1.0 (0.40)

Note: For inlet designations refer to Site Description section.

3.2 Catch Basin Inserts

The research objectives for the sites are twofold:

1. To compare the efficiencies and operation and maintenance of two different commercially available types of catch basin inserts; and
2. To determine whether or not the inserts are effective enough to justify their continued usage.

The two different commercial catch basin inserts that have been tentatively chosen for comparison are Hydro-Kleen and Fossil Filter. Further investigations of other

commercially available catch basin insert manufacturers will be completed prior to final design. The brand of insert filters used in the study will be agreed upon between Caltrans and NRDC following a more detailed comparison between the various commercially available units.

In situations where more than two inlets exist at a site, the decision of which inlets to use for the study was based on the expected flow rate to the inlets, estimated potential to generate constituents of concern, and inlet suitability for other pilot retrofit projects (See Chapter 8). In general, it is beneficial for the tributary areas on the site to each inlet to be similar.

3.3 Site Descriptions

3.3.1 Foothill MS

The Foothill Maintenance Station is located at 850 East Huntington Drive near the corner of Mountain Ave. and East Huntington Dr., just off the 210 freeway, Mountain Avenue offramp. The site area was estimated by field observation to be approximately 4.5 acres (1.8 hectares). The site drainage system contains four inlets. One inlet, located along the southern side of the station, was not considered for selection because it has a very small tributary area and it is covered by a storage container. Of the remaining three inlets, the two with that were chosen for retrofit were the upper inlets because they had the most similar tributary areas. This is important for the purposes of monitoring and comparison. The station is located in an industrial area with buildings on both sides and a major storm drain channel along the western side of the facility. The site is equipped with an onsite storm drain system.

The Foothill Maintenance Station contains approximately 20 heavy maintenance vehicles and 20 employee vehicles. The site drainage consists of swales flowing into four grate inlets. This onsite drainage system discharges directly to the adjacent flood control channel. Examples of the grate inlets are shown in *Figure 3-1* and *Figure 3-2*.

A central inlet in the Station was not chosen for retrofit because it received a very small portion of tributary area (approximately 0.1 acres (0.04 hectares)).

Figure 3-1 (One upstream inlet)

Figure 3-2 (Downstream inlet)

Other aspects of this site that are relevant to the selection criteria include storage of onsite petroleum based substances, such as oil waste, asphalt crack sealant, and solid asphalt.

3.3.2 Las Flores

The Las Flores Maintenance Station is located at 2503 Las Flores Canyon Road in the City of Malibu, approximately one half a mile east of the Pacific Coast Highway. The site area was estimated by field observation to be approximately one acre (0.4 hectares). The site is located in a rural, sparsely populated residential area. The yard itself is split in two with an upper area where the office is located, and a lower area where the maintenance yard equipment is located. The lower portion of the site is equipped with three drain inlets leading to a nearby creek. The top inlet receives approximately 0.1 acre (0.4 hectares), the central inlet receives about 0.3 acre (0.12 hectares), and the lower inlet receives about 0.6 acre (0.24 hectares). *Figures 3-3* and *3-4* show the two inlets chosen for monitoring. The third inlet, located further upstream, was not chosen due to the lack of tributary area.

Figure 3-3 (Upstream Inlet)

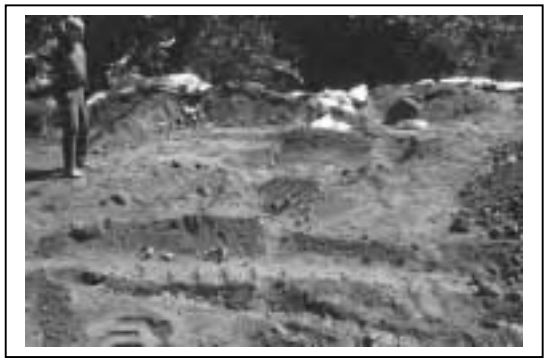


Figure 3-4 (Downstream Inlet)

The Las Flores Maintenance Station is currently being rebuilt after being seriously damaged from a recent fire. The estimated opening date is May, 1998. The station has two enclosed maintenance bays, one wash rack, and above ground tanks for refueling.

The inlets shown will be surrounded by asphalt parking and storage once construction is complete.

3.3.3 Rosemead

The Rosemead Maintenance Station is located at 9153 Lower Azusa Road, about one mile North of the 10 freeway, Rosemead offramp. The site area was estimated by field observation to be approximately two acres (0.8 hectares). The station is located in a commercial area with stores on either side.

The yard is equipped with two drain inlets that capture about seventy percent of the total site runoff (*Figure 3-5* and *Figure 3-6*). Inlet number one captures about 0.4 acre (0.16 hectares), while inlet two captures approximately 1.0 acre (0.4 hectares). The remaining runoff drains as sheet flow out the front gate to the street curb.

Figure 3-5 (Upstream Inlet)

Figure 3-6 (Downstream Inlet)

The site contains approximately 10 heavy vehicles with about 10 employee cars. The drain inlets capture all runoff from these parking areas.

4.0 Introduction

As part of the District 7 Pilot Retrofit Program, Robert Bein, William Frost & Associates (RBF) has selected three sites for extended detention basins to evaluate the feasibility and effectiveness of this type of best management practice in removing potential pollutants from urban road and highway runoff. Selection of these sites is consistent with provisions in the Retrofit Pilot Studies Stipulation dated August 27, 1997. The Stipulation specifies that Caltrans shall select two sites in District 7 for the purpose of constructing and monitoring two pilot extended detention basins, if deemed appropriate following initial investigation of the conditions necessary for their siting in drainage pathways from freeways and highways. A third site was selected by mutual agreement between NRDC and Caltrans as a substitute for an infiltration basin pilot project that was not sited. This substitution is further discussed in Section 4.3.1 and Chapter 5.

Extended detention basins are basins that hold runoff for at least 24 hours for the purpose of removing sediment and particulate forms of other potential pollutants. For this study, a detention period of 48-72 hours has been specified. The extended detention basins in this study are designed to remain dry, except during a runoff event and a specified detention period after the runoff event.

Extended detention basin outlets may require energy dissipaters and downstream receiving channel stabilization. These actions would mitigate scouring in the downstream channel that could otherwise produce sediment in the receiving waters.

Storm water runoff constituent removal efficiencies, as well as the operational and maintenance experience, will be monitored for a period of two years.

4.1 Extended Detention Basins

The research objectives of this pilot project are to investigate the feasibility and performance of extended detention basins for use along Caltrans freeways and highways. The basic water quality objectives of an extended detention basin are to remove sediment and suspended materials. Some heavy metals in particulate form, toxic materials, and oxygen demanding materials can also be removed. Extended detention basins can remove up to 90 percent of particulates, if storm water is retained for more than 24 hours.

4.2 Site Evaluation

Site evaluations for the selection of potential sites required field reconnaissance, site surveys and geotechnical evaluations of Caltrans-owned land adjacent to highways and freeways within District 7. These evaluations provided information on location, available space, tributary area, maintenance access, proximity to structures, depth to water table and soil characteristics. In addition to site surveys by RBF and Caltrans personnel, several potential sites were reviewed with Caltrans representatives and Dr. Richard

Horner on November 18-19, 1997 and December 10, 1997. The recommended sites were also reviewed by Dr. Horner on January 5, 1998.

The three main considerations in finding candidate sites for extended detention basins were: 1) the availability of adequate space; 2) proximity to a state highway or freeway; and 3) land ownership. Sites that were outside of Caltrans right-of-way were not considered in this study.

Depth to water table and soil characteristics were also considered. However, these factors were not as important for locating extended detention basin pilot projects as for locating infiltration basin pilot projects because extended detention basins can be designed with a high groundwater table in mind, making water table and soil characteristics less relevant.

Size and shape considerations included the natural slope of the land and the acreage available. A basin site must be located at the watershed low point, and have a suitable outfall location. It should be noted that the opportunity existed to site pilot retrofit extended detention basins within existing Caltrans right-of-way. Safety concerns dictate several siting criteria, including the reservation of a 30 foot clear recovery zone (for motorist safety) around the perimeter of the basin. In addition, the basin must be protected by a 'k'-rail at the periphery of the 30-foot clear zone. A section of the California Highway Design Manual documenting the basis for this setback is contained in Appendix D. Other criteria, such as maintenance access and suitable site topography must also be satisfied.

Areas that contain sufficient acreage may not provide the necessary maintenance access. For example, long and narrow extended detention basins may not offer adequate maintenance access and safety buffers between the edge of the basin and traveled way (including on- and off-ramps). Extended detention basins require moderate to high levels of maintenance, making maintenance access an important criterion in the site evaluation process.

The following sites were investigated:

- Interstate 5 (Southbound), south of I-5 (Southbound) connector to I-605 (Southbound);
- Interstate 5 (Southbound), between the I-5 and the I-605 (Southbound)/I-5 (Southbound) connector;
- Interstate 605 (Northbound) and State Route 91 (Westbound) connector;
- Interstate 605 (Southbound), south of State Route 91 (Eastbound) connector;
- I-605 (Southbound), between the SR 91(Eastbound)/I-605 (Southbound) connector and I-605 (Southbound); and
- Interstate 605 (Southbound), at Whittier on-ramp.

The information gathered during the preliminary phase was then evaluated using a weighted decision matrix. Each site was evaluated and compared with respect to several different criteria or characteristic categories. Criteria were given a value, or weight (1-10) with respect to their importance and relevance to the site selection process. These criteria are explained in depth in Appendix C.

The characteristics determined to be important for siting extended detention basins are the following:

- sufficient area for siting the extended detention basins (1-10);
- site storm drain configuration (1-10); and
- maintenance access (1-10).

Site storm drain configuration refers to the arrangement of inlets, outlets, and conveyance routes. These may influence the design of the extended detention basin. The optimal drain inlet/outlet structure is an in-line system where the inlet and outlet are located at opposite ends of the basin. The longer the flow length the greater the constituent removal capacity. Care must also be taken to ensure that a backwater condition is not created for the existing upstream storm drain.

The sites investigated within Districts 7 are given in Table 4-1, the site selection decision matrix.

Table 4-1
Extended Detention Basin (District 7) Decision Matrix

Site	Site Number	Space Available*	Site Storm drain Configuration	Maintenance Access	Weighted Total
Weight		*10*	*8*	*8*	-------
Site 1: Interstate 5 (southbound), south of I-5 southbound connector to I-605 southbound	1	4	6	7	144
Site 2: Interstate 5 (southbound), between the I-5 and the I-605(s) –I-5(s) connector	**2**	**4**	**5**	**10**	**160**
Site 3: I-605 (northbound) and SR 91 (westbound) connector	3	10	8	9	236
Site 4: I-605 (southbound), south of SR 91 eastbound connector	4	8	3	6	152
Site 5: I-605 (southbound), between the SR 91 (e) – I-605(s) connector and I-605(s)	**5**	**9**	**7**	**9**	**218**
Site 6: I-605 (southbound), Whittier onramp	6	4	6	6	136

*** Note: With respect to estimated tributary area and size.**

The sites that best fit all the criteria are those at the **Site 2** and **Site 5** (shown bold in Table 4-1), which are further described in the following paragraphs. Field notes for each of the sites visited are provided in Appendix B.

The decision matrix indicates that Site 1 is a small site in which a basin could not be constructed in accordance with safety and maintenance access requirements. Site 3 could accommodate an extended detention basin, however this site is currently being recommended for an infiltration basin because of acceptable infiltration rates, siting of this BMP would take precedence over siting for an extended detention basin due to the difficulty in locating sites with suitable infiltration. Site 4 could accommodate a basin, but it receives limited runoff and has poor maintenance access. Site 6 is a relatively small site with a small tributary area and possible maintenance access problems. Sites 2 and 5 were chosen as the preferred locations for the extended detention basin pilot project because they best met all the selection criteria, including construction feasibility, and they were not recommended for other pilot projects that are more difficult to site.

4.3 Site Description

Site 2, Interstate 5 (Southbound), between the I-5 and the I-605 (Southbound)/I-5 (Southbound) connector, is located in the City of Downey in southeastern Los Angeles County. The available site was estimated by field observation to be approximately 0.7 acres (0.3 hectares). The watershed area tributary to the site is approximately five acres (2 hectares). Easy maintenance access is provided by an access road off the I-5 southbound. The proposed extended detention basin site is equipped with compatible existing drainage facilities, including two inlets from other areas, a downdrain from the I-5 southbound and a single culvert outlet. The selected site is shown in *Figures 4-1 and 4-2.*

Figure 4-1(Upper inlet)

Figure 4-2 (Access & basin view)

Site 5, I-605 (Southbound), between the SR 91(Eastbound)/I-605 (Southbound) connector and I-605 (Southbound), is located in the City of Cerritos. It is a relatively large site with approximately 0.4 hectares (one acre) available for construction of an extended detention basin. It has easy maintenance access from the I-605 and has a

tributary area of approximately four acres (1.6 hectares). The site lies at a depth of approximately 20 feet (6 meters) below the grade of the I-605. An existing culvert outlet can be modified to handle discharges from an extended detention basin. This site is shown in *Figures 4-3 and 4-4.*

Figure 4-3(Tributary area & south view)

Figure 4-4 (Outlet & north view)

4.3.1 Additional Extended Detention Basin Site – District 11

Through mutual agreement between Caltrans and NRDC, an additional extended detention basin pilot project has been included in the District 7 BMP Retrofit Pilot Program in lieu of the one infiltration basin (of the three required by the Stipulation) that was not sited (see Chapter 5). The substitute extended detention basin project will be located in District 11. The site selection was made using the selection matrix from Chapter 5 for infiltration basins, and choosing the site with the highest composite score that was not selected as an infiltration site; the selection criteria for extended detention basins and infiltration basins is similar with the exception of soil permeability. The selected site is at the SR 78/I-15 interchange in San Diego.

The site is located in a large existing depression bounded by the SR 78 on the north, the I-15 on the east, and the I-15 north connector to the SR 78 east, on the south-west. The interchange is located in Escondido, San Diego County. The selected site is shown in *Figures 4-5 and 4-6*.

The site was estimated by field observation to be approximately 1 acre. The proposed extended detention basin receives drainage from a 24-inch (60 cm) culvert pipe, which routes runoff from an estimated tributary area of eight acres (3.2 ha) from the SR 78 (westbound). The inlet and outlet culverts may need to be modified for the proposed project.

Figure 4-5 (Site location)

Figure 4-6 (Existing site outlet)

5.0 Infiltration Basins

As part of the BMP Retrofit Pilot Program, RBF has reviewed Caltrans freeways and highways in Districts 7 and 11 for the purpose of selecting three sites to evaluate the feasibility and effectiveness of installing infiltration basins. The District 7 Stipulation allows two of the infiltration basin pilot projects to be located in District 11, if site conditions are similar to those in District 7 and other conditions are met as specified in Part 1F of the Stipulation.

An infiltration basin is an excavated depression. It captures a specified design storm and allows the runoff to percolate into the ground through permeable soils. Infiltration basins are generally dry except immediately following storms. As the stormwater percolates into the ground, physical, chemical, and biological processes occur, which may remove both soluble and small particulate constituents. Constituents are trapped in the upper layers of the soil.

Stormwater runoff constituent removal efficiencies, in addition to operation and maintenance, will be monitored for a two-year period.

Infiltration basins require permeable soils or subsoils to function properly. A minimum infiltration rate of greater than or equal to 7 mm/hr (1.94 (10^{-4}) cm/s) is required, which corresponds to sand, loamy sand, sandy loam, loam, and silt loam soil groups.

Infiltration basins may be used for drainage areas up to approximately 50 acres (20 hectares). The basins must be between 2 to 4 feet (0.6 and 1.2 m) above the seasonable high water table. They should not be located within 100 feet (30 meters) of drinking water wells to avoid possible contamination (FHWA, 1996). Basins should be at a minimum of 10 feet (3 meters) down-gradient or 100 feet (30 meters) up gradient from building foundations. The Puget Sound Water Quality Authority's (State of Washington) stormwater quality control program recommends that 150 ft^2 of basin surface area be available for every 10,000 ft^2 of catchment area. Basins should be located down gradient from highway pavement to avoid infiltration to the pavement edge-drain system. The slope of the contributing drainage basin should be no more than 20%.

Infiltration basin outlets may require energy dissipaters and downstream receiving channel stabilization. These actions would mitigate scouring in the downstream channel that could otherwise produce sediment in the receiving waters.

5.1 Site Selection Process

The site selection process began with a reconnaissance of Caltrans highways and freeways in Los Angeles County, District 7. Sites comparable to those reviewed in District 7 were also investigated in District 11. See field notes in Appendix B.

Preliminary investigations to determine areas owned by Caltrans along freeway and highway interchanges, and on-ramps and off-ramps were first performed. The preliminary investigation included review of topographic mapping to identify potential sites. Viable candidate sites from the preliminary phase were further investigated to determine available area, and estimated tributary watershed through a field review process. Adequacy of the site was determined by estimating the required basin surface area (a function of tributary area), including safety setback limits required by Caltrans.

Safety concerns dictate several siting criteria, including the reservation of a 30 foot clear recovery zone (for motorist safety) around the perimeter of the basin. In addition, the basin must be protected by a 'k'-rail at the periphery of the 30-foot clear zone. Other criteria, such as maintenance access and suitable site topography must also be satisfied. A section of the California Highway Design Manual documenting the basis for this setback is contained in Appendix D.

The placement of infiltration BMPs adjacent to bridge structures must be carefully evaluated since saturation of the area around a bridge column or abutment could reduce the foundation load capacity. A 100-foot setback criterion was developed for the purpose of siting infiltration BMPs in the vicinity of bridge structures. Use of this setback is considered the minimum safe distance for which a more detailed site structural and geotechnical investigation would not be required. A memorandum documenting the basis for this setback is contained in Appendix D. This criterion is subject to further consideration based on detailed structural and geotechnical analysis and measurements during the siting of potential future permanent infiltration basins.

The information gathered during the preliminary phase was then evaluated using a weighted decision matrix process. Each site was evaluated and compared with respect to several different preliminary criteria or characteristic categories. The criteria were given a value, or weight (1-10) with respect to their importance and relevance to the site selection process.

The characteristics determined to be important for siting infiltration basins are the following:

- estimated soil type (1-10);
- sufficient area for siting the infiltration basin (1-10);
- location away from building foundations and highway pavement (1-10); and
- maintenance access (1-10).

The sites investigated within Districts 7 and 11 are given in Table 5-1, the site selection decision matrix. The best sites as determined through the decision matrix process using the criteria indicated above were then be subject to a more detailed geotechnical investigation to determine in-field permeability rates and distance above the ground water table. A potential basin site at the I-5 and SR-76 interchange was eliminated from the

matrix due to a slope of about 15% and due to insufficient tributary area. The site at I-5 and La Costa Blvd. (east) has a good potential relative to soil permeability, but does not have sufficient space for the construction of a basin, and has a significant amount of offsite flow tributary to the site. The rating system for scoring sites on each criterion is located in Appendix C.

Despite its high score in the matrix, the I-605 (southbound), between the SR-91(e)-I-605 (southbound) connector and I-605(s) was not selected for infiltration testing because estimated soil characteristics were poor, the permeability from the adjacent site was marginal, and the consulting geotechnical firm felt that there was a better chance of finding sandy soils with good infiltration rates along the coastal area in San Diego. Therefore, once one feasible site was found in District 7 at the I-605 (northbound), SR-91 (westbound) Connector, geotechnical testing was focused on sites in San Diego County.

Table 5-1: Infiltration Basin Decision Matrix

Site	Estimated Soil	Space Available *	Proximity to Structures	Maintenance Access	Weighted Total
Weight	*6*	*10*	*10*	*8*	-------
I-605 (southbound), Whittier onramp, D7	7	4	6	6	190
I-605 (southbound), between the SR-91(e) – I-605(s) connector and I-605(s), D7	7	9	8	9	284
I-605 (southbound), south of SR-91 eastbound connector, D7	6	8	8	6	244
I-605 (northbound), SR-91 (westbound) Connector, D7	**8**	**10**	**10**	**9**	**320**
I-5 south of I-5 southbound connector to I-605 (s), D7	4	4	4	7	160
I-5 south of I-605 southbound between the I-5 and the I-605(s) – I-5(s) connector, D7	6	4	6	9	208
I-5 and La Costa Blvd. (east), D11	8	5	7	7	224
I-5 and La Costa Blvd. (west), D11	**9**	**9**	**7**	**7**	**270**
I-5/SR 56 Interchange, D11	5	4	7	9	212
I-5/Manchester Ave (east), D11	**9**	**7**	**7**	**9**	**266**
I-5/Manchester Ave (west), D11	**9**	**6**	**7**	**8**	**248**
I-5/San Dieguito River, D11	8	8	6	2	204
SR78 at Melrose (e), D11	5	4	7	6	188
SR78/I-15, D11	**5**	**10**	**9**	**10**	**300**

*** Note: With Respect to estimated tributary area and size.**

After preliminary selection of the sites, RBF met with representatives of Caltrans and NRDC for a site review. On November 18th and 19th, 1997, inspections of these sites concluded with a verbal agreement between all parties on the selection of these sites as primary or secondary locations for construction of the Pilot projects.

The five sites indicated in bold face type in Table 5-1 were the subject of a detailed geotechnical investigation to determine in-field permeability rates and ground water levels. The site in District 7 along the I-605 (southbound), between the SR-91(e) – I-605(s) connector and I-605(s) scored higher in the evaluation process than the selected sites in San Diego. However, as mentioned previously, preliminary geotechnical testing had showed this area to be potentially marginal in terms of permeability, and the site is extremely well suited for an extended detention basin; consequently, the site was chosen for an extended detention basin pilot project.

5.2 Discussion of Geotechnical Investigation

In-drill hole field permeability tests were attempted at seven sites and conducted at five sites with the highest scores from the matrix to determine if the site soils possess suitable infiltration rates for the construction of an infiltration basin. The tests were conducted by first drilling a 10 inch diameter core to refusal (bedrock) or until groundwater was encountered, or to a depth sufficiently below the bottom of the basin if neither of the aforementioned conditions was encountered to adequately understand the local site lithology. Typically, the maximum target drilling depth was about 30 to 35 feet (9.1 to 10.6 meters).

At the I-605 site the borehole was subsequently backfilled with bentonite chips to a depth below ground surface (bgs) of about 20 feet (6 meters). A 4-inch well screen was inserted and backfilled with gravel to a depth of about 10 feet (3 meters) bgs, permeable backfill was also placed between the well screen and the core hole wall. The remaining 10 feet (3 meters) to the ground surface was backfilled with bentonite chips surrounding a 3-inch diameter brass pipe used to introduce water to the test zone (10 to 20 feet (6 meters) bgs). At all other sites similar test procedures were used, except that the permeability test zone was adjusted to 5 through 15 feet (1.5 through 4.5 meters) bgs to better simulate field operation of the pilot BMP. Samples of soils were taken at 6 feet (1.8 meters), 10 feet and 15 feet (3 and 4.5 meters) bgs for later laboratory permeability tests. The results of the field permeability tests for the selected sites are given in Table 5-2.

Table 5-2: Infiltration Basin Permeability Rates		
Site	**Permeability (ft/s)**	**Permeability (cm/s)**
I-605 (n), SR-91 (w) connector, D7	$5.4(10^{-6})$	$1.6(10^{-4})$
I-5 and La Costa Bl. (w), D11	$2.0(10^{-5})$	$6.2(10^{-4})$
I-5/Manchester Ave (e), D11	Water at 2.75'	Water at 84 cm
I-5/Manchester Ave (w), D11	Water at 3.75'	Water at 114 cm
SR-78/1-15, D11	$7.5(10^{-7})$	$2.5(10^{-5})$

The investigation also determined the location of the seasonal high water table relative to the existing grade. Geotechnical notes can be found in Appendix A.

5.2.1 I-605 (northbound), SR-91 (westbound) Connector

The in-drill hole permeability rate was found to be 5.4×10^{-6} ft/s (1.6×10^{-4} cm/s) for this site, measured as an average rate in a 4 inch diameter well above the ground water table, at a depth of between 10 (3 meters) and 20 (6 meters) feet below the ground surface. The laboratory permeability rate at this site was found to be 9.9×10^{-5} cm/s (3.2×10^{-6} ft/s) at a depth of 6 feet (1.8 meters) and 5.5×10^{-6} cm/s (1.8×10^{-7}) at a depth of 10 feet (3 meters). Laboratory samples were collected in 6-inch by 2.5-inch brass tubes using a split tube sampler and driven with a hydraulic hammer at all sites. Falling head permeability tests were conducted on samples taken at six and 10 feet (3 meters) below the ground surface.

The average permeability rate at this site, 5.4×10^{-6} ft/s, is considered to be marginally acceptable for infiltration as compared to the desired minimum rate of 6.25×10^{-6} ft/s. However, given the site's exceptional space and access characteristics, it is considered a suitable pilot project location.

5.2.2 I-5 at La Costa Blvd. (West)

Initially, it was assumed that the groundwater elevation at this site would preclude its use for infiltration. Two borings about 50 feet (15 meters) apart were drilled in the vicinity of the proposed basin area. The groundwater elevation was measured at eight feet (2.4 meters bgs and nine (2.7 meters) bgs for each of the test holes respectively.

The depth to the water table was re-measured about one week later at high tide to ensure that local groundwater fluctuations did not significantly alter the depth to the free water surface. The second measurement indicated that the depth to the water table was in excess of five feet (1.5 meters) from the ground surface. This depth, while not ideal would allow a shallow basin (about two feet or 0.6 meters deep) to be constructed?

Infiltration tests were also completed at the site. A 10 inch diameter well was constructed and the lower portion to the depth of the water table backfilled with bentonite chips. A four inch well screen was inserted, and the top two feet (0.6 meters) backfilled with

concrete. The results of the percolation tests indicate infiltration rates of $6.2(10^{-4})$ cm/s or $2.0(10^{-5})$ ft/s, which are within the criteria established for infiltration of $1.94(10^{-4})$ cm/s or $6.25(10^{-6})$ ft/s respectively.

5.2.3 I-5 at Manchester Ave. (East)

A 10-inch core hole was drilled in the area of the lower one-third of the site for the purpose of infiltration testing. Fine to medium grey sand was encountered at about five feet (1.5 meters) bgs. Groundwater was encountered at about eight feet (2.4 meters) bgs. The lower portion of the hole was backfilled with bentonite chips and a 4" well screen was installed and backfilled with permeable material. The top five feet (1.5 meters) of the test hole was backfilled with concrete and the well was presaturated with potable water. About four days after completion of the test well, and prior to initiation of the in-hole permeability test, the groundwater level was remeasured. The groundwater level had risen to 2.75 feet (.84 meters) bgs. Since this value was higher than the estimated floor elevation of the basin, further geotechnical investigation was discontinued.

5.2.4 I-5 at Manchester Ave. (West)

A 10-inch core hole was drilled in the area of the lower one-third of the site for the purposed of infiltration testing. Fine to medium grey sand was encountered at about five feet (1.5 meters) bgs. Groundwater was encountered at about seven feet (2.1 meters) bgs. The lower portion of the hole was backfilled with bentonite chips and a 4" well screen was installed and backfilled with permeable material. The top five feet (1.5 meters) of the test hole was backfilled with concrete and the well was presaturated with potable water. About four days after completion of the test well, and prior to initiation of the in-hole permeability test, the groundwater level was remeasured. The groundwater level had risen to 3.75 feet (1.1 meter) bgs. Since this value was higher than the estimated floor elevation of the basin, further geotechnical investigation was discontinued.

5.2.5 SR 78 at I-15

The proposed site includes an existing excavation (basin) where the existing site storm drain enters and exits under adjacent roadway ramps. The geotechnical investigation was completed on the existing basin side slope, about seven feet (2.1 meters) above the basin floor. Clays were encountered below the fill material at the level of the existing basin floor (about six feet or 1.8 meters), bedrock was encountered at about 30 feet (9.1 meters).

A wellscreen was installed beginning about four feet (1.2 meters) below the grade of the existing basin, and continuing another 10 feet (3 meters) deep. The wellscreen above and below the test zone was sealed with benonite chips and pre-saturated.

The in-drill hole permeability tests were completed about three days later once the

ground had become saturated. An average in-drill hole permeability rate of $7.5(10^{-7})$ ft/s (0.03 in/hr) or $2.5(10^{-5})$ cm/s was determined. This rate is substantially less than the minimum established value of $6.25(10^{-6})$ ft/s (0.3 in/hr). Consequently, this site was eliminated from further consideration.

5.3 Conclusions and Site Descriptions

With respect to the final selection group, geotechnical investigation revealed that only two sites displayed acceptable infiltration capacities and water table levels. These sites are the I-605 (northbound), SR-91 (westbound) connector in District 7 and the I-5 and La Costa Blvd. (west) in District 11. Two additional sites in District 11, near the San Dieguito River and I-5 at Via de la Valle and at I-5 and Highway 56 were also attempted for a geotechnical investigation. In each case, the terrain was too steep to allow access for the drill rig from Caltrans right-of-way and permanent maintenance access or field review of the site soils eliminated them from further consideration.

In District 7, the highest scoring site for an infiltration basin is the space created by the cloverleaf interchange from the 605 northbound to the 91 eastbound in the city of Cerritos. The site may be accessed easily from the 605 northbound freeway. The tributary drainage area to the site is approximately six acres (2.4 hectares) and includes the 91 westbound, the Caltrans Cerritos Maintenance Station, and the 605 northbound. The drainage system consists of one culvert and one curb drain. No major structures exist within the vicinity of the proposed basin site. The slope at the site is approximately one percent and the soil type is sandy. The basin and its outlet structure can be seen in *Figures 5-1 and 5-2*, respectively.

*Figure 5-1 (*Site location *)*

Figure 5-2 (Outlet structure)

In District 11, the only viable infiltration basin site of those investigated is La Costa Blvd. west. The infiltration rate at this location is 6.2 (10^{-4}) cm/s. The area can be accessed from the I-5 southbound offramp, and adequate space is available to construct a guardrail and locate a 30-foot clear recovery zone, as required by Caltrans for safety

reasons. The site receives up to about 3 acres (1.2 hectares) of drainage area from I-5 and the southbound offramp at La Costa Blvd. Drainage flows from the I-5 Southbound to an overside drain drainage inlet. Runoff from the offramp also flows through the same overside drain. The proposed site location for the infiltration basin is in the center of the grassy area shown in *Figure 5-3*. The basin location can be seen in *Figure 5-4*. The distance from edge-of-infiltration basin to the edge of the Lagoon will be approximately 100 feet (30.5 meters). Discharge from the basin at high flows will exit into an existing open channel to the shore of Bataquitos Lagoon. The Lagoon was recently dredged and restored as a part of a mitigation program for the expansion of the Port of Los Angeles.

Figure 5-3 (Site vicinity)

Figure 5-4 (Basin location)

Caltrans and NRDC have mutually agreed to substitute an extended detention basin pilot project for the single remaining (per the Stipulation) infiltration basin pilot that was not sited as a part of this investigation. The extended detention basin pilot project is located at the SR78/I-15 interchange and is discussed in Chapter 4 of this report.

6.0 Introduction

As part of the District 7 Pilot Retrofit Program, RBF investigated Caltrans maintenance stations in District 7 and District 11 with the goal of selecting four sites for the purpose of evaluating the feasibility and effectiveness of installing infiltration trenches.

An infiltration trench is typically a long and narrow excavation which is lined with filter fabric and backfilled with stone aggregates, gravel, or sand to form an underground basin. Runoff is diverted into the trench and exfiltrates into the soil. Infiltration trenches effectively remove soluble and particulate pollutants from surface runoff for the portion of the storm flow that is infiltrated to the soil.

The trench effectiveness, in addition to operation and maintenance requirements, problems and procedures, will be monitored for a two-year period. The District 7 Stipulation to Conduct Retrofit Pilot Studies indicates that infiltration trenches shall be constructed at Caltrans Maintenance Yards. The Stipulation also requires that two of the infiltration trenches be constructed in combination with biofiltration devices.

6.1 Infiltration Trenches

Infiltration trenches require permeable soils or subsoils to allow for infiltration. A minimum infiltration rate of greater than or equal to 7 mm/hr (0.27 in/hr) is required, which corresponds with sand, loamy sand, sandy loam, loam, and silt loam soil groups.

Infiltration trenches are prone to clogging by deposited solids and therefore should not be used to trap sediments. Special inlets or grass buffers can be used to capture sediment before it enters an infiltration trench.

While infiltration trenches provide the advantage of allowing groundwater recharge, the possibility for low levels of ground-water contamination has been noted for nitrates, chlorides and gasoline. Sufficient separation from groundwater should be maintained to protect groundwater resources. Monitoring of groundwater in the vicinity of the trench will be one of the research objectives of the program.

A drainage area of less than ten acres (4.0 hectares) is recommended. The slope of the bottom of the trench should be approximately zero. Ample distance away from wells and structural foundations should be provided. The bottom of the facility should be at least four feet (1.2 meters) above bedrock and two to four feet (0.6 to 1.2 meters) above the seasonally high water table.

The trench design is a *water quality exfiltration system,* which is volumetrically designed to handle and exfiltrate the design storm volume. Storms of greater magnitude than the design storm volume will bypass the facility.

6.2 Site Selection Process

The site selection process began by meeting with Caltrans officials to request site plans and related information. Caltrans assisted with field investigations of the maintenance

stations including tours of the grounds, photos, and observations of drainage patterns and general housekeeping practices. Appendix B contains site notes for all sites visited.

This information was then evaluated using a weighted decision matrix process. Each site was evaluated and compared with respect to several different criteria and characteristic categories. Each criteria or characteristic category was given a value, or weight (1-10) with respect to its importance and relevance to the site selection process.

The characteristics determined to be important were the following:

- space available to place the trench and biofilter;
- proximity to adjacent structures and slopes ;
- drainage patterns of site;
- type of maintenance activities and equipment storage at the yard; and
- sediment and debris accumulation potential.

The site characteristic values were assigned for each category at each site. For example, proximity to structures is very important in locating trenches at maintenance stations. Infiltration is not allowed in the vicinity of bridge columns for structural reasons, consequently, many of the stations located under bridges received very low scores in this category.

The placement of infiltration BMPs adjacent to bridge structures must be carefully evaluated since saturation of the area around a bridge column or abutment could reduce the foundation load capacity. A 100 foot setback criteria was developed for the purpose of siting infiltration BMPs in the vicinity of bridge structures. Use of this setback distance is considered the minimum safe distance for which a more detailed site structural and geotechnical investigation would not be required. A memorandum documenting the basis for this setback is contained in Appendix D. This criterion is subject to further consideration based on detailed structural and geotechnical analysis and measurements during the siting of potential future permanent infiltration trenches.

Each site was then rated by developing a composite score, representing all of the individual characteristic categories, as shown in Table 6-1. The selection criteria area discussed in detail in Appendix C.

The maintenance stations investigated within District 7 and 11 were as follows:

- Alameda
- **Altadena**
- Apple Street
- Artesia
- Aviation
- Buena Vista
- Camino Del Rio
- **Carlsbad**
- Central
- Century
- **Cerritos**
- Chula Vista
- Coronado Bridge
- Diamond Bar
- East LA
- East Region
- **Escondido**
- **Foothill**
- Florence
- Imperial
- **Kearny Mesa**
- Las Flores
- Long Beach
- Metro
- Otay
- Pacific Highway
- Pomona
- Pacific Place
- **Rosemead**
- Terminal Island
- **San Fernando**
- Santee
- Sawtelle
- **Tarzana**
- Westwood
- **Westdale**
- Willow

The 10 sites with the highest composite scores (see Table 6-1) were chosen for further consideration and are denoted in bold above. Of the 10 sites, Rosemead and Foothill Maintenance Stations were previously designated as Catch Basin Insert sites. Maintenance stations with multiple drain inlets, a requirement of the Catch Basin Insert retrofit project, are the most difficult pilot to site, and therefore take precedence over the infiltration trench pilot. The eight remaining sites were further evaluated by a geologist for suitability relative to infiltration rate, distance to groundwater, distance to bedrock, and proximity to structures that may be impacted by infiltration. The eight sites are discussed in the following section. Altadena Maintenance Station was originally selected as an oil/water separator site. However, it was recommended for a detailed geotechnical investigation following consultation with the geotechnical engineer after four other District 7 maintenance stations were determined (through a geotechnical investigation) to have extremely low infiltration rates.

Table 6-1
Site Selection Matrix

Site *Weight*	District	Type Activities *6*	Drainage Pattern *7*	Space Available *10*	Proximity to Structures *10*	Total
Alameda	7	9	8	10	2	179
Altadena	**7**	**8**	**7**	**7**	**6**	**227**
Apple Street	7	4	4	5	3	132
Artesia (Closing in '98)	7	2	8	8	8	228
Aviation	7	4	5	6	4	159
Buena Vista	7	3	7	3	8	175
Carlsbad	11	8	8	8	6	**244**
Camino Del Rio	11	5	5	6	6	185
Central)	7	7	7	2	6	171
Century (Under reconstruction)	7	8	7	6	2	177
Cerritos	**7**	**7**	**8**	**9**	**8**	**268**
Chula Vista	11	9	5	7	7	217
Coronado Bridge	11	2	6	3	4	124
Diamond Bar	7	7	4	7	5	190
East LA	7	8	6	7	5	210
East Region	7	7	4	4	7	180
Escondido	11	8	9	8	9	**281**
Foothill (CB Inserts)	7	8	9	8	9	281
Florence (Closing)	7	4	6	5	8	196
Imperial	7	5	7	6	7	209
Kearny Mesa	11	8	9	8	8	**271**
Las Flores (CB Inserts)	7	7	8	2	2	138
Long Beach	11	8	5	3	7	183
Metro	7	8	7	4	2	157
Otay	11	4	3	6	7	175
Pacific Highway	11	4	7	5	6	183

Site ***Weight***	**District**	**Type Activities** ***6***	**Drainage Pattern** ***7***	**Space Available** ***10***	**Proximity to Structures** ***10***	**Total**
Pomona	7	4	6	8	8	226
Pacific Place	7	5	4	7	8	208
Rosemead (CB Inserts)	7	7	8	8	8	258
Terminal Island (Under Construction)	7	4	5	7	3	159
Sawtelle	7	4	3	4	3	115
San Fernando	**7**	**9**	**7**	**8**	**8**	**263**
Santee	11	7	7	7	7	231
Tarzana	**7**	**8**	**8**	**8**	**8**	**264**
Torrance	7	6	7	6	7	215
Westwood	7	4	7	8	7	203
Westdale	**7**	**9**	**9**	**8**	**8**	**277**
Willow	7	3	5	7	3	153

After preliminary selection of the sites, RBF met with representatives of Caltrans and NRDC for a site review. On November 18th and 19th, 1997, inspections of these sites concluded with a verbal agreement between all parties on the selection of these sites as primary or secondary locations for construction of the Pilot projects.

6.3 Discussion of Geotechnical Investigation

Field permeability tests were conducted for the eight sites with the highest composite scores as shown in Table 6-1. The tests were conducted by first drilling a 10-inch (25.4 centimeters) diameter core to refusal (bedrock) or until groundwater was encountered, or to a depth sufficiently below the bottom of the trench if neither of the aforementioned conditions was encountered to adequately understand the local site lithology. Typically, the maximum drilling depth was about 30 to 35 feet (9.1 to 10.7 meters).

At Cerritos, San Fernando, Tarzana and Westdale Maintenance Stations, the bore holes were subsequently backfilled with bentonite chips to a depth below ground surface (bgs) of about 20 feet (6.1 meters). A 4-inch (10 centimeters) well screen was inserted and backfilled with gravel to a depth of about 10 feet (3 meters) bgs, permeable backfill was also placed between the well screen and the bore hole wall. The remaining 10 feet (3 meters) to the ground surface was backfilled with bentonite chips surrounding a 3-inch (7.6 centimeters) diameter brass pipe used to introduce water to the test zone (from 10 to 20 feet (3 to 6.1 meters) bgs).

At Altadena, Carlsbad, Escondido, and Kearny Mesa Maintenance Stations the boreholes were subsequently backfilled with bentonite chips to a depth below ground surface of about 15 feet (4.6 meters). A 4-inch (10 centimeters) well screen was inserted and backfilled with gravel to a depth of about 5 feet (1.5 meters) bgs, permeable backfill was also placed between the well screen and the bore hole wall. The remaining 5 feet (1.5 meters) to the ground surface was backfilled with bentonite chips surrounding a 3-inch (7.6 centimeters) diameter brass pipe used to introduce water the test zone (from 5 to 15 feet (1.5 to 4.6 meters) bgs). The test zone was raised as compared with earlier tests in consultation with NRDC in an attempt to better approximate the actual operation of the BMP.

Samples of soils at all sites were taken at 6 feet (1.8 meters), 10 feet (3 meters) and 15 feet (4.6 meters) bgs for later laboratory permeability tests. The results of the field permeability tests for the selected sites are given in Table 6-2.

Table 6-2
Results of Permeability Tests

Site	District	Permeability (ft/s)	Permeability (cm/s)
Altadena	7	$3.5(10^{-5})$	$1.1(10^{-3})$
Carlsbad	7	$2.8(10^{-5})$	$8.7(10^{-4})$
Cerritos	11	$2.5(10^{-6})$	$7.5(10^{-5})$
Escondido	7	Water at 3'	Water at 91 cm
Kearny Mesa	11	$7.7(10^{-8})$	$2.4(10^{-6})$
San Fernando	7	$7.5(10^{-8})$	$2.3(10^{-6})$
Tarzana	7	$1.1(10^{-7})$	$3.4(10^{-6})$
Westdale	7	$1.4(10^{-8})$	$4.4(10^{-7})$

The infiltration rates given for most sites are substantially below the value indicated in the Scoping Study for acceptable infiltration. The Scoping Study provides for a minimum of about 0.27 in/hr (7mm/hr) or $6.25(10^{-6})$ft/s or $1.94(10^{-4})$cm/s. From these results, only the Altadena and Carlsbad site met the permeability requirements. The third best rate was found at the Cerritos Maintenance Station. The Cerritos results were about 0.1 in/hr (2.5mm/hr), which is still significantly below minimum acceptable published criteria. The geotechnical information is contained in Appendix A.

The Cerritos site laboratory data (Boring B-1 is the trench location) varied fairly widely across the depths tested, with the shallower value higher (infiltration rate) than the in-field test, and the deeper values lower than the in-field test. The geotechnical engineer recommends a design value for a trench of about five feet (1.5 meters) deep at the Cerritos location of about $5.0(10^{-5})$ cm/s ($1.6(10^{-6})$ ft/s), which is less than the field infiltration test results. This recommendation is based on a review of the boring log which shows significantly more silts in the core both above and below the six foot sample depth. It is the opinion of the geotechnical engineer that retesting of the site using a 5 to 15 feet (1.5 to 4.6 meters) bgs testing zone would not alter the results significantly (see geotechnical opinion, Appendix A) and that the site is most likely not suited for an infiltration BMP. Consequently, The Cerritos MS is not recommended for a trench BMP retrofit pilot project.

6.4 Preliminary Trench Designs

Preliminary trench designs were completed to understand the approximate trench depths given the site constraints, and to compute a drain time using the field permeability tests to further assess the site viability with respect to in-drill hole permeability rates. Table 6-3 provides the estimated trench dimensions for two of the eight highest scoring sites, as well as the trench volume and estimated drain time. The treated storm water volume was

computed using the *Caltrans Staff Planning and Design Guide*, dated September 1997 for an 80% annual runoff capture. Detailed calculations are included in Appendix E.

Table 6-3
Preliminary Trench Design

Facility	Surface Area	Depth	Net Volume	Drain Time
Cerritos	1200 ft^2	4.5 ft	1930 ft^3	5.5 days
Westdale	-	-	-	200+ days
Tarzana	5000 ft^2	2 ft	9000 ft^3	154 days
San Fernando	-	-	-	200+ days

Detailed designs were not completed for Westdale, San Fernando, Escondido and Kearny Mesa due to their extremely low infiltration rates, less than $6(10^{-4})$ in/hr and associated excessive drain times.

Relatively shallow bedrock depths were encountered at both the Westdale and San Fernando sites. Bedrock was located at about five feet (1.5 meters) bgs at San Fernando, and at about 20 feet (6.1 meters) bgs at Westdale. The formation at Westdale is actually an extremely hard siltstone and not strictly bedrock, but with the associated low infiltration rates. The Kearny Mesa site consisted of fine to medium grade sandstone at a depth of 15 feet (4.6 meters) bgs. This sandstone material is also associated with low infiltration rates. The Escondido site was estimated to have ground water approximately 3 feet (0.9 meters) below ground surface.

Given the long drain times for the trenches the Westdale, Tarzana, San Fernando, and Kearny Mesa, as well as a high groundwater table at Escondido, these sites are not considered feasible for an infiltration trench pilot study. The Cerritos calculated drainage time exceeds the design drainage time of 72 hours specified in the Scoping Study. Based on a geotechnical review, including infiltration rate testing, field geotechnical evaluation and drainage time calculations, Cerritos facility is also not considered an acceptable candidate site.

6.5 Geotechnical Evaluation of Suitability of Other Maintenance Stations

In general, maintenance stations located in older terrace deposits will generally exhibit poor permeability, with old alluvium exhibiting rates which are also most likely too low for a suitable trench site. Locations with young alluvium are potentially suitable. Appendix A contains a table of anticipated geotechnical properties at the maintenance stations in District 7 and 11. Those entries marked as ‘na’ were not evaluated for one of the following reasons:

- Covered by bridge
- Facility is closed or closing
- Outside of Los Angeles County or San Diego County

Using Table 6-1 as a guide to sites that are potentially suitable for trench installation given the siting criteria previously discussed, and cross referencing this information with the potential geotechnical properties listed in Appendix A, the potential suitability of alternate sites may be assessed. Table 6-4 provides the results of this analysis. Sites with fair or poor potential for well drained soils were excluded from further consideration, as were sites that are closing or have been selected as primary candidates for other BMPs with more complex siting constraints. The candidates in Table 6-4 represent the remaining possibilities for maintenance stations within District 7 and 11 that could be viable from a geotechnical perspective.

Table 6-4
Potential Viable Sites Based on Geotechnical Opinion

Site	District	Matrix Value (from Table 6-1)	Preliminary Geotechnical Soil Suitability Assessment
Buena Vista	7	175	Good
Camino Del Rio	11	185	Good/fair
Chula Vista	11	217	Good/fair
Long Beach	7	183	Good/fair
Pomona	7	226	Good/fair
Pacific Highway	11	183	Good/fair
Pacific Place	7	208	Good/fair
Terminal Island	7	159	N/a

A discussion of each of these potential candidate sites relative to other siting criteria is provided in the following paragraphs.

6.5.1 Buena Vista

The Buena Vista Maintenance Station is a very small facility with several problems associated with trench siting. It is a landscape only facility limiting the types of activity. About one-half of the site is covered by a bridge, blocking rainfall and presenting a conflict relative to siting of trenches adjacent to column foundations. Trenches must be sited at least 100 feet (30.5 meters) from bridge foundations to preclude possible settlement of the bridge structure. Finally, siting the trench at such a small site would be difficult without disrupting the Station operation.

6.5.2 Camino Del Rio

This site is small with only landscaping crews and is also partially covered by a bridge.

6.5.3 Chula Vista

The Chula Vista MS has an area of about 4.2 acres (1.7 hectares) and is completely exposed to rainfall. However, most of the runoff (70 to 80%) drains as sheet flow through the front gate of the facility, greatly limiting to potential for an infiltration trench installation. Consequently, further geotechnical investigation and permeability testing is not recommended due to the physical site constraints.

6.5.4 Long Beach

The Long Beach Maintenance Station is primarily limited by space. The total site area is about 1.4 acres (0.6 hectares), and the site is virtually 100% utilized for buildings, equipment and parking. There are no viable areas to construct an infiltration trench without compromising the Station operation.

6.5.5 Pomona

Site drainage pattern at the Pomona Maintenance Station is not suited to the installation of an infiltration trench. The site drainage pattern does not concentrate flow; rather sheet flow occurs in many different directions. Substantial change to the drainage patterns at the site would be required to accommodate an infiltration trench. Further, the site is a landscape/electrical facility only, limiting the types of activity that typically creates more potential for contamination of stormwater runoff.

6.5.6 Pacific Highway

This site is small and houses only landscaping crews. The site is also partially covered by a bridge.

6.5.7 Pacific Place

The Pacific Place Maintenance Station is space limited for a trench installation. The site area is only 0.5 acres (0.2 hectares).

6.5.8 Terminal Island

The Terminal Island Maintenance Station is currently undergoing upgrading and reconstruction, and is located under the Vincent Thomas Bridge, with associated trench siting problems relative to bridge foundations. Furthermore, the site is only 0.3 acres (0.12 hectares) and locating a trench on such a small site would be difficult. It is not considered a good candidate for trench installation for these reasons.

6.6 Site Description

Two sites were selected for infiltration trench installations, Altadena MS (District 7) and Carlsbad MS (District 11).

6.6.1 Altadena MS

The Altadena Maintenance Station is located at 2122 North Windsor Avenue just off the 210 Freeway, North Windsor Avenue offramp. The station area is approximately 2.5 acres (1 hectare). It is located in an urban area with commercial use on adjacent sides and the 210 freeway behind. The site is equipped with an onsite storm drain system. Unlike many other maintenance stations, the Altadena site is completely exposed. All the onsite flow is directed to swales, which lead to a gutter and inlet as shown in *Figures 6-1 and 6-2*. The gutter is located about one meter outside the site fence and is within Caltrans right-of-way.

Figure 6-1 (Altadena MS)

Figure 6-2 (Inlet)

6.6.2 Carlsbad MS

The Carlsbad Maintenance Station is located in the City of Carlsbad one block south of Palomar Airport Road at 6050 Paseo Del Norte. The site is bounded by Paseo Del Norte to the west and commercial and industrial uses to the south, east and north. Site drainage is sheet flow to concrete swales and gutters, concentrating along a gutter in the entrance drive to the Station and ultimately discharging to Paseo Del Norte. The site includes a vehicle maintenance shop, fueling island, wash rack and storage areas for maintenance equipment and supplies. *Figure 6-3* provides an overview of the site. *Figure 6-4* indicates the location of the proposed trench.

Figure 6-3 (Calrsbad MS)

Figure 6-4 (Trench Site)

6.7 Conclusions

Each of the maintenance stations in District 7 and 11 were visited and reviewed with respect to the potential for siting of an infiltration trench. The eight preliminary sites, selected from the weighted decision matrix process, were selected for further feasibility investigation with a field infiltration study and geotechnical review of the site. The results of the field infiltration tests indicate that only the Altadena and Carlsbad sites were suitable for infiltration. The other six sites considered were eliminated due to extremely low infiltration rates.

Preliminary trench designs were developed for two of the candidate sites, Cerritos and Tarazana, with marginal infiltration rates to further assess their viability. Drain times were subsequently computed for the preliminary design configuration, in some cases, multiple preliminary design configurations were developed to try to achieve the minimum drain time. Drain times computed for each site were in excess of any published maximums, which are generally as long as 3 days.

Finally, the geotechnical engineer rendered an opinion as to the potential suitability of the remaining maintenance stations in District 7 and 11 that were not previously selected for other BMPs. Sites that were potentially suitable based on a review of soil surveys, known soil properties, and previous investigations were reevaluated using the weighted decision matrix process. The reevaluation of these sites (Table 6-4) indicates that none of the remaining locations are suitable for a trench installation due to physical site limitations.

This study concludes that only two of the six required infiltration trenches are able to be sited. Both infiltration trenches will be constructed in combination with biofiltration strips, as required by the Stipulation.

6.8 Proposed Substitutions

Two of the six stipulated infiltration trenches were sited in Districts 7 and 11. Due to the limited availability of suitable sites for locating this BMP, and lacking an option to terminate this program prior to construction in the Stipulation, it was mutually agreed

between Caltrans and the Plaintiff that additional BMP Pilot Projects would be included in the Retrofit Program. A compost media filter at Kearny Mesa Maintenance Station in District 11 is proposed as a substitution for one of the infiltration trenches. The Multi-Chambered Treatment Train (MCTT) is a relatively new structural stormwater BMP developed by the US EPA at the University of Alabama that will be used in District 7. A discussion of siting of the MCTT Retrofit Pilot Projects is provided in Chapter 10.

7.0 BIOFILTRATION SWALES AND STRIPS

7.0 Introduction

As part of the District 7 Pilot Retrofit Program, RBF has selected six Caltrans sites for the purpose of evaluating the feasibility and effectiveness of installing four biofiltration swales and two biofiltration strips in District 7. RBF has also selected three Caltrans sites in District 11 for two biofiltration swales and one biofiltration strip. Site locations include ones receiving runoff from Caltrans maintenance stations and freeways or highways.

Biofiltration swales and strips (biofilters) are defined as vegetated pathways where constituents are removed by filtration through grass, deposition in low velocity areas, and infiltration into the subsoil. (All information on biofilter characteristics and criteria for siting biofilters is referenced to FHA, 1996[i]).

Biofilters typically are designed to remove suspended solids and metals associated with particulates, such as lead and zinc. Constituent removal efficiency is related to facility dimensions, longitudinal slope, and type of vegetation. Increased removal of solubles, particularly nutrients and soluble metals may be accomplished with reductions in flow rate, and increased contact time with swale vegetation.

Biofilters are commonly used as a pretreatment for other BMPs. Where they are used as such, the combination of BMPs are commonly referred to as a "treatment train." Infiltration devices, such as infiltration trenches often contain a biofilter pretreatment to increase overall constituent removal and long term efficiency.

In accordance with the Caltrans Retrofit Pilot program, stormwater runoff constituent removal efficiencies, in addition to operation and maintenance, will be monitored for a two-year period.

7.0.1 Biofiltration Swales

Swales can be used to serve small areas, less than 10 acres (4 hectares) in size. They should not serve highly urbanized areas or construction sites where large volumes of runoff or high sediment loads can overwhelm the system. They should be used for areas with slopes no greater than five percent. The seasonable high water table should be at least one to two feet (0.3 to 0.6 meters) below the surface. The site should be at least 10 feet (3 meters) from surrounding buildings.

The area required for a swale system varies. The area needed depends mainly on the desired contact time between the runoff and the vegetation. Three variables affect contact time. They are length, width, and slope. The shorter the length, the wider the site must be to allow for sufficient contact time. Acceptable lengths range from 25 feet (7.6 meters) to about 200 feet (61 meters). Width varies from two to eight feet (0.6 to 2.4

meters), with a maximum of 10 feet (3 meters) if adequate infiltration length cannot be achieved.

The topography of the site should permit the design of a channel with a slope and cross sectional area sufficient to maintain an appropriate flow velocity. Recommendations for longitudinal slopes range between 0.02 and 6 percent, although lesser slope gradients are acceptable. Steep slopes may require energy dissipation and grade check to allow adequate detention time.

7.0.2 Biofiltration Strip

Biofilter strips, also known as vegetated buffer strips, are vegetated sections of land similar to grassed swales, except they are essentially flat with low longitudinal slopes (usually 2–4%), and are designed only to accept runoff as overland sheet flow. Dense vegetative cover facilitates conventional constituent removal through detention, filtration by vegetation, and infiltration into soil.

Biofilter strips effectively reduce particulate constituent levels such as sediment, organic materials, and trace metals. Soluble constituent removal is minor but occurs when constituents infiltrate into the soil, some of which is then taken up by rooted vegetation.

Successful performance of filter strips relies heavily on maintaining sheet flow. This ideally requires a limited drainage area of five to 12.5 acres (2 to 5 hectares) with a flat surface immediately preceding the filter strip. Sites that do not convey sheet flow may require the addition of a level-spreading device for even distribution of runoff prior to the biofilter strip.

7.1 Site Selection Process

The site selection process began with a thorough reconnaissance of Caltrans facilities in Los Angeles County (District 7) and comparable sites in San Diego (District 11). The District 7 Stipulation allows for locating two biofiltration swales and a biofiltration strip in District 11 if sites comparable to those in District 7 can be found. Initially, an attempt was made to locate biofilters as pretreatment devices for infiltration trenches at Caltrans maintenance stations. However, due to low infiltration rates only one site was feasible for siting an infiltration trench/biofilter combination at a District 7 maintenance station, the Altadena Maintenance Station (See Chapter 5: Infiltration Basin Study, Geotechnical Discussion). One location, Carlsbad Maintenance Station, was found to be feasible to site an infiltration trench/biofilter combination at District 11 (Infiltration Trench Siting Study, Retrofit Pilot Program, Caltrans District 11, December 18, 1997). Thus, the siting for most biofilters was refocused in District 7 and District 11 to highways and freeways.

A two-phase site selection process was used. Initial visual inspections of areas owned by Caltrans along freeways and highways, freeway and highway interchanges, and on-ramps and off-ramps were conducted as a first phase selection process. Criteria for phase one

selection included tributary area estimations, location of both inlets and outlets, estimated slope, and Caltrans right-of-way availability.

Of the areas identified as feasible for installing biofilters after review of phase one criteria, these sites were selected for further analysis. The second phase of the selection process included photos, more detailed site evaluations of drainage systems and patterns, and meetings with Caltrans officials to request site plans and related information.

The sites selected for second phase consideration were then evaluated using a weighted decision matrix process. The sites in District 7 and 11 were evaluated using the same process. Each site was evaluated and compared with respect to several different criteria or characteristic categories. Each criteria or characteristic category was given a value, or weight (1-10) with respect to its importance and relevance to the site selection process. Definitions for the selection criteria can be found in Appendix C.

The characteristics determined to be most significant were the following:

- estimated soil type;
- tributary drainage area;
- length of swale/strip;
- slope of swale/strip.

Site characteristic values were assigned for each category at each site. For example, if the site contained an estimated slope between 2–5%, it would receive a score of 10. Conversely, the presence of runoff not linked to highways or freeways (offsite) would receive a low score. Each site is then rated by developing a composite score, representing all of the individual characteristic categories, as shown in Table 7-1.

The sites selected for second phase evaluation were as follows:

1. Behind Cerritos MS (SR 91 Westbound), District 7
2. Between I-605 (Northbound), I-605 (Northbound)/SR 91 (Westbound), and SR 91 (Westbound)/I-605 (Southbound) connector, District 7
3. I-605 (Northbound), SR 91 (Westbound) connector, District 7
4. I-605 (Northbound), along side of freeway South of SR 91 (Westbound) connector, District 7
5. I-605 (Northbound) along freeway between Carson St. and Del Amo Blvd., District 7
6. I-605 (Southbound), Whittier onramp, District 7
7. I-605 (Southbound) along side freeway South of Telegraph Rd., District 7
8. I-605 (Southbound), next to the SR 91 (Eastbound)/I-605 (Southbound) connector, District 7
9. I-605 (Southbound), between SR 91 (Eastbound)/I-605 (Southbound) connector and I-605 (Southbound) freeway, District 7
10. I-5 (Southbound), I-605 (Southbound) onramp, District 7
11. I-5 (Southbound), I-605 (Southbound) offramp, District 7
12. Carlsbad Maintenance Station (infiltration trench pre-treatment), District 11

13. Kearny Mesa Maintenance Station, District 11
14. I-5 (Northbound) shoulder (South of San Onofre Power plant), District 11
15. I-5 (Northbound) shoulder before Canon Avenue offramp, District 11
16. I-5 (Southbound) shoulder before Palomar Airport Rd., District 11
17. SR 78 (Eastbound) shoulder before Melrose Ave., District 11
18. Altadena MS (pre-trench), District 7
19. SR 78 near Sycamore, District 11
20. I-15 and Mar Vista, District 11
21. I-5 at Manchester, District 11
22. I-5 at SR 56, District 11

A site was chosen to be either a swale or a strip, based on the composite matrix score and the configuration of the site. Sites having greater available width and in a location accepting predominately sheet flow were designated as strips while other chosen sites better suited to discharge concentrated flow were designated as swales.

Table 7-1: Biofiltration Site Selection Matrix						
Weight		*5*	*8*	*9*	*10*	***Total weighted Value***
Site Number	**Possible Biofilter Method**	**Estimated Soil Type**	**Estimated Tributary Area**	**Length**	**Slope**	
1	**Swale**	**6**	**3**	**9**	**8**	**215**
2	***Strip*, Swale**	**8**	**2**	**10**	**9**	**236**
3	Swale	8	7	10	6	246
4	Strip	8	2	9	7	207
5	**Swale**	**6**	**2**	**10**	**10**	**236**
6	Swale	6	5	7	5	183
7	Strip, Swale	6	2	8	4	158
8	Strip, Swale	9	8	10	7	269
9	Strip, Swale	6	3	10	6	204
10	**Strip, Swale**	**8**	**3**	**8**	**9**	**226**
11	Strip, Swale	6	8	9	8	255
12	***Strip***	***10***	***6***	***6***	***8***	***232***
13	Strip, Swale	4	7	7	8	219
14	Strip,Swale	5	7	10	5	221
15	Swale	5	6	7	6	196
16	**Swale**	**9**	**8**	**10**	**8**	**279**
17	**Swale**	**5**	**7**	**8**	**7**	**223**
18	***Strip***	***9***	***8***	***7***	***8***	***252***
19	Swale	5	7	10	4	211
20	Swale	8	8	10	6	254
21	Swale	7	7	10	6	241
22	Strip, Swale	7	8	5	6	204

The following six sites, denoted in bold in Table 7-1, were selected for biofiltration swale installations in Districts 7 and 11:

- Behind Cerritos MS (SR 91 Westbound), District 7 – Site 1
- Between I-605 (Northbound), I-605 (Northbound)/SR 91 (Westbound), and SR 91 (Westbound)/I-605 (Southbound) connector, District 7 – Site 2
- I-605 (Northbound) along freeway between Carson St. and Del Amo Blvd., District 7
- I-5 (Southbound), I-605 (Southbound) onramp, District 7 – Site 10
- I-5 (Southbound) shoulder before Palomar Airport Rd., District 11 – Site 16
- SR 78 (Eastbound) shoulder before Melrose Ave., District 11 – Site 17

The following three sites from Table 7-1 were selected for biofiltration strip installations in Districts 7 and 11:

- Between I-605 (Northbound), I-605 (Northbound)/SR 91 (Westbound), and SR 91 (Westbound)/I-605 (Southbound) connector, District 7 – Site 2
- I-605 (Southbound) along freeway between Carson St. and Del Amo Blvd., District 7 – Site 12
- Altadena MS (pre-trench), District 7 – Site 18

Note that while some of the sites in District 11 scored higher in the decision matrix process than those in District 7, they were not selected since the Stipulation limits the number of biofilter projects that may be transferred to District 11 to three. Sites affected by this restriction are 13 and 14.

Some District 7 sites scored higher than the sites chosen for construction of strips or swales. These sites were not chosen for one or more of the following reasons: (1) they were previously chosen for another BMP which was more difficult to site; (2) they provided no space for construction or maintenance access; or (3) they were either too narrow to operate as a strip or not long enough to operate as a viable swale site.

For example, sites 8 and 11, which score within the top three in the matrix, were chosen as extended detention basin sites. Site 3, which ranked sixth, was previously chosen as an infiltration basin site. The fourth highest scoring site, Site 20, had no space for construction or maintenance access (refer to Appendix B for site notes). Site 21 was not wide enough for either a strip or a swale (Refer to Appendix B for notes).

During the preliminary site selection process, RBF met with representatives of Caltrans and NRDC for a site review. On November 18th and 19th, 1997, inspections of potential sites concluded with a preliminary verbal agreement between all parties on the selection of locations for construction of the biofiltration pilot projects.

7.2 Site Descriptions

7.2.1 SR 91 (Westbound) (Swale), Behind Cerritos MS, District 7, Site 1

The proposed biofiltration swale site is located behind the southern side of the Cerritos Maintenance Station along the SR 91 westbound embankment (*Figure7.1*). The proposed bioswale site can be accessed from the Maintenance Station, which is off of Studebaker Road in the City of Cerritos.

The precise location for the swale is from the SR 91 drainage outlet, located at the foot of the SR 91 westbound slope, to the main area outlet culvert (*Figure 7.2*). The direct length between outlet and culvert is approximately 100 feet (30 meters), although enough area exists to increase the length if needed.

Figure 7-1 (Swale location adjacent to MS)

Figure 7-2 (Bioswale outlet site)

7.2.2 I-605 (Northbound), I-605 (Northbound)/SR 91 (Westbound) Connector, and the SR 91 (Westbound)/I-605 (Southbound) Connector (Strip and Swale), District 7, Site 2

These proposed biofiltration sites are located between the I-605 Northbound, the SR 91 Westbound – I-605 Southbound connector, and the I-605 Northbound – SR 91 Westbound connector. Access to this area can be achieved from the I-605 Northbound mainline. The site receives approximately two acres (0.81 hectares) of drainage from the I-605 freeway (drainage area 1), and one acre from a downdrain off of the SR 91 Westbound – I-605 Southbound connector (drainage area 2). Drainage area 1 flows off the I-605 through overside drains to a swale running parallel to the I-605 in a northerly direction and out a culvert outlet. Drainage area 2 flows directly from the downdrain outlet to the outlet culvert via sheet flow.

The proposed site for the biofiltration swale is along the flow path of drainage area 2 (*Figure 7-3*). The distance from inlet to outlet is approximately 200 feet (61 meters) with a slope of 3 – 5%.

The proposed site for the biofiltration strip is along the flow path of drainage area 1 (*Figure 7-4*). A strip can be placed parallel to the I-605 freeway for a distance of approximately 150 feet (46 meters). The longitudinal slope is approximately 1% with a cross slope of 2 – 4%.

Figure 7-3 (Swale Site)

Figure 7-4 (Strip Site)

7.2.3 I-605 (Northbound)/Carson St. and Del Amo Blvd. (Swale), District 7, Site 5

The proposed biofiltration swale site is located along the I-605 Northbound between the Del Amo Blvd and Carson St. exits. Access to the area can be achieved from the I-605 northbound shoulder. The site receives approximately eight acres (3.2 hectares) of runoff from the I-605 freeway. The site currently contains a 25-foot shoulder that drains into a vegetated swale *(Figure 7-5)*. The swale runs parallel to the I-605 freeway northbound. It terminates into a grate drain inlet structure*(Figure 7-6)*. The area contains a longitudinal slope of approximately 1-2% and a cross slope of 5-6%.

Figure 7-5 (Swale Site)

Figure 7-6 (Site Drain)

7.2.4 I-5 (Southbound)/I-605 (Southbound) (Swale), District 7, Site 10

The proposed biofiltration swale is located between the I-5 southbound and the I-605 northbound connector. This is also a site for a detention basin. Access to the basin can be achieved by parking 300 feet (91 meters) south of the southernmost edge of the siting area. The site receives approximately two acres (0.81 hectares) of runoff from the I-5

southbound. Site drainage consists of one pipe drain inlet from the I-5 and a drain outlet located in the middle of the existing depression *(Figures 7-7 and 7-8).*

Figure 7-7 (Swale Site)

Figure 7-8 (Site Drain)

The proposed location for the biofiltration swale is from the outlet of the downdrain, to the outlet structure. The estimated distance is 150 feet (46 meters) with room to lengthen. The swale slope is estimated to be approximately 2%.

7.2.5 Carlsbad MS (Pre-trench Strip), District 11, Site 12

The Carlsbad Maintenance Station is located in the City of Carlsbad one block south of Palomar Airport Road at 6050 Paseo Del Norte. The site is bounded by Paseo Del Norte to the west and commercial and industrial uses to the south, east and north. Site drainage is sheet flow to concrete swales and gutters, concentrating along a gutter in the entrance drive to the Station and ultimately discharging to Paseo Del Norte. The site includes a vehicle maintenance shop, fueling island, wash rack and storage areas for maintenance equipment and supplies. *Figure 7-9* provides a view of the overall site, and *Figure 7-10* indicates the proposed location of the infiltration trench.

Figure 7-9 (Carlsbad MS)

Figure 7-10 (Trench site)

Carlsbad MS is a candidate site for an infiltration trench. The location of the biostrip would be adjacent to the trench as a pre-treatment device.

7.2.6 I-5 (Southbound) at Palomar Airport Rd. (Swale), District 11, Site 16

The proposed biofiltration swale site is located along the I-5 southbound shoulder prior to the Palomar Airport Road offramp. Access to the area can be achieved from the I-5 southbound shoulder. The site receives approximately 6 acres (2.4 hectares) of runoff from the I-5 southbound mainline. The site currently consists a 30-foot shoulder, which drains freeway runoff via sheetflow to an adjacent frontage road storm drain.

The proposed location for the biofiltration swale is along the area parallel to the I-5 freeway. This area contains a longitudinal slope of approximately 1-2% and a cross slope of 2%. *Figures 7-11 and 7-12* indicate the swale location and site proximity respectively.

Figure 7-11(Swale Site)

Figure 7-12 (Site Drain)

7.2.7 SR 78 (Eastbound), Melrose Ave. (Swale), District 7, Site 17

The proposed biofiltration swale site is located along the SR 78 eastbound shoulder prior to the Melrose Avenue offramp. The site can be accessed from the SR 78 eastbound shoulder. The site receives approximately 5 acres (2 hectares) of runoff from the I-78 freeway. The site currently contains a 20-60 foot shoulder, which discharges into a drain inlet. The drain inlet runs underneath the frontage road and out to an unnamed stream.

Figure 7- 13

Figure 7-14

The proposed location for the biofiltration swale is along the area parallel to the SR 78 freeway and the Melrose offramp. The swale will eventually terminate into the same stream as the drain outlet. This area contains an estimated longitudinal slope of 1-3% and a cross slope of 2%. *Figure 7-14* indicates the swale location and *Figure 7-13* indicates the site proximity.

7.2.8 Altadena Maintenance Station (pre-trench strip), District 7, Site 18

The Altadena Maintenance Station is located at 2122 North Windslow Drive, just off the 210 freeway. The station area was estimated by field observation to be approximately 3 acres (1.2 hectares). It is located in an urban area with stores on both sides and in front of the 210 freeway. The site is completely equipped with onsite drainage facilities.

Unlike several other maintenance sites that were located under bridges, Altadena is completely exposed. All the onsite flow is directed to the pre-trench strip site, which lead to a gutter and drop inlet as shown in *Figures 7-16* and *7-17*. The gutter is located about 3 feet (1 meter) outside the site fence and is within the Caltrans right-of-way. Hay bails are set up in front of the flow path as a temporary sediment filter.

Figure 7-16 (Proposed Trench/Swale Site)

Figure 7-17 (Site drain inlet)

The site is also relatively safe are for sampling. Since the main outlet drain is located onsite, near the property periphery, no interference from street or onsite traffic is anticipated.

8.0 Media Filters

As part of the District 7 Pilot Retrofit Program, RBF has selected three Caltrans maintenance stations and three Caltrans park & ride lots in Districts 7 and 11 as sites for the purpose of evaluating the feasibility and effectiveness of installing sand media filters. In addition, one maintenance station in District 11 was selected as a site for the purpose of evaluating the feasibility and effectiveness of installing a compost media filter. The compost media filter is proposed in substitution of one of the District 11 infiltration trenches (see Chapter 6) that was not sited in District 11.

Media filters are defined as chambers containing filtering media such as sand, compost, or sand/peat layers that discharge to an underdrain or storm drain system. Media filters are designed to remove primarily fine sediment or particulate pollutants. Other runoff constituents such as nutrients, heavy metals, oil and grease, and bacteria and viruses may also be reduced.

Storm water runoff constituent removal efficiencies, in addition to operation and maintenance, will be monitored for a two-year period.

8.1 Site Evaluation

The process of locating seven sites for the Pilot Retrofit Program involved field reviews of maintenance stations and park & ride facilities in District 7, and comparable facilities in District 11. Since media filter functioning is based on gravity flow, sites must have storm drain systems with sufficient amount of hydraulic head to operate the filter. Preliminary estimates suggest that a hydraulic head of three feet (~one meter) or more is sufficient.

The site selection process began by meeting with Caltrans officials to request site plans and related information for maintenance stations and park & rides. Caltrans assisted with field investigations of the maintenance stations. This included: tours of the grounds, photos, and observations of drainage patterns and general housekeeping practices.

The sites that did not make final selection were eliminated due to one or more of the following criteria:

- not enough hydraulic head in the site storm drain system;
- low onsite vehicular or heavy equipment usage at maintenance stations; and
- low volume of parking at park & rides.

After preliminary selection of the sites, RBF met with representatives of Caltrans and NRDC for a site review. On November 18th and 19th, 1997, inspections of potential sites concluded with an initial agreement between all parties on the selection of the primary or

secondary locations for construction of the Pilot projects. Further field investigations eliminated some of the initial locations for lack of available hydraulic head and additional observation of park and ride facility utilization was made. An additional site tour with Caltrans and NRDC representatives was conducted on January 5th, 1998.

An initial site evaluation was performed on all sites reviewed to classify whether or not the sites were physically capable of a media filter installation. As stated previously, a media filter requires approximately three feet of head to function properly. Several of the sites reviewed could not support this required head. Table 8-2 shows which sites possessed the minimum hydraulic head to operate the filter. The sites that received a "Y," were chosen for further consideration and sites that did not have adequate hydraulic head were eliminated from further study. Field notes for media filter sites can be found in Appendix B.

Table 8-1 shows the three criteria categories used to select the sites. It shows, with respect to the siting criteria, how each site compares to each other. Criteria involved not only site drainage characteristics but also site location and use. Column one, "Drainage Pattern", refers to the types of onsite drainage, as well as, the amount of confluence at the proposed location of media filter. Column two, "Vehicles and Heavy Equipment," refers to the types of maintenance activities and equipment storage at maintenance stations, as well as parking volume and presence of bus transfer bays at park & ride facilities. Column three, "Space Available/Access", refers to the amount of space available to construct, maintain and monitor the media filter. Appendix C describes the scoring system for each criteria category used in Table 8-1.

Table 8-1: Media Filter Selection Matrix

Weights		*8*	*10*	*6*	
	District	**Drainage Pattern**	**Vehicle & Heavy Equipment**	**Space Available/ Access**	Total
Maintenance Stations					
Alameda	*7*	*7*	*8*	*7*	*178*
Altadena	7	9	7	8	190
Century	7	6	4	5	118
Eastern Regional	**7**	**9**	**8**	**7**	**194**
Escondido	**11**	**9**	**8**	**9**	**215**
Foothill	**7**	**8**	**8**	**8**	**192**
Kearny Mesa	**11**	**8**	**10**	**8**	**212**
Las Flores	7	9	6	6	168
Metro	7	8	7	6	170
Rosemead	7	8	6	7	166
Santee	11	7	8	8	184
Terminal Island	7	5	5	6	126
Park & Rides					
Artesia	7	5	3	9	124
Aviation	7	8	2	7	126
Carson	7	7	1	7	108
Harbor Park	7	7	2	7	118
Hawthorne S	7	6	2	8	116
La Costa	11	6	6	10	168
Lakewood Blve. S	7	7	6	7	158
Manchester	7	5	0	5	70
Newhall-East	7	9	5	5	152
Paxton	**7**	**9**	**6**	**9**	**186**
Rosecrans	7	8	0	9	118
Route 78/I-5	**11**	**8**	**8**	**9**	**207**
Sierra Madre	7	8	5	7	156
Slauson	7	7	0	8	104
Termination	**7**	**9**	**10**	**8**	**220**
Via Verde	*7*	*9*	*6*	*7*	*174*

After office and field review, the sites that best met the site selection criteria were determined to be the **Eastern Regional, Escondido, Kearny Mesa, and Foothill** maintenance stations, and the **SR 78/I-5, Termination** and **Paxton** park & rides. The Kearny Mesa Maintenance Station was selected as a compost media filter site, in substitution for one of the unsited District 11 infiltration trenches (see Chapter 6). Altadena MS also scored higher than Paxton but it was subsequently selected to be an infiltration trench site.

Maintenance stations might be considered to generate greater amounts of chemical constituents than park and ride facilities. However, park and rides can be subjected to illicit discharge of used motor oil and other contaminants by motorists since park and rides are not supervised lots as there are maintenance stations. In addition, older vehicles located at park and rides are more likely to have oil leaks than are newer, regularly maintained vehicles at Caltrans maintenance stations. Moreover, there are approximately three times as many park and ride lots as are maintenance stations in District 7. Therefore, it is consistent with the fundamental evaluation criteria that park and rides scored as highly in the decision matrix as did maintenance stations.

8.2 Site Descriptions

8.2.1 Eastern Regional MS

The Eastern Regional Maintenance Station is located at 19405 Workman Mill Road, just off the 60 Freeway in the city of Whittier. The site area is approximately five acres (2 ha) and is located in a commercial/industrial area.

The site drainage consists primarily of sheet flow to a swale or curb, which leads to one of two outlet structures. The main outlet structure, shown in *Figure 8-2*, is a drain inlet located just outside the yard's fence within a Caltrans right-of-way and receives approximately 70 percent of the total runoff. The other structure is a parkway culvert, which routes the runoff to the street. *Figure 8-1* shows the general site condition.

Figure 8-1(Eastern Regional MS)

Figure 8-2 (Main Drain Inlet)

The drain inlet is situated in an ideal location about ten feet (three meters) below the yard's main runoff confluence point. From this point, the runoff flows down a fifteen foot (4.5 meter) swale at a 10 to 15 percent grade into a riser inlet structure. The riser pipe invert is approximately one meter below the rim.

This maintenance station has multi-crew operations and experiences heavy vehicular traffic. The proposed media filter site is located in an area that is free from traffic and storage facilities, allowing acceptable access.

8.2.2 Escondido Maintenance Station (MS)

The Escondido Maintenance Station is located at 1780 West Mission Avenue just off the Nordahl Road offramp. The station area is approximately 4.5 acres (1.8 ha). The area is bounded
by Mission Avenue, State Route 78, and industrial activity on two sides. The site is equipped with onsite drainage facilities.

Figure 8-3 (Area)

Figure 8-4 (Vvehicles)

Escondido contains approximately 15 heavy multi-crew maintenance vehicles and 25 employee vehicles as shown in *Figures 8-3 and 8-4.*

This maintenance station is completely exposed. The site drainage system consists of three drain inlets, one culvert inlet and one overside drain. The flow patterns for this area consists of mostly curb, swale, and sheet flow.

8.2.3 Kearny Mesa MS

The Kearny Mesa Maintenance Station is located adjacent to the 805 Freeway at 7179 Opportunity Road in San Diego. The site is bounded by commercial uses to the east, Opportunity Road to the north, and the I-805 freeway to the south and west. Site drainage is divided into two main areas; the easterly portion of the site is tributary to drain inlets and an underground drainage system. The westerly portion of the site is tributary to an overside drain that discharges to a culvert passing under I-805. Site uses include heavy equipment parking, equipment storage such as engine powered generators, vehicle fueling and an equipment wash rack. The proposed site location for the media filter is next to the main inlet shown in *Figure 8-6*.

Figure 8-5 (Kearny Mesa MS)

Figure 8-6 (Site Inlet)

8.2.4 Foothill MS

The Foothill Maintenance Station is located at 850 East Huntington Drive near the corner of Mountain Ave. and East Huntington Dr., just off the 210 freeway, Mountain Avenue offramp. The site area was estimated by field observation to be approximately 4.5 acres (1.8 ha). The station is located in an industrial area with buildings on both sides and a major storm drain channel along the western side of the facility. The site is completely equipped with onsite drainage facilities.

The Foothill Maintenance Station contains approximately 20 heavy maintenance vehicles and 20 employee vehicles. The entire Foothill Maintenance Station is exposed to rainfall. The site drainage consists of swales flowing into four drain inlets. This onsite drainage system runs directly out to the adjacent flood control channel. Examples of the drain inlets are shown in *Figure 8-7* and *Figure 8-8*.

Figure 8-7 (Upstream inlet)

Figure 8-8 (Downstream inlet)

Other aspects of this site that are relevant to the selection criteria include storage of onsite petroleum based substances, such as oil waste, asphalt crack sealant, and solid asphalt.

8.2.5 Paxton P&R

The Paxton park & ride facility is located at the I-210/SR118 in the Pacoima region of the City of Los Angeles. It is on the southeast corner of Paxton Street and Foothill Boulevard, with access from both streets. It has convenient nearby access to and from I-210, with access to and from SR118 located approximately one-half mile (0.3 km) to the southwest. The facility occupies approximately one acre (0.4 ha) and has capacity for 114 cars and small trucks. Approximately 95 percent of the site is exposed to direct rainfall. The balance of the site is partially sheltered by the I-210/SR118 transition road flyovers.

The site slope ranges from two to five percent. Approximately 90 percent of the total site drains to a single curb/drain inlet near the northeastern corner of the site (*Figure 8-10*).

Figure 8- 9 (Paxton P&R)

Figure 8-10 (Drain inlet)

The invert of the storm drain is approximately three feet (~one meter) below the grate. The remainder of the facility drains southwest through a driveway to Foothill Boulevard. Both discharge points direct the runoff to the city storm drain system.

8.2.6 SR 78/I-5 P&R

The 5/78 Park & Ride is located just off the Interstate 5 freeway at the intersection with highway 78 freeway in the City of Carlsbad. The site was estimated by field observation to be approximately half of an acre. The park & ride is located in a residential area, adjacent to the freeway.

The site drainage system consists exclusively of two drain inlets located at the eastern end of the parking lot adjacent to the Interstate 5 right-of-way. The northernmost inlet captures approximately 65 percent of the total runoff, and thus is chosen for media filter retrofit (*Figure 8-12*). *Figure 8-11* shows the overall site vicinity.

Figure 8-11 (P & R lot)

Figure 8-12 (Main drain inlet)

Although this park & ride is relatively small, it was chosen due to its extensive use. During the field review, approximately fifty cars were parked, which filled almost every stall. The flow pattern of this lot consists of a downstream curb structure that captures sheet flow and routes it to one of the two drain inlet structures. Runoff from this lot is tributary to Buena Vista Lagoon. The Buena Vista Lagoon is a sensitive estuarine environment. Beneficial uses for these waters included habitat for marine life, recreation, boating, shipping, and commercial and sport fishing. Conditions in the coastal lagoons may result in the development of a unique biologic community specific to the area. Buena Vista Lagoon is a 303(d) listed water waterbody due to impairments to aquatic life from excess sediment and elevated nutrient levels. It is also impaired for recreation due to high coliform count. Further, illegal dumping has been know to occur at this facility (per. comm., Caltrans District 11 personel).

The proposed media filter location is at the southern most inlet receiving runoff from the upstream inlet and the parking lot.

8.2.7 Termination P&R

The Termination park & ride is a large facility at the eastern terminus of I-105 in the City of Norwalk at the I-105/I-605 interchange. The facility occupies approximately 15 acres (6 ha) and has a capacity for 1,500 cars. It is adjacent to a Green Line Metrolink station and has a bus terminal integrated into the park & ride facility. The lot has direct access to the car pool lanes of the 105. It is located in a predominantly residential area with residential areas to the east, south and west. It is bounded on the north by on-ramps and off-ramps for the 105. The largest portion of the facility, including the bus terminal, is located south of the 105 and east of the 605. A small portion of the facility is on the west side of the 605, also south of the 105.

The site drainage system consists of concrete swales which discharge to the city storm drain system through parking drains. A series of three drain inlets, shown in *Figure 8-14*, receive the runoff from the central section of the large lot east of the 605. These inlets capture approximately 25 percent of the total runoff from the site.

Figure 8-13 (Termination P&R)

Figure 8-14 (Drain inlet)

The proposed site for the media filter is at the downstream end of the three inlets shown above. *Figure 8-13* shows the general site vicinity.

Table 8-2: Media Filter Sites
Assessment of Minimum Available Hydraulic Head

Facility	District	Site Storm Drain/Avail. Head
Maintenance Stations		
Alameda	7	Y
Altadena	7	Y
Apple Street	7	N
Artesia	7	N
Aviation	7	N
Buena Vista	7	N
Camino Del Rio	11	N
Carlsbad	11	N
Central	7	N
Century	7	Y
Chula Vista	11	N
Coronado Bridge	11	N
Diamond Bar	7	N
East LA	7	N
East Region	7	Y
Escondido	11	Y
Florence	7	N
Foothill	7	Y
Imperial	11	N
Kearny Mesa	11	Y
Las Flores	7	Y
Long Beach	7	N
Metro	7	Y
Otay	11	N
Pacific Highway	11	N
Pacific Place	7	N
Pomona	7	N
Rosemead	7	Y
San Fernando	7	N
Santee	11	Y
Sawtelle	7	N
Tarzana	7	N
Terminal Island	7	Y
Westdale	7	N
Westwood	7	N
Willow	7	N

Table 8-2: Media Filter Sites
Assessment of Minimum Available Hydraulic Head

Facility	District	Site Storm Drain/Avail. Head
Park and Rides		
Artesia	7	Y
Avalon	7	N
Aviation	7	Y
Birmingham Dr./I-5	11	N
Butler	7	N
Carmel Valley Rd.	11	N
Carson	7	Y
Century/Harbor Jct.	7	N
Cerritos	7	N
College Blvd. South	11	N
Crenshaw	7	N
Diamond Bar-East	7	N
Diamond Bar-West	7	N
El Norte/I-5	11	N
Garey/Rte 10	7	N
Grand Ave.	7	N
Harbor Park	7	Y
Hawthorne NE	7	N
Hawthorne NW	7	N
Hawthorne S	7	Y
La Costa	11	Y
Lakewood Blvd. N	7	N
Lakewood Blve. S	7	Y
Lakewood-East	7	N
Lakewood-West	7	N
Lone Hill	7	N
Long Beach Blvd. N	7	N
Long Beach Blvd. S	7	N
Manchester	7	Y
Newhall-East	7	Y
Pathfinder Rd.	7	N
Paxton	7	Y
Rosecrans	7	Y
Route 78/College Blvd.	11	N
Route 78/I-5	11	Y
San Pedro	7	N
San Pedro 2	7	N
Sierra Madre	7	Y

Table 8-2: Media Filter Sites
Assessment of Minimum Available Hydraulic Head

Facility	District	Site Storm Drain/Avail. Head
Skirball & Mullholland	7	N
Slauson	7	Y
Termination	7	Y
Vermont Ave.	7	N
Via Verde	7	Y
Willowbrook	7	N

9.0 Oil/Water Separators

As part of the Caltrans District 7 Retrofit Pilot Program, RBF has investigated Caltrans maintenance stations in District 7 and 11 for the purpose of evaluating the feasibility of installing four Oil/Water Separators. All of the primary maintenance sites in District 7 and 11 were investigated by field review. Site investigations included a general tour of the grounds, photos, and observations relative to current housekeeping practices, yard activities, and existing structural BMP controls.

9.1 Site Selection Process

Twenty-two maintenance yards were investigated within District 7 and District 11. See Appendix B for field notes on the candidate sites. The characteristics determined to be important for selecting an oil/water separator were the following: presence of heavy equipment, method of asphalt containment, quality of oil waste storage, type of runoff flow paths (for sampling), site exposure to rain, type of on-site drainage, accessibility of site, and safety with respect to vehicular traffic.

The site characteristic values are assigned for each category at each site. For example, the presence of heavy vehicles in uncovered parking areas receives the highest value of 10. Conversely, if a site does not display a certain characteristic, it will yield a low score. Each site is then rated by developing a composite score, representing all of the individual characteristic categories, as shown in *Table 9-1*.

This information was then evaluated using a weighted decision matrix process. Each site was evaluated and compared with respect to several different criteria and characteristic categories. Each criteria or characteristic category was given a value, or weight (1-10) with respect to its importance and relevance to the site selection process. See Appendix C for the criteria rating system.

The following 10 stations had the highest composite score and were chosen for further consideration:

Alameda	**Altadena**	Eastern Region	**Escondido**
Foothill	Kearny Mesa	**Metro**	San Fernando
Tarzana	Westdale		

Of the ten highest scoring sites in the matrix, four sites were selected. The final selected sites were Alameda, Altadena, Escondido and Metro. San Fernando, Foothill and Kearny Mesa also scored high in the decision matrix. The drainage area for San Fernando Maintenance Station is divided into three areas, reducing the potential concentration of oil and grease that would otherwise collectively leave the site at a central location. This station is also in a relatively outlying area removed from the other stations making it difficult to sample the 'first flush' runoff during the storm water sampling screening phase of this program. The Foothill Maintenance Station was noted to have multiple

drain inlets, which made this site an excellent choice for the catch basin insert retrofit pilot study. Kearny Mesa, while potentially a good choice for an oil/water separator, is over three times larger than other 'typical' maintenance stations and currently operates wash bays with pollution control devices. It was agreed that the Escondido Maintenance Station was more representative of typical conditions at Caltrans maintenance facilities. Tarzana and Westdale were not selected due to absence of available hydraulic head at these sites, prohibiting installation of an oil/water separator unit. See Table 9-3 for an assessment of available hydraulic head at each of the candidate sites.

Table 9-1: Oil Water Separator Selection Matrix for Stormwater Monitoring Project									
Weight	*10*	*6*	*7*	*6*	*7*	*7*	*5*	*5*	
	Heavy Vehicles	**Asphalt Contnmt**	**Oil Waste Storage**	**Flow path**	**Site Exposure**	**Onsite Drainage**	**Access**	**Traffic Safety**	***Total Score***
District 7 Sites									
Apple St. (L)	6	2	5	4	2	4	6	8	243
Alameda	**10**	**5**	**7**	**8**	**9**	**8**	**8**	**7**	**421**
Altadena	**10**	**7**	**7**	**8**	**10**	**8**	**9**	**9**	**455**
Aviation	3	0	0	7	1	2	8	7	168
Buena Vista (L)	3	0	0	1	1	1	6	5	105
Central	7	4	2	6	10	6	6	6	316
Diamond Bar	6	2	3	4	8	4	7	8	276
East LA.	8	5	5	*5*	7	2	7	7	308
East Region HQ	8	5	2	7	10	8	8	8	*372*
Foothill	9	8	3	6	10	10	9	6	410
Las Flores	6	2	2	7	10	10	1	8	313
Metro	**8**	**5**	**7**	**8**	**7**	**9**	**8**	**8**	***399***
Rosemead	5	0	0	5	10	8	3	9	266
San Fernando	9	8	6	7	10	6	5	9	404
Sawtelle	2	0	0	5	1	2	6	5	126
Tarzana	7	*5*	8	6	10	6	8	7	379
Westdale	6	7	3	7	8	6	9	8	362
Westwood (E)	4	0	0	5	10	4	10	9	263
District 11 sites									
Carlsbad	8	2	2	6	10	5	10	7	337
Chula Vista	7	2	2	3	10	5	6	8	289
Escondido	**6**	**5**	**6**	**8**	**10**	**9**	**7**	**8**	**388**
Kearny Mesa	10	7	6	8	10	9	5	7	425
Santee	8	2	2	6	10	7	2	6	301

9.2 Site Descriptions

9.2.1 Alameda Maintenance Station

The Alameda Maintenance Station is located at1740 East 15th Street, just off the 10 freeway, Alameda Street offramp. The site is located under an I-10 freeway bridge. The station area was estimated by field observation to be approximately 2.5 acres (1 hectare). The site is equipped with onsite drainage facilities.

The Alameda station yielded the second highest composite value of the final sites (see Table 9-1). Even though half of this site is located under a bridge, all heavy vehicles (over 25) are located in the exposed areas, as shown in *Figure 9-6*. Employee vehicles are parked under the bridge.

Figure 9-1 (Alameda MS)

Figure 9-2 (Main outlet)

All the onsite flow is directed to swales, which lead to a curb inlet on a street adjacent to the site, which is shown in *Figure 9-7*. Hay bails are set up near the drainage inlet as a temporary sediment filter.

Other aspects of this site that are relevant to the selection criteria include onsite petroleum based substance storage, such as oil waste, asphalt crack sealant, and solid asphalt. These facilities are mostly covered by the bridge, but due to bridge column downdrain runoff, they may come into contact with stormwater.

9.2.2 Altadena Maintenance Station

The Altadena Maintenance Station is located at 2122 North Windsor Avenue just off the 210 freeway, North Windsor Ave. offramp. The station acreage was estimated by field observation to be approximately 2.5 acres (1 hectare). It is located in an urban area with commercial use on both sides and the 210 freeway behind. The site is completely equipped with onsite drainage facilities.

The Altadena station yielded the highest composite value with respect to the site characteristic criteria (see Table 9-1).

This station was rated in the top two for number of large vehicles stored in exposed areas. Approximately 25 heavy vehicles ranging from backhoes to dump trucks, in addition to at least 20 employee cars, were parked at the site.

Unlike several other maintenance sites that were located under bridges, Altadena is completely exposed. All the onsite flow is directed to swales, which lead to a gutter and drain inlet as shown in *Figures 9-3* and *9-4.* The gutter is located about one meter outside the site fence and is within the Caltrans right-of-way. Hay bales are set up in front of the flow path as a temporary sediment filter.

Figure 9-3 (Onsite swale)

Figure 9-4 (Site drain inlet)

The site also is a relatively safe area for sampling. Since the main outlet drain is located onsite, near the property periphery, no interference from street or onsite traffic is anticipated.

Other aspects of this site that are relevant to the selection criteria include onsite petroleum based substance storages, such as oil waste, asphalt crack sealant, and solid asphalt.

The construction of an oil/water separator at this site seems feasible with respect to construction implementation. The asphalt pavement will have to be modified for installation.

9.2.3 Escondido Maintenance Station

The Escondido Maintenance Station is located at 1780 West Mission Avenue just off the Nordahl Road offramp. The station area is approximately 4.5 acres (1.8 hecteres). The area is bounded by Mission Avenue, State Route 78, and industrial activity on two sides. The site is equipped with onsite drainage facilities.

Figure 9-5 (Area)

Figure 9-6 (Vehicles)

Escondido contains approximately 15 heavy multi-crew maintenance vehicles and 25 employee vehicles as shown in *Figure 9-6.*

Figure 9-7 (Onsite culvert inlet)

Figure 9-8 (Swale to grate inlet)

This maintenance station is completely exposed. The site drainage system consists of three grate inlets, one culvert inlet and one overside drain. The flow patterns for this area consists of mostly curb, swale, and sheet flow.

9.2.4 Metro Maintenance Station

The Metro Maintenance Station is located at 2187 Riverside Drive, about 1 mile from the Riverside Dr. offramp of the 5 freeway. The station area was estimated by field observation to be approximately 3 acres (1.2 meters). It is located directly under the State Route 2. The site is equipped with onsite drainage facilities.

The Metro station yielded the fifth highest composite value and was selected due to its location with respect to the other chosen sites

Metro contains approximately 15 heavy maintenance vehicles and 20 employee vehicles. Most of the heavy vehicles were parked in the exposed areas, whereas most of the employee vehicles were parked under the bridge.

Figure 9-8 (Heavy vehicles)

Figure 9-9 (Onsite v-ditch)

About 65% of the site is exposed. About 60% of site drainage consists primarily of swale flow into a large onsite downstream v-ditch (see *Figure 9-9*). From the v-ditch, the runoff flows into a drain inlet. The remaining runoff runs directly from the lot over the sidewalk to the curb inlet as sheetflow. Bridge column downdrains are also located onsite and drain to the v-ditch.

Other aspects of this site that are relevant to the selection criteria include onsite petroleum based substance storages, such as oil waste, asphalt mulch, and solid asphalt.

9.3 Sampling Program Test Results

Stormwater runoff from the four maintenance stations described above was sampled during storm events in November 1997 through January 1998 and analyzed for total concentration of oil and grease (see Table 9-2). The results indicate that the average concentration of oil and grease in the runoff make the use of a commercial coalescing plate oil/water separator device ineffective for most of the sites. Oil/water separators may be used to reduce oil and grease to as low as 10 mg/l. Installing such a device where the initial average concentration of oil and grease is less than 10 mg/l before treatment is not practical. The average concentration at Altadena while greater than 10 mg/l, remains a marginal site opportunity since plate separators do not function effectively at such relatively low total oil and grease concentrations. Persuant to the option allowed in the Stipulation, Caltrans and NRDC have agreed that an oil/water separator will be installed only at the Alameda Maintenance Station. The raw sampling data for each of the sampled storms is summarized in Table 9-2.

Table 9-2: Oil/Grease Results (mg/L)

Site Location	*Storm Date*								
	Nov.10	*Nov.13*	*Nov.26*	*Nov.30*	*Dec.18*	*Jan.9*	*Jan. 12*	*Jan.15*	*Average*
Alameda MS	34.0	6.1	12.0	19.0	135.0	21.0	16.0		**34.7**
Altadena MS	9.7	5.8	23.0		41.0	23.0		19.0	20.3
Metro MS	2.1	6.8	16.0		9.3				8.6
Escondido MS	12.0	4.3	8.2		13.0				9.4

Table 9-3: Assessment of Minimum Available Hydraulic Head at Potential Oil/Water Separator Sites

Facility	Site Storm Drain/Avail. Head
District 7 Sites	
Alameda	**Y**
Altadena	**Y**
Apple Street	N
Aviation	N
Buena Vista	N
Central	N
Century	Y
Diamond Bar	N
East LA	N
East Region	Y
Foothill	Y
Las Flores	Y
Metro	**Y**
Rosemead	Y
San Fernando	N
Sawtelle	N
Tarzana	N
Terminal Island	Y
Westdale	N
Westwood	N
District 11 Sites	
Carlsbad	N
Chula Vista	N
Escondido	**Y**
Kearney Mesa	Y
Santee	Y

10.0 Multi-Chambered Treatment Train (MCTT)

As part of the District 7 Pilot Retrofit Program, RBF has selected one Caltrans maintenance station and two park & ride lots as sites for the purpose of evaluating the feasibility and effectiveness of installing multi-chambered treatment train (MCTT) BMPs. The MCTTs are proposed in substitution of three infiltration trenches that were unsited in District 7 due to limited availability of suitable sites for infiltration trenches (see Chapter 6).

MCTTs are three-chambered vaults that incorporate three different treatment mechanisms. The first chamber is the catchbasin grit chamber designed to capture sediment and debris. The second chamber is the main settling chamber and includes plate separators, aerators and sorbent pads. This secondary sedimentation chamber also removes free oil and grease by the use of sorbent pillows. The third chamber is the filter chamber and contains layers of sand and a layer of sand/peat covered by a filter fabric. This chamber is a finishing or polishing step that further treats filterable constituents.

MCTTs are designed to reduce concentrations of the following constituents: suspended solids (SS), chemical oxygen demand (COD), turbidity, phosphorus, lead, zinc, and organics.

Storm water runoff constituent removal efficiencies, in addition to operation and maintenance, will be monitored for a two-year period for the MCTT device.

10.1 Site Evaluations

After a review of the MCTT literature, the siting criteria were found to be very similar to those of the media filters. Like the media filters, the MCTTs require approximately three feet (one meter) of head to operate efficiently.

As a result, site selections were made from the media filter selection matrix. The sites with the highest composite scores, among those not previously chosen for media filters, were selected for MCTT installation. For media filter site location characteristics, refer to *Chapter 8.1*.

Utilizing the selection matrix from the media filter section (*Table 10.1*), the three sites with the highest scores were selected for MCTT implementation.

The following sites are proposed:

1. **Lakewood Blvd., South lot (P&R)**
2. **Metro (MS)**
3. **Via Verde (P&R).**

Table 10.1: District 7 MCTT Selection Matrix

Weights	*8*	*10*	*6*	
	Drainage Pattern	**Vehicle & Heavy Equipment**	**Space Available/ Access**	Total
Maintenance Stations				
Alameda	***7***	***8***	***7***	***178***
Altadena	***9***	***7***	***8***	***190***
Century	6	4	5	118
Eastern Regional	***9***	***8***	***7***	***194***
Foothill	8	8	8	192
Las Flores	9	6	6	168
Metro	***8***	***7***	***6***	***170***
Rosemead	8	6	7	166
Terminal Island	5	5	6	126
Park & Rides				
Artesia	5	3	9	124
Aviation	8	2	7	126
Carson	7	1	7	108
Harbor Park	7	2	7	118
Hawthorne S	6	2	8	116
Lakewood Blvd. S	***7***	***6***	***7***	***158***
Manchester	5	0	5	70
Newhall-East	9	5	5	152
Paxton	***9***	***6***	***9***	***186***
Rosecrans	8	0	9	118
Sierra Madre	8	5	7	156
Slauson	7	0	8	104
Termination	***9***	***10***	***8***	***220***
Via Verde	***9***	***6***	***7***	***194***

The maintenance station at Alameda was previously selected as an oil/water separator site. Altadena MS has been selected as an infiltration trench and biofiltration strip site. Foothill, Rosemead, and Las Flores maintenance stations have been selected for catch basin inserts. Eastern Regional MS and Paxton, Termination, and Via Verde park & rides have been selected as media filter sites.

10.2 Site Descriptions

Metro MS

The Metro maintenance station is located at 2187 Riverside Drive, about 1 mile from the Riverside Dr. offramp of the 5 freeway. The station area was estimated by field observation to be approximately 3 acres (*Figure 10-1*). It is located directly under State Route 2. The site is equipped with onsite drainage facilities.

About 65% of the site is exposed. About 60% of site drainage consists primarily of swale flow into a large onsite downstream v-ditch. From the v-ditch, the runoff flows into a drain inlet (*Figure 10-2*). The remaining runoff, flow runs directly from lot over the sidewalk to the curb inlet. Bridge column down-drains are also located onsite and drain to the v-ditch.

Figure 10-1 (MS site)

Figure 10-2 (Inlet)

The proposed site for the installation of a MCTT unit is along the v-ditch just upstream of the inlet. The outlet of the MCTT can tie into the existing drain inlet.

Lakewood Blvd. P & R

The Lakewood Blvd. Park & ride, is located at the SR-105/Lakewood Blvd. interchange in the City of Downey. The site area was estimated by field observation to be approximately one acre with a parking capacity of 308 automobiles (*Figure 10-3*).

The site's drainage pattern consists of sheet flow and curb flow to an inlet that connects to the City drainage system (*Figure10-4*). The estimated site slope is two percent.

The proposed MCTT location is along the curb adjacent to the existing drain inlet. The MCTT will discharge directly to the storm drain lateral serving the site.


Figure 10-3 (Site)


Figure10-4 (Inlet)

10.2.3 Via Verde P & R

The Via Verde Park & Ride is located at the I-210/Via Verde intersection inside the I-210 Southbound onramp in the City of San Dimas. The site area tributary to the main drain outlet was estimated by field observation to be approximately three-quarters of an acre. The lot has a parking capacity of 90 automobiles.

The site slope ranges from one to five percent with the sump located inside the lot itself (*Figure 10-5*). One grated drain inlet captures all the runoff from the site and discharges it to the City storm drain. The proposed location for the MCTT is at this inlet (*Figure10-6*).


Figure 10-5 (Lot)

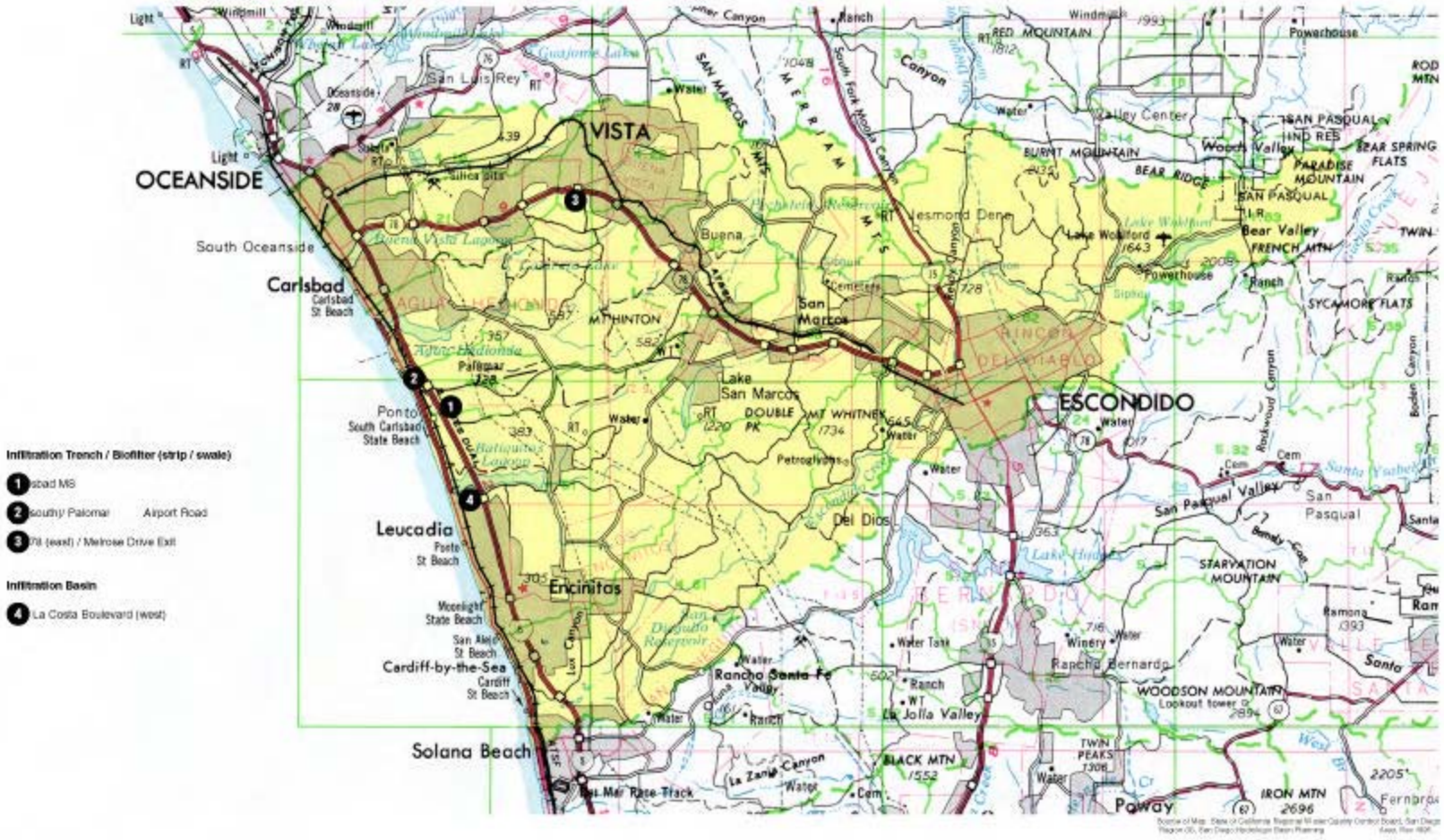

Figure 10-6 (inlet)

[i] Federal Highway Administration, Office of Environment and Planning, 1996. *Evaluation and Management of Highway Runoff Water Quality.* Publication No. FHWA-PD-96-032, Washington D.C..

Not to Scale

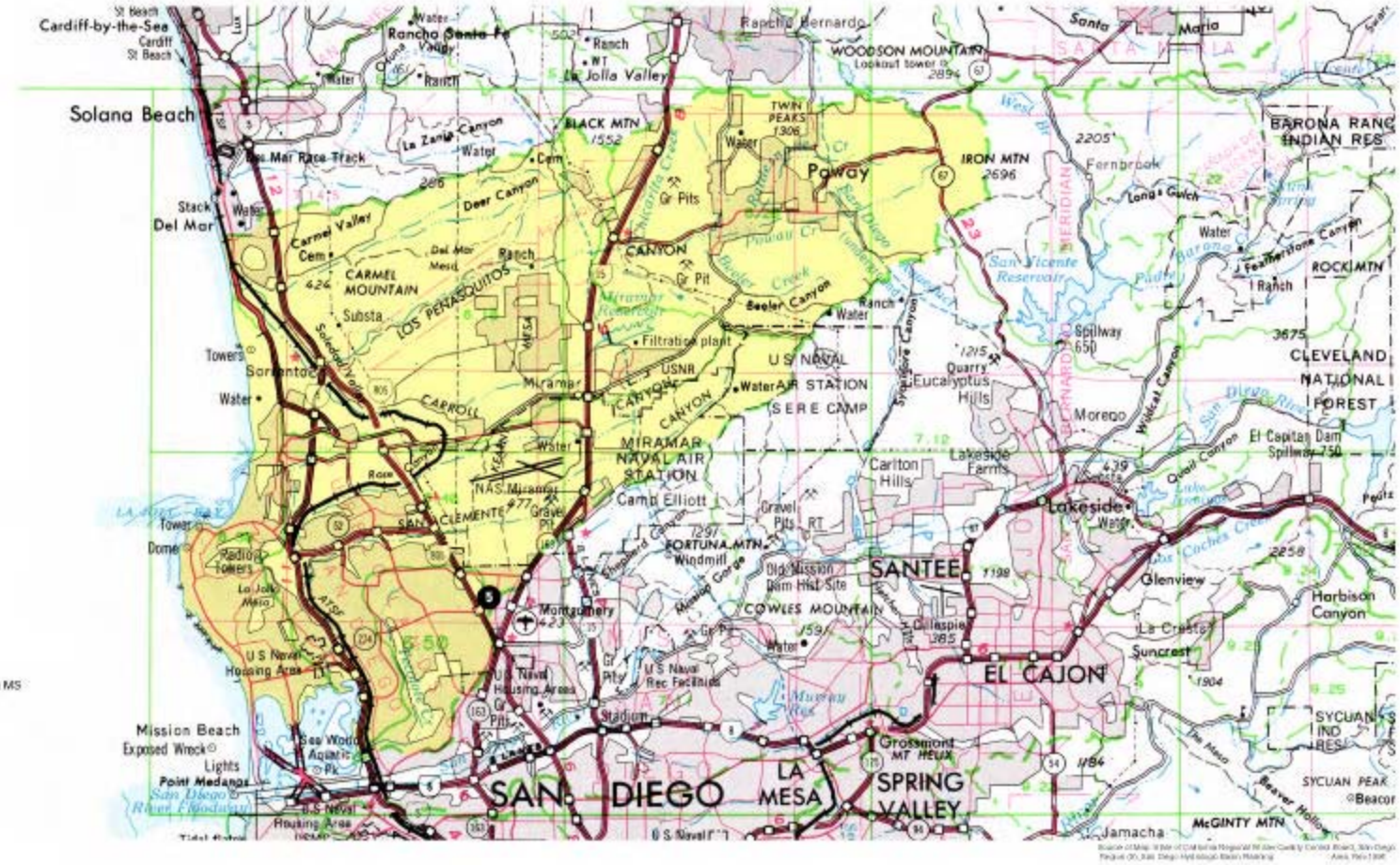
Caltrans BMP Retrofit Pilot Program, District 7

Exhibit A



Caltrans BMP Retrofit Pilot Program, District 11 for District 7 Program

Exhibit B



Caltrans BMP Retrofit Pilot Program, District 11 for District 7 Program

Exhibit C

Appendix A

Geotechnical Notes

DISTRICT 7

GEOTECHNICAL NOTES

THE L·K·R GROUP
CONSULTING GEOTECHNICAL ENGINEERS

Robert Bein, William Frost and Associates
14725 Alton Parkway
Irvine, CA 92618-2069

January 14, 1998

97-1019

Attention: Scott Taylor

Subject: In-Drill Hole Permeability Tests at District 7 Altadena Caltrans Maintenance Station

Scott:

On January 13, 1998, The LKR Group (LKR) drilled a soil boring at the Caltrans District 7 Altadena Maintenance Station site in Los Angeles County, California. A 4-inch well was installed in a 10-inch boring to perform in-drill hole permeability tests. The drill site and boring number are listed as follows:

SITE LOCATIONS

Site Name	Location	City	Boring Numbers
Altadena M. S.	2122 N. Windsor Ave.	Altadena	B-7

Boring B-7 encountered Gravelly to Cobbly, fine- to coarse- grained Sand. A sample was taken at 5 feet with refusal on a cobble after driving 8-inches. The sample was disturbed and not representative of in-place material. The drilling stopped at 7 feet as the auger had refusal on a large cobble. The boring was moved approximately 4 feet and re-drilled to a total depth of 15 feet.

A 4-inch PVC well was installed from the ground surface to 13 feet. From 3 to 13 feet from the surface, a .040-inch wide (040) slot screened section was installed and gravel packed with medium aquarium gravel. The boring above and below the screened section was sealed with medium bentonite chips. The well was pre-saturated with potable water on January 13, 1998.

Since the boring was in sand and gravel and no ground water was encountered, this site was considered feasible for in-drill hole tests. Since the in-place material was gravelly to cobbly, no sample could be collected for laboratory testing. The in-drill hole permeability tests were performed 1 day after the pre-saturation on January 14, 1998. An average in-drill hole test yielded a permeability rate of **3.5×10^{-5} feet/s** or **1.1×10^{-3} cm/s** for the Altadena M. S. site. No laboratory tests will be performed for this site.

If you have any questions, please do not hesitate to contact **The LKR Group, Inc.** at (310) 320-5100.

THE L.K.R GROUP, INC.

Steven Kolthoff, Project Geologist

Cc: Tom Ryan

971019b7

GT-2

THE L·K·R GROUP
CONSULTING GEOTECHNICAL ENGINEERS

Robert Bein, William Frost and Associates
14725 Alton Parkway
Irvine, CA 92618-2069

January 12, 1998
* revised 1/20/98
97-1019

Attention: Scott Taylor

Subject: PermeabilityTest Interval Vs. Shallow Depth

Scott:

As requested **The LKR Group, Inc.** did further evaluations of permeability data collected for the two Cerritos, West Dale, Tarzana and San Fernando sites in District 7 to determine if it would be necessary to perform additional permeability testing at a shallower depth of 3 to 10 feet. The initial in-drill hole testing was conducted within the interval of 10 and 20 feet below the surface. Laboratory samples were taken at the 6, 10, 15 and 20 foot level. The following table summarizes the permeability rates for the in-drill hole and selected laboratory tests.

Site	Boring No.	In-Drill Hole Permeability (cm/s)	# Laboratory Permeability (Ave. cm/s)	Laboratory Permeability (cm/s)	Depth (in feet)
Cerritos M.S.	B-1	$7.5x10^{-5}$	$3.4x10^{-4}$	$9.5x10^{-4}$	6*
				$1.1x10^{-6}$	10*
				$4.4x10^{-7}$	15*
Cerritos	B-2	$1.6x10^{-4}$	$5.2x10^{-5}$	$9.9x10^{-5}$	6*
				$5.5x10^{-6}$	10*
West Dale	B-3	$4.4x10^{-8}$		Not ran	10 – 20**
Tarzana	B-4	$3.4x10^{-5}$	$8.0x10^{-6}$	$1.6x10^{-5}$	6*
				$4.4x10^{-9}$	10*
Tarzana	B-5	$3.3x10^{-6}$	$2.3x10^{-5}$	$4.3x10^{-5}$	6*
				$2.8x10^{-5}$	10*
				$6.6x10^{-7}$	15*
San Fernando	B-6	$7.5x10^{-8}$		Not ran	10 – 20**

Average permeability of the laboratory samples
* Depth of laboratory sample
** In-Drill hole test interval

In-drill hole and laboratory tests were performed as a tool to screen the sites for feasibility. In general, the in-drill hole tests were conducted in a designed water well in a bore hole above the water table. The top casing was left blank and the test interval from 10 to 20 feet was slotted and gravel packed. A bentonite seal on top and below the gravel pack insured that the side wall infiltration area would not change. With this method, water is added to the well. As the water falls down the blank section, it infiltrates along the gravel filled boring annulus for the complete length of the slotted interval. Since the falling water is not obstructed within the test interval, during the field test, the water can permeate freely through the gravel pack to all portions of the side wall not discriminating between fast or slow permeable layers. The final result will be somewhat of an average permeability of the side wall interval.

Selected 6-inch by 2.5-inch brass tube samples were tested in the laboratory. With this test, water is allowed to flow through the sample from top to bottom until saturated. After saturation, a falling head test is performed by measuring the time for a column of water to fall as it permeates through the sample. If the sample is layered, the different layers could have different permeability properties. The test results will reflect the layer with the slowest permeability.

After examining the samples and boring logs, at the Cerritos sites, B-1 encountered an olive brown fine-grained sandy silt fill from the surface to 3 feet. The surface material at B-2 was covered with organic mulch. Below the fill and mulch at both sites, B-1 and B-2, gray brown medium-grained sand was encountered from approximately 3 to 4 feet to 10 feet. Below 10 feet sandy silt to clayey silt was encountered.

At the West Dale site, B-3 encountered a sandy to clayey fill material to 20 feet. Below 20 feet, a dense silt or siltstone was encountered to 25 feet. Since the in-drill hole test revealed that the material from 10 to 20 feet had a slow permeability, laboratory tests were not ran on the tube samples.

Both Tarzana sites B-4 and B-5 encountered a clayey to silty sand in the upper 5 feet. Below 5 feet, the material became more granular. The permeability rates were slow with the in-drill hole test and slow to very slow with the laboratory tests.

The San Fernando site at B-6 encountered dense slity sandstone from below the parking area structural section to 21 feet. Since this site had slow in-drill hole permeability rates, laboratory tests were not performed on the tube samples.

At the Cerritos sites, based on boring log descriptions and laboratory grain size analysis, the sandy material was encountered from about 3 to 10 feet. From the surface to about 3 feet and from 10 feet to 30 feet, the material is sandy silt to clayey silt. This material will be less permeable than what was encountered in the 3 to 10 feet interval.

Given the variability of the actual site soil conditions and considering the proposed Cerritos sites, it is unlikely, in our opinion, that retesting at a shallower depth will significantly alter the in-drill hole test results. Since the site conditions are marginal at the Cerritos Maintenance Station, if further investigations are desired, a small scale prototype trench is recommended for testing.

At the Tarzana site, the upper 5 feet was low permeablity clayey sand. The West Dale and San Fernando sites had similar slow permeability material from the surface to the bottom of the in-drill hole test well.

If you have any questions, please do not hesitate to contact **The LKR Group, Inc.** at (310) 320-5100.

THE L.K.R GROUP, INC.

MDR by SK

Michael D. Reader, G.E. 2259
Project Manager

Steven H. Kolthoff, C.E.G. 1965
Project Geologist

Cc: Tom Ryan 971019-9a

THE L·K·R GROUP

CONSULTING GEOTECHNICAL ENGINEERS

PROJECT MEMORANDUM

ROBERT BEIN, WILLIAM FROST AND ASSOCIATES
14725 Alton Parkway
Irvine, CA 92618-2069

Date: 12/10/97
97-1019

Attention: Scott Taylor

Subject: **In-Drill Hole vs. Laboratory Percolation Rates for Selected District 7 Caltrans Sites**

Scott:

The in-drill hole permeability rates for the selected District 7 sites are finalized. The values are average rates measured in a 4-inch diameter well above the ground water table in the interval from approximately 10 to 20 feet below the ground surface.

Selected samples were collected in 6-inch by 2.5-inch brass tubes using a split tube sampler and driven with a hydraulic hammer at all sites. Since the in-drill hole permeability rates for West Dale and San Fernando sites were slow, laboratory tests were not performed on those laboratory samples. Samples from the Cerritos and Tarzana sites were transported to the laboratory where falling head permeability tests were conducted on samples taken at 6, 10 and 15 feet below the ground surface.

The laboratory permeability rates were compared with the aforementioned in-drill hole rates. At the Tarzana site, the average permeability rate at B-4 and the laboratory rate at 6 feet had similar values. At B-5, the laboratory percolation rate at 6 feet is a magnitude faster than the average permeability rates.

Since the in-drill hole permeability rates are close in value and magnitude to the laboratory rates at the 6-foot level, it is our opinion that new tests do not need to be performed at the same sites within the 5 to 15 foot interval.

If you have any questions, please do not hesitate to contact **The LKR Group, Inc.** at (310) 320-5100.

Respectfully Submitted,

THE L.K.R GROUP, INC.

Steven Kolthoff, Project Geologist

CC: Tom Ryan

971019-3

BOREHOLE AND LABORATORY PERMEABILITY RATES

SITE	BORING	BORE-HOLE PERMEABILITY	BORE-HOLE PERMEABILITY	LABORATORY PERMEABILITY	DEPTH
CERRITOS	B-1	$2.5x10^{-6}$ ft/s	$7.5x10^{-5}$ cm/s	$9.5x10^{-4}$ cm/s	6
				$1.1x10^{-6}$ cm/s	10
				$4.4x10^{-7}$ cm/s	15
	B-2	$5.4x10^{-6}$ ft/s	$1.6x10^{-4}$ cm/s	$9.9x10^{-5}$ cm/s	6
				$5.5x10^{-6}$ cm/s	10
WESTDALE	B-3	$1.4x10^{-8}$ ft/s	$4.4x10^{-7}$ cm/s		
TARZANA	B-4	$1.1x10^{-7}$ ft/s	$3.4x10^{-6}$ cm/s	$1.6x10^{-5}$ cm/s	6
				$4.4x10^{-9}$ cm/s	10
	B-5	$1.1x10^{-7}$ ft/s	$3.3x10^{-6}$ cm/s	$4.3x10^{-5}$ cm/s	6
				$2.8x10^{-5}$ cm/s	10
				$6.6x10^{-7}$ cm/s	15
SAN FERNANDO	B-6	$7.5x10^{-8}$ ft/s	$2.3x10^{-6}$ cm/s		

PROJECT MEMORANDUM

Robert Bein, William Frost and Associates
14725 Alton Parkway
Irvine, CA 92618-2069

Date: 12/8/97
97-1019

Attention: Scott Taylor

Subject: **Anticipated Geotechnical Properties at Selected Caltrans Maintenance Yards, District 7, California**

Scott:

As requested, here is a list of Caltrans sites in District 7 and the anticipated soil type, ground water depth and permeability properties. This data was derived from researching regional geology maps, ground water depth maps and the knowledge of the area only. No reconnaissance, site visits or field exploration were performed. Since this report is based on in-house research, if on site exploration is conducted, the geotechnical properties of each site could differ from the data as noted on the following table.

The anticipated soil types and permeability rates for the selected sites are explained in the following section. The anticipated permeability rates are relative from good, fair to poor depending on the site location and soil type.

1. Young alluvium – This sedimentary deposit should be less indurated than the other three soil types. The young alluvium deposits could range from a granular gravelly to cobbly sand near the foothills of the San Gabriel Mountains to sands and silts in the lower flood plains. In isolated areas, clay and dense silt deposits or layers could be encountered. Permeability rates should be good in the granular material but reduced to fair to poor if clays or dense silts are encountered.

2. Old alluvium – This material should be similar to the younger alluvium deposits but moderately indurated. Mild development of secondary mineral deposits, such as caliche, could be present. Increases in clay throughout the matrix and within mildly developed soil horizon are comon. This material should have fair to poor permeability rates.

3. Terrace – This material, in general, should consist of well indurated silty to clayey sediments with clayey soil horizons and well developed secondary mineral deposits. Isolated gravel and cobble horizons could be common throughout. Permeability rates, in this material, should range from fair to poor.

4. Bedrock – In the District 7 area, bedrock consists of crystalline granitic rock in the San Gabriel Mountains and sedimentary rock in the Los Angeles basin. The sedimentary siltstone, claystone and sandstone deposits are well indurated with cemented zones common. The granitic material should have poor permeability rates. If highly fractured, the permeability rates in the granitic rock could increase. Sedimentary rock deposits should range from fair to poor but in most cases, poor.

General water depths were estimated to be greater (>) or less (<) than the general base level. Base level was set at 50 feet below the ground surface unless the depth was known more accurately.

If you need any additional information, please feel free to contact The LKR Group, Inc. at (310) 320-5100.

Respectfully Submitted,

THE L.K.R. GROUP, INC.

Steven Kolthoff, Project Geologist

CC: Tom Ryan

971019-5

ANTICIPATED GEOTECHNICAL PROPERTIES AT SELECTED CALTRANS SITES

Caltrans Site	District	Region	Anticipated Soil Type	Anticipated Water Depth (feet)	Anticipated Permeability	Comments
Ventura Rd MS	7	#2W	n/a	n/a	n/a	
Garden St. SM	7	#2W	n/a	n/a	n/a	
Westwood MS	7	#2W	terrace	> 50 feet	fair/poor	Possible shallow perched water
Apple St. MS	7	#2W	old alluvium	< 50 feet	fair/poor	
West Dale MS	7	#2W	terrace/fill	>50 feet	poor	Drilled by LKR for this study
Sawtelle MS	7	#2W	terrace/alluvium	>50 feet	fair/poor	Possible old alluvium present
Tarzana	7	#2W	old alluvium	> 50 feet	fair/poor	Drilled by LKR for this study
Las Flores	7	#2W	bedrock	< 50 feet	poor	Numerous landslides in this area
Aviation MS	7	#2W	n/a	n/a	n/a	
Lebec MC	7	#3N	n/a	n/a	n/a	
Lancaster MS	7	#3N	n/a	n/a	n/a	
Newhall Reg. Off	7	#3N	alluvium/bedrx	< 50 feet	good/poor	Possible sedimentary bedrock present
Chilao MD	7	#3N	bedrock	unknown	poor	Crystalline granitic bedrock
Sheldon MS	7	#3N	n/a	n/a	n/a	
Buena Vista MS	7	#3N	young alluvium	< 50 feet	good	Coarse grained material
Altadena MS	7	#3N	young alluvium	> 50 feet	good	Coarse grained material
North Hollywood	7	#3N	young alluvium	< 50 feet	good/poor	
San Fernando MS	7	#3N	bedrock	< 50 feet	poor	Saugus Formation (sandstone), drilled by LKR for this study
Metro MS	7	#3N	alluvium/bedrx	> 50 feet	good/poor	
Alameda MS	7	#5S	young alluvium	> 50 feet	good/fair	
Florence MS	7	#5S	young alluvium	> 50 feet	good/fair	
Proposed Reg. Off	7	#5S	young alluvium	< 50 feet	fair/poor	Possible shallow perched water
Torrance MS	7	#5S	old alluvium	> 50 feet	fair/poor	
Artesia MS	7	#5S	n/a	n/a	n/a	
Long Beach MS	7	#5S	young alluvium	< 30 feet	good/fair	
Pacific Pl MS	7	#5S	young alluvium	< 50 feet	good/fair	
San Pedro MS	7	#5S	young alluvium	+/- 10 feet	good/fair	
Foothill MS	7	#4E	young alluvium	< 50 feet	good	Coarse grained material
Rosemead MS	7	#4E	young alluvium	> 50 feet	good/fair	
Pomona MS	7	#4E	young alluvium	> 50 feet	good/fair	Recent LKR project < 1 mile north of this site
Eastern Reg Off	7	#4E	young alluvium	> 50 feet ?	good/fair	
Humphrey St MS	7	#4E	n/a	n/a	n/a	
East LA MS	7	#4E	alluvium ?	< 50 feet ?	fair/poor	
Diamond Bar MS	7	#4E	bedrock	unknown	poor	
SP Crew Off	7	#4E	young alluvium	< 50 feet	good/fair	Caltrans As-Built LTB for Lakewood I-5
Bellflower MS	7	#4E	young alluvium	< 50 feet	good/fair	
Cerritos MS	7	#4E	young alluvium	> 30 feet	good	Drilled by LKR for this study
Willow MS	7	#4E	terrace	> 50 feet	fair/poor	

n/a - not applicable
bedrx - bedrock
? - queryed
< = less than
> = greater than

District 11

Geotechnical Notes

THE L·K·R GROUP
CONSULTING GEOTECHNICAL ENGINEERS

PROJECT MEMORANDUM

Robert Bein, William Frost and Associates
14725 Alton Parkway
Irvine, CA 92618-2069

Date: 12/29/97
97-1019B

Attention: Scott Taylor

Subject: **Anticipated Geotechnical Properties at Selected Caltrans Maintenance Yards, District 11, California**

Scott:

As requested, we have reviewed the list of Caltrans sites in District 11 for estimated soil or rock type, ground water depth and permeability properties. This data was derived from researching regional geology maps, ground water depth maps and the knowledge of the area only. No reconnaissance, site visits or field exploration were performed unless noted. Since this report is based on in-house research, the data should be used for rough estimates only, and if on site exploration is conducted, the geotechnical properties of each site could differ from the data as noted on the following table.

In general, the north county sites, along the coast, consists of poorly graded non-cemented **sandstones** in the topographic high areas and unconsolidated alluvium sands to silty sands in the low lying valleys, along rivers and lagoons. Coastal south county sites have a thick layer of very dense **conglomerate** with thick beds of sandstone. These sandstones are tight and usually cemented. Below the conglomerates is a thick dense sandstone. Valleys in the southern areas are usually filled with **alluvium** and/or river sands, gravels and cobbles. The east county region is within the **granite** rocks of the southern California batholith. The low lying areas to the east are usually veneered with weathered granite and/or alluvium.

The anticipated soil types and permeability rates for the selected sites are explained in the following section. The anticipated permeability rates are relative from good, fair to poor depending on the site location and soil type.

1. **Alluvium** – This sedimentary deposit should be less indurated than the other soil and rock types found in the low lying valleys, old river canyons and along the edge of lagoons. The alluvium deposits in the coastal areas of north county are usually sandy and derived from local sandstones. In the inland areas of the south county region, alluvium deposits have abundant cobbles and gravels that increase in sand content toward the coast. Alluvium in the east county region consists of sands to cobbles with clay. This material is usually derived from weathered granites.

Permeability rates should be good in the northern coastal areas, good to fair in the southern regions and fair to poor in the eastern regions. If the material is clayey, permeability rates should be poor.

2. **Bedrock** – Ranged from sedimentary sandstones and conglomerates in the north coastal and southern areas to granitic in the east. The sandstones in the north consist of a fine- to medium-grained poorly graded sand. This material is non-cemented and moderately indurated. The conglomerates in the southern regions are common on top of the elevated mesas. This material is usually hard and cemented with a tight grained matrix. Dense and hard sandstone beds are common within and underlying the conglomerate beds. To the east, hard granitic rock is common. The northern sandstones should have good to fair permeability rates. The conglomerates and associated units should have fair to poor and usually poor permeability rates due to the tight and cemented nature of the rock. The granitic material, if unfractured, could have poor permeability properties. The granitic rocks may have a good to fair permeability rate if fractured and if secondary mineralization or sediments are not present infilling the fractures.

General water depths were estimated to be greater (>) or less (<) than the general base level. Base level was set at 50 feet below the ground surface unless the depth was known more accurately.

If you need any additional information, please feel free to contact The LKR Group, Inc. at (310) 320-5100.

Respectfully Submitted,

THE L.K.R. GROUP, INC.

Steven Kolthoff, Project Geologist

CC: Tom Ryan

971019-b5.DOC

**ANTICIPATED GEOTECHNICAL PROPERTIES AT SELECTED CALTRANS SITES

Caltrans Maintenance Stations	District	Thomas Guide Number	Anticipated Soil Type	Anticipated Water Depth (feet)	Anticipated Permeability	Comments
Carlsbas MS	11	1126	Sandstone	> 50	good	Drilled by LKR for this study (non-cemented sandstone)
Chula Vista MS	11	1310	Alluvium	< 20	good/fair	Near the beach (possible beach deposits)
Camino Del Rio MS	11	1269	Alluvium	< 20	good/fair	Near the San Diego River (possible river terrace deposits)
Escondido MS	11	1129	Alluvium	3	n/a	Drilled by LKR for this study (old bog deposits)
Imperial MS	11	1289	Conglomerate	> 50	poor	Stadium Conglomerate and Sandstone (very dense)
Kearney Masa MS	11	1249	Conglomerate	> 50	poor	Stadium Conglomerate and Sandstone (very dense)
Otay MS	11	1350	Conglomerate	> 50	poor	Stadium Conglomerate and Sandstone (very dense)
Pacific Highway MS	11	1268	Alluvium	< 20	good/fair	Near the San Diego River (possible river terrace deposits)
Santee MS	11	1231	Granite/Alluvium	n/a	fair/poor	Granite could be weathered or fractured
Coronado Bridge M	11	1289	Alluvium	< 20	good	Possible beach or near shore deposits

**List Revised 1/15/98

n/a - not applicable

? - queryed

> = greater than

< = less than

THE L·K·R GROUP
CONSULTING GEOTECHNICAL ENGINEERS

Robert Bein, William Frost and Associates
14725 Alton Parkway
Irvine, CA 92618-2069

December 16, 1997

97-1019

Attention: Scott Taylor

Subject: In-Drill Hole Permeability Tests at Selected District 11 Caltrans Sites

Scott:

On December 11 and 12, 1997, The LKR Group (LKR) drilled, or attempted to drill, soil borings at selected Caltrans District 11 sites in San Diego County, California. If the conditions were favorable, 4-inch wells were installed in 10-inch borings to perform in-drill hole permeability tests. The drill sites and boring numbers are listed as follows:

SITE LOCATIONS

Site Name	Location	City	Boring Numbers
Carlsbad M. S.	6050 Paseo Del Norte	Carlsbad	SD-1
I-5 & Manchester	East and West Side	Encinitas	SD-2 & SD-3
San Dieguito River	East of I-5	San Diego	No public access*
Carmel Valley Road	I-5 and Sorrento V. Road	San Diego	Adverse terrain**
Kearny Mesa M. S.	7179 Opportunity Road	San Diego	SD-4
Escondido M. S.	1780 W. Mission Ave.	Escondido	SD-5
I-15 & SR-78	Interchange	Escondido	SD-6
La Costa	La Costa Ave. & I-5	Leucadia	WW-1 & WW-2

* No public access to drill site.
** Access was too adverse for conventional drill rig.

Carlsbad Maintenance Station

The first site (SD-1) was drilled at the south side of the Carlsbad Maintenance Station paved parking lot. The asphalt pavement encountered was 3-inches thick on top of 6-inches of aggregate base. One inch by 2.5-inch brass ring samples were taken at a depth of 3 feet, and 6-inch by 2.5-inch brass tube samples were taken at depths of 5, 10 and 15 feet below the ground surface. Below the aggregate base a light brown silty

fine- to medium-grained sandstone was encountered to a total depth of 15 feet. No ground water was encountered.

A 4-inch PVC well was installed from the ground surface to 15 feet. From 5 to 15 feet from the surface, a .040-inch wide (040) slot screened section was installed and gravel packed with medium aquarium gravel. The boring above and below the screened section was sealed with medium bentonite chips. A blank section of PVC was installed and sealed with medium bentonite chips in the top 5 feet of the well. The well was pre-saturated with potable water on December 11, 1997.

Since the boring was in sandstone and no ground water was encountered, this site was considered feasible for in-drill hole permeability tests. The in-drill hole permeability tests were performed 4 days after the pre-saturation on December 15, 1997. An average in-drill hole permeability rate of 2.8×10^{-4} feet/s or 8.7×10^{-4} cm/s was determined for the Carlsbad site.

I-5 and Manchester Interchange

The second and third sites (SD-2 and SD-3) were drilled in the northeast and northwest un-improved areas within the I-5 and Manchester on- off-ramps, north and adjacent to the San Elijo Lagoon. The drill site at SD-2 was on a non-vegetated disturbed area while SD-3 was in a grassy natural area. A 6-inch by 2.5-inch brass tube sample was taken in both borings at 5 feet below the surface. Both sites encountered a saturated light gray, fine- to medium-grained sand at approximately 5 feet or greater below the ground surface. Ground water was encountered in the bore holes at approximately 8 feet at SD-2 and approximately 7 feet at SD-3.

A 4-inch PVC 040 slot screened section was installed gravel packed with medium aquarium gravel from the ground surface to 5 feet. The bottom boring section was sealed with medium bentonite chips and top with concrete. No blank section of PVC was installed. The well was pre-saturated with potable water on December 11, 1997.

After the installation of the wells, the water levels were re-measured 4 days later on December 15, 1997. The ground water level in SD-2 at 9:00 AM was 3.75 feet and in SD-3 at 9:20 AM was 2.75 feet below the ground surface respectfully. Since the ground water levels were shallow, these sites were considered unfeasible for in-drill hole permeability tests.

San Dieguito River Area

At the San Dieguito River site, there was no public access. This site was not drilled.

Carmel Valley Road

At the Carmel Valley Road site, the access was too adverse for a conventional drill rig to access. This site was not drilled. The LKR Group, Inc. understands that this site will be drilled at a later time.

Kearny Mesa Maintenance Station

The Kearny Mesa Maintenance Station site (SD-4) was drilled at the west side of the yard on a paved area adjacent to I-805. The asphalt pavement encountered was 3-inches thick on top of 6-inches of aggregate base. Since the natural material encountered below the base was very hard, no samples were recovered. The natural material, logged from drill cuttings, consisted of a moist to dry reddish brown silty fine- to medium-grained sandstone. This material was encountered to a total depth of 15 feet. No ground water was encountered.

A 4-inch PVC well was installed from the ground surface to 15 feet. From 5 to 15 feet from the surface, a 040 slot screened section was installed and gravel packed with medium aquarium gravel. The boring above and below the screened section was sealed with medium bentonite chips. A blank section of PVC was installed and sealed with medium bentonite chips in the top 5 feet to the surface of the well. The well was pre-saturated with potable water on December 11, 1997.

Since the boring was in sandstone and no ground water was encountered, this site was considered feasible for in-drill hole permeability tests. The in-drill hole permeability tests were performed 4 days after the pre-saturation on December 15, 1997. An average in-drill hole permeability rate of 7.7×10^{-5} feet/s or 2.4×10^{-4} cm/s was determined for the Kearny Mesa site.

Escondido Maintenance Station

The Escondido Maintenance Station site (SD-5) was located along the central section of the west yard fence on a paved parking lot. The asphalt pavement encountered was 3-inches thick on top of 6-inches of aggregate base. Since the natural material encountered cobbles or large gravels, no samples were recovered. The natural material, logged from drill cuttings, consisted of a moist to wet gray to dark brown silty to clayey fine-grained micaceous sand to gravelly to cobbly sand. This material was encountered to a total depth of 20 feet. Ground water was encountered in the bore hole at approximately 8 feet.

A 4-inch PVC 040 slot screened section was installed and gravel packed with medium aquarium gravel from the ground surface to 5 feet. The boring bottom section was sealed with medium bentonite chips and top with concrete. No blank section of PVC was installed. The well was pre-saturated with potable water on December 12, 1997.

After the installation of the well, the water level was re-measured 3 days after pre-saturation on December 15, 1997. The well was silted up to 3 feet from the surface. This indicates that the water level is approximately 3 feet from the surface. Since the ground water level was shallow, this site was considered unfeasible for in-drill hole permeability tests.

I-15 and SR-78 Interchange

At the I-15 and SR-78 interchange between the SR-78 east bound to I-15 north and south off-ramps the site (SD-6) was drilled 6 to 8 feet above a small basin. The first 6 feet of drilling encountered large gravel to boulder size fill material with a clayey to silty sand matrix. Below the fill, natural material encountered consisted of a moist to wet dark gray clayey to silty fine- to coarse-grained sand (disintegrated granite, D G) to a total depth of 30 feet. At 25 feet, weathered granitic rock was encountered. Ground water and fresh granitic rock was encountered at 30 feet.

Since the boring was drilled above the proposed basin level, a 4-inch PVC well was installed from 20 feet to the ground surface. From 20 to 10 feet from the surface, a 040 slot screened section was installed and gravel packed with medium aquarium gravel. The boring above and below the screened section was sealed with medium bentonite chips. A blank section of PVC was installed and sealed with medium bentonite chips in the top 10 feet to the surface of the well. The well was pre-saturated with potable water on December 12, 1997.

Since the boring below 6 feet was in natural material and weathered bedrock and ground water was below the well bottom, this site was considered feasible for in-drill hole permeability tests. The in-drill hole permeability tests were performed 3 days after pre-saturation on December 15, 1997. An average in-drill hole permeability rate of 7.5×10^{-7} **feet/s** or 2.4×10^{-5} **cm/s** was determined for this Escondido site.

I-5 South La Costa Avenue Off-ramp

On December 12, 1997 in the late afternoon, two shallow borings 50 feet apart were drilled west of the I-5 south La Costa Avenue off-ramp in a grassy natural area south of the Batiquitos Lagoon. During the time of drilling, it was noticed that the tidal level was low in the Bastiquitos Lagoon. The borings were excavated to determine approximately where ground water was located and not to determine average in-drill hole permeability rates or to collect samples for laboratory testing.

Boring WW-1 encountered approximately 5 feet of silty to clayey sandy fill. Below the fill, a light gray fine-grained sand with a mild sulfur smell was encountered to 15 feet below the surface. In the boring, the ground water level was measured at approximately 8 feet.

Boring WW-2 was drilled 50 feet to the south of boring WW-1. The upper section encountered approximately 5 feet of silty to clayey sandy fill. Below the fill, a light gray fine-grained sand was encountered to 10 feet below the surface. In the boring, the ground water level was measured at approximately 9 feet.

Both borings were backfilled with medium bentonite chips and allowed to hydrate with natural moisture.

A report will be written to present the final data. At that time, the data will incorporate the laboratory tests and the final field test data.

If you have any questions, please do not hesitate to contact **The LKR Group, Inc.** at (310) 320-5100.

THE L.K.R GROUP, INC.

Steven Kolthoff, Project Geologist

Cc: Tom Ryan

971019-7

THE L·K·R GROUP
CONSULTING GEOTECHNICAL ENGINEERS

PROJECT MEMORANDUM

ROBERT BEIN, WILLIAM FROST AND ASSOCIATES
14725 Alton Parkway
Irvine, CA 92618-2069

Date: 12/22/97
97-1019 B

Attention: Scott Taylor

Subject: **Preliminary Laboratory Permeability Rates for the Carlsbad M. S. and Manchester and I-5 Sites District 11 Caltrans Sites**

Scott:

Here are preliminary permeability rates and laboratory data for the Carlsbad M.S. and Manchester I-5 east and west sites.

TABLE OF LABORATORY RESULTS

Boring Number	Depth (ft)	Moisture Content (%)	Dry Density (pcf)	Permeability
SD-1	5'	3.9	104.6	1.7×10^{-7} ft/s
				5.2×10^{-5} cm/s
	10'	6.5	96.2	1.9×10^{-6} ft/s
				5.8×10^{-5} cm/s
	15'	1.6	98.7	4.9×10^{-6} ft/s
				1.5×10^{-4} cm/s
SD-2	5'	16.5	108.4	1.9×10^{-7} ft/s
				5.9×10^{-6} cm/s
SD-3	5'	16.0	110.1	3.0×10^{-7} ft/s
				9.2×10^{-6} cm/s

The average permeability, for the Carlsbad M. S., was 2.3×10^{-6} ft/s, (7.1×10^{-5} cm/s) for all the laboratory samples tested. The average in-drill hole permeability for this site was 2.8×10^{-6} ft/s (8.7×10^{-4} cm/s). The laboratory average was slightly slower than the in-drill hole average. The laboratory permeability rates for Manchester & I-5 east and west are as noted on the table for SD-2 and SD-3. No in-drill hole tests were performed.

If you have any questions, please do not hesitate to contact The LKR Group, Inc. at (310) 320-5100.

Respectfully Submitted,

THE L.K.R GROUP INC.

THE L·K·R GROUP
CONSULTING GEOTECHNICAL ENGINEERS

PROJECT MEMORANDUM

ROBERT BEIN, WILLIAM FROST AND ASSOCIATES
14725 Alton Parkway
Irvine, CA 92618-2069

Date: 12/18/97
97-1019

Attention: Scott Taylor

Subject: **Preliminary Laboratory Permeability Rates for Selected District 11 Caltrans Sites**

Scott:

Here are preliminary permeability rates and laboratory data for the I-15 / SR-78 site in Escondido.

TABLE OF LABORATORY RESULTS

Boring Number	Depth (ft)	Moisture Content (%)	Dry Density (pcf)	Permeability
SD-6	10'	12.4	120.4	4.9×10^{-6} ft/s
				1.5×10^{-6} cm/s
	12'	7.8	134.2	3.1×10^{-6} ft/s
				9.5×10^{-7} cm/s
	20'	8.2	117.5	1.2×10^{-7} ft/s
				3.7×10^{-6} cm/s
	25'	14.4	114.0	7.2×10^{-7} ft/s
				2.2×10^{-6} cm/s

The average permeability was 4.6×10^{-7} ft/s, (7.0×10^{-6} cm/s) for all the samples and 6.7×10^{-6} ft/s, (2.0×10^{-6} cm/s) for the samples taken within the test interval from 10 to 20 feet. The average in-drill hole permeability for this site was 7.5×10^{-7} ft/s (2.4×10^{-6} cm/s).

If you have any questions, please do not hesitate to contact **The LKR Group, Inc.** at (310) 320-5100.

Respectfully Submitted,

THE L.K.R GROUP, INC.

THE L·K·R GROUP, INC. 2041 W. 205th St. Suite 103 Torrance, California 90501-1437 310/320-5100 fax. 310/320-2110

District 7

Maintenance Station Field Notes

Caltrans

I

BMP FIELD INVESTIGATION FORM

Date: 10/3/97	**District:** 7	**Field Representative:** TR

Location: Alameda (MS)

Possible BMP Method(s):

- Oil water Sep. · Swale · Insert
- Tarch. · Strip.

Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
2	Y	1-3%	N	—	Sheet - Swale	1) drop inlet 2) sheet off side	—

Other considerations: ***Proximity to water wells, bedrock location, water table depth, distance to foundations.***

Field Notes:

- Best site for Oil/Grease · Multi Cross
- Drop inlet catches ~ 70% runoff
- 4 downdrains onsite
- 50'. bridge cover
- All employee cars parked under bridge
- All heavy vehicles (2/5) parked in exposed area.

Caltrans

BMP FIELD INVESTIGATION FORM

Date: 10/9/97	**District:** 7	**Field Representative:** TR

Location: Altadena MS

Possible BMP Method(s):

- Oil/Water Sep.
- Trench
- Swale
- Insert

Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
4	4	1-3%	Y	—	Swale (sheet)	Offsite (but within Caltrans ROW)	—

Other considerations: ***Proximity to water wells, bedrock location, water table depth, distance to foundations.***

Field Notes:

- 100% exposed
- major swale runoff
- good cond. for oil/water Sep.
- Hwy 9ft ± (20)
- Multi Crew
- No brm on asphalt storage
- haybails infront of fence before Qout
- Several Workers (~ 25+)
- Next to CHP
- Possible for inerts (other side of fwy)
- Sediment found in d/s swale.

Caltrans

BMP FIELD INVESTIGATION FORM

Date: 10/3/97	**District:** 7	**Field Representative:** TR

Location: Apple Street (MS)

Possible BMP Method(s):

- Oil wat sep. (?)
-

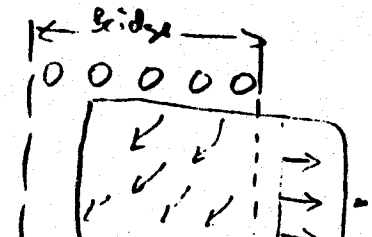
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3/4	None	1-10%	N	—	Sheet	Single Curb Inlet	—

Other considerations: *Proximity to water wells, bedrock location, water table depth, distance to foundations.*

Field Notes:

- 3 pillar runoffs
- Heavy rgt covered by bridge
- No apparent oil leakage.



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BMP FIELD INVESTIGATION FORM

Date: 10/30/97	District: 7	Field Representative: TR

Location: Artesia Landscape MS

Possible BMP Method(s):

- /
- Basin

N

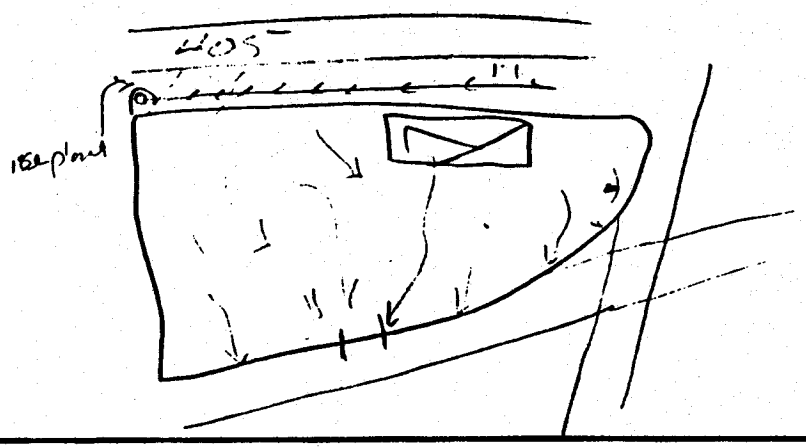
Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
1 one						Sheet		100%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

- Closing station (May)
- sheet flow off site to street curb
- Closing site (next yr.)



BMP FIELD INVESTIGATION FORM

Date: 10/2/97 **District:** 7 **Field Representative:** TR

Location: Aviation MS.

Possible BMP Method(s):

- Oil Wat Sep.

Checklist

Tributary Area	Space Available ~~(Dim.)~~	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
1	small	1-2%	N	—	Sheet & swale	offsite curb inlet	—

Other considerations: *Proximity to water wells, bedrock location, water table depth, distance to foundations.*

Field Notes:

- 90% covered by bridge
- 80% asphalt 20% dirt
- No visual oil leakage
- Not many employees
- Receive a lot of pillar down drain runoff.

BMP FIELD INVESTIGATION FORM

Date: 10/2/97 | **District:** 7 | **Field Representative:** TR

Location: Buena Vista (Landscape Yard) MS

Possible BMP Method(s):

- Nothing

Checklist

Tributary Area (acre)	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3/4	OK	1-2% all directions	N	—	Sheet	offsite street curb	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- Too small and clean for any BMP!
- 100% covered by bridge

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BMP FIELD INVESTIGATION FORM

Date: 10/2/97 **District:** 7 **Field Representative:** TR

Location: Central (Special Crews Office) MS

Possible BMP Method(s):

- Swale, Trench
- Inlet
- Oil Water Sep.

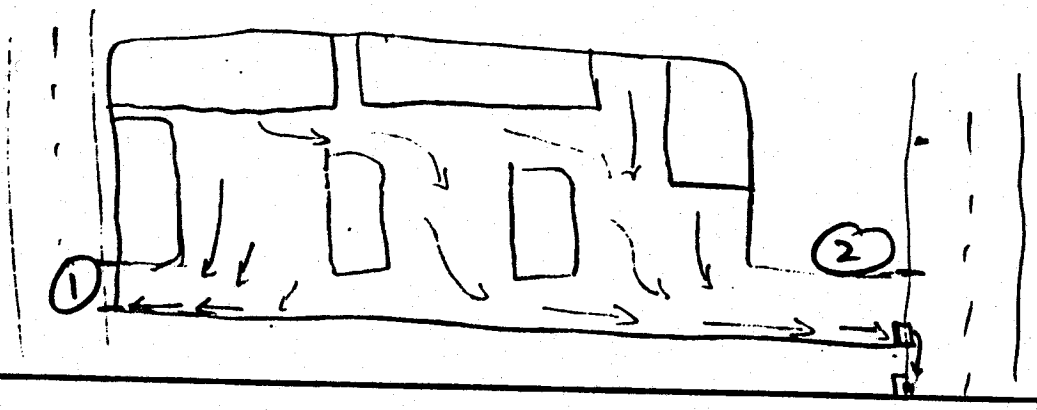
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
5 acres	OK	1%-2%	N	—	sheet - Swale curb.	curb inlet	—

Other considerations: ***Proximity to water wells, bedrock location, water table depth, distance to foundations.***

Field Notes:

- 100% exposed
- yard (ns) connected to other yards (est yard)
- Very clean
- Good sampling locat.
- 90% runoff goes out #(2)
- Multi crew operation
- most vehicle are covered.



BMP FIELD INVESTIGATION FORM

Date: 10/30/97	District: 7	Field Representative: TR
Location: Next to Century MIS (Park & Ride)		

Possible BMP Method(s):

- insert
- media filter
- trench
- swale grassy

Y

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
2		< 3%	N	Clayey	Grate	Just Swale & grate		50%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

- 20 cars @ 9:30 AM.
- One main swale running to drain.
- New site, not much oil
- 90% covered.
- May receive down drain runoff from adjacents.

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BMP FIELD INVESTIGATION FORM

Date: 10/30/97	District: 7	Field Representative: TR
Location: Century MS (Not built yet) May '98		
Possible BMP Method(s):		

N

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
? 10acm	?	?	?		?	?	?	70%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

- Huge & nice facility
- Surrounding areas may be good for BMP locations
- Bridge column downdrains
- Get Plans.

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BMP FIELD INVESTIGATION FORM

Date: 10/27/97	**District:** 7	**Field Representative:** TR

Location: Corridor (2nd Visit)

Possible BMP Method(s): (3)

- Area(1): trench, area behind MS.
- Area(2): Swale, between onramps ? 605
- Area(3): Basin (Clearcreek)

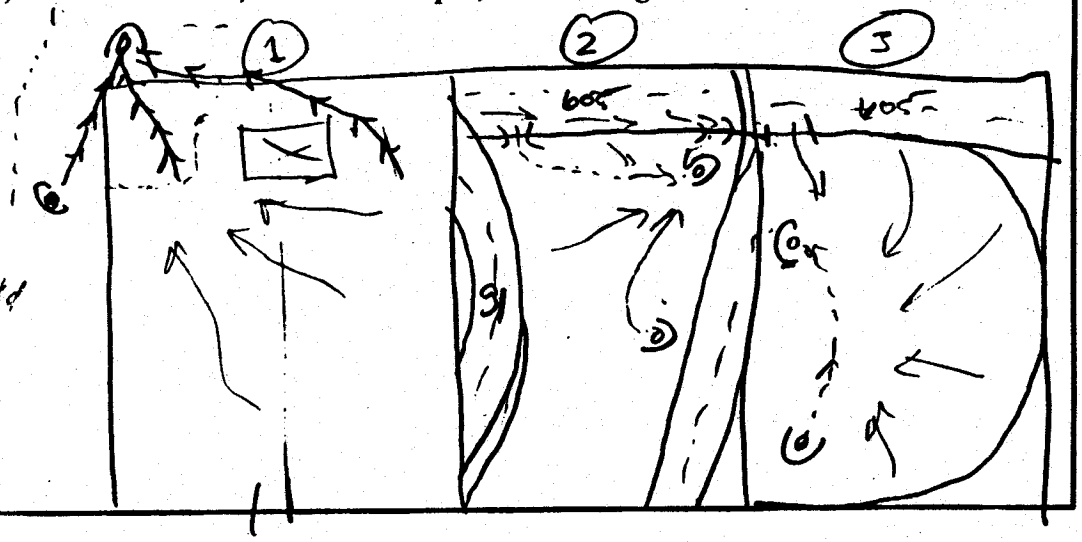
Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
- 1 acre - 2 acre - 2 acre		1) 2) 5% 3)	Y	Silt	(1) culvert (2) culvert (3) culvert	swale/sheet - -		100%

***Other considerations:** Proximity to water wells, bedrock location, water table depth, surrounding land uses.*

Field Notes:

- Good place for a trench or combo trench + swale or strip, Behind MS.
- Most 90% of runoff is divided to backside of lot to a culvert inlet.
- ~5 heavy vehicles
- 1 or 2 workers at site.



BMP FIELD INVESTIGATION FORM

Date: 10/9 **District:** 7 **Field Representative:** DR

Location: Diamond Bar

Possible BMP Method(s):

- Trash
- Oil wat/sep.

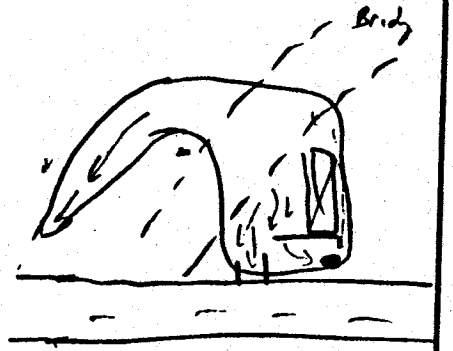
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
2	?	1-6%	Y	—	Sheet. Swale	culvert → street	0

Other considerations: *Proximity to water wells, bedrock location, water table depth, distance to foundations.*

Field Notes:

- 90% exposed
- Bridge w/ one downdrain
- Flow: 90% → driveway to street gutter
  10% → Swale – sidewalk – street gutter
- Not good sampling local
- 10-15 employees
- Must redirect flows if retrofit
- ≈ 15 heavy eqt. on site.



BMP FIELD INVESTIGATION FORM

Date: 10/3	District: 7	Field Representative: TR
Location: East LA. (MS)		
Possible BMP Method(s): . Oil/water Sp.		

Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
1	N	2%	N	—	Sheet · curb	Onsite curb	—

Other considerations: ***Proximity to water wells, bedrock location, water table depth, distance to foundations.***

Field Notes:

- 30% covered by bridge
- No onsite drains —
- Several - heavy sgt. (~20)
- Not good site for sampling
- Oil spots found.
- good place for oil & grease
- Multi Crew

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BMP FIELD INVESTIGATION FORM

Date: 10/9	**District:** 7	**Field Representative:** TR

Location: East Region (MS)

Possible BMP Method(s):

- Insert
- Oil Wat/Sep.
- I Trench

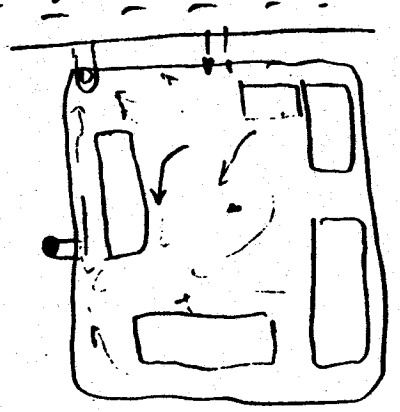
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3+	Y.	1%	N	Clay	Sheet Swale	Drop inlet outside fence.	—

Other considerations: ***Proximity to water wells, bedrock location, water table depth, distance to foundations.***

Field Notes:

- 80% → drop inlet (side of yard)
  20% → culvert pipe) (front of yard) } Runoff V
- Clean operation
- 100% exposed
- 10+ large Vehicles onsite
- 8+ employees
- Difficult water sampling location
- multi crew
- No berm on asphalt
- Room for construction



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BMP FIELD INVESTIGATION FORM

Date: 10/27/97	District: 7	Field Representative: TR

Location: Florence

Possible BMP Method(s):

- None recomended

N

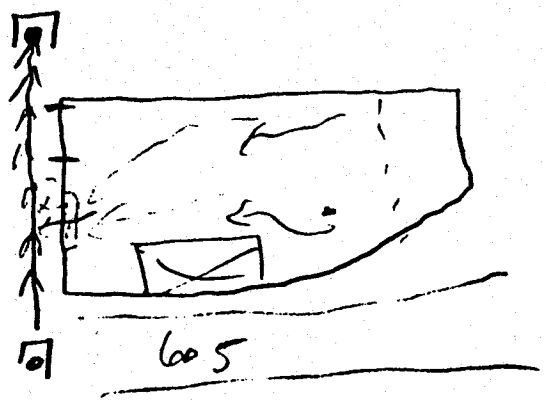
Checklist

Tributary Area (Ac)	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
1	—	-	Y	Sandy	Sheet to V-ditch	sheet		100%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

- ½ asphalt, ½ dirt cover
- only one Concentration pt.
- Not enough generated flow to worry - small site
- Not many heavy vehicles.



BMP FIELD INVESTIGATION FORM

Date: 10/9	**District:** 7	**Field Representative:** TR

Location: Foothill (MS)

Possible BMP Method(s):

- Oil/wat Sep.
- Inserts

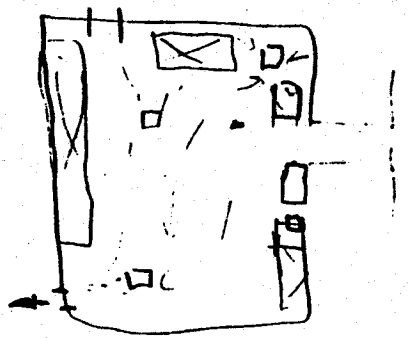
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3	OK	1-5%	Y	—	Street - Inlet - pipe	drop inlet	4

Other considerations: ***Proximity to water wells, bedrock location, water table depth, distance to foundations.***

Field Notes:

- Sediment from trucks & storage on lower end of site.
- 4 onsite inlets
- 60% at lower drain - Multi crew opp.
- No burn or smat storage
- Great for Inserts
- Several Workers (15)
- Several Heavy Vehicles (~20)



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BMP FIELD INVESTIGATION FORM

Date: 10/9	District: 7	Field Representative: TR

Location: Long Beach

Possible BMP Method(s):

- Oil Water Separator
- I Trench

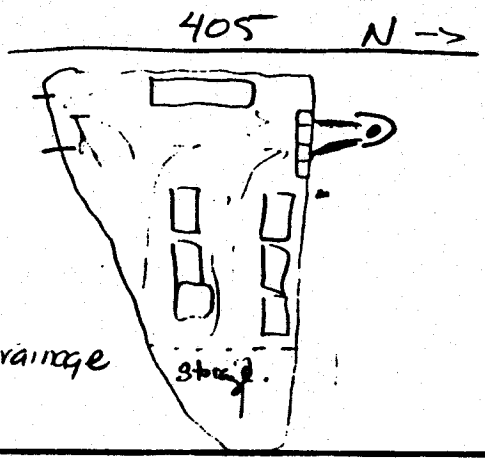
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
2	None!	1%	Y	—	Sheet	offsite culvert	—

Other considerations: ***Proximity to water wells, bedrock location, water table depth, distance to foundations.***

Field Notes:

- No room for anything!
- Oil spots were seen.
- Sediment found in downstream sump.
- Poor maintenance of control area
- Not a good site for BMP Potentials – space, offsite drainage in RR right-of-way,



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BMP FIELD INVESTIGATION FORM

Date: 10/2/97 **District:** → **Field Representative:** TR

Location: Metro MS

Possible BMP Method(s):

- Oil Wtr Sp
- Inf Trench
- Insert

Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
1½	—	1-2%	N	—	Sheet - 40% Swale - 60%	V-ditch storage, drop inlet	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

1 Drop inlet → insert possible.

- 45% exposed
- Site receives direct overhead frwy. runoff via pillar downdrains (20)
- Several heavy vehicle (~20)
- Multidept. crews
- Good sampling locations

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BMP FIELD INVESTIGATION FORM

Date: 10/30/97	**District:** 7	**Field Representative:** TR

Location: Pacific Place (landscape MS)

Possible BMP Method(s):

- Inf. Trench, ✓ Media Filter Either

Y

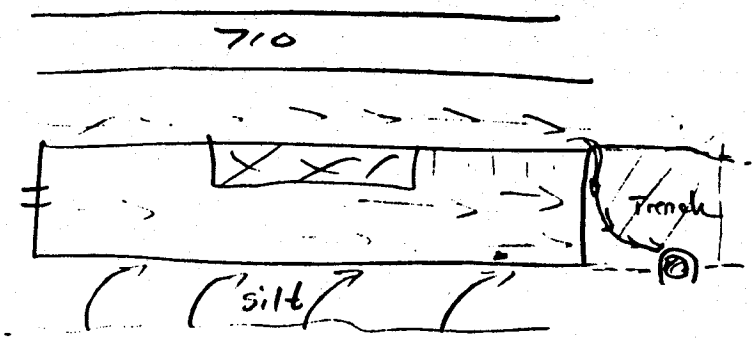
Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
½ acre	40' x 100"	~3%	Y	Sandy	channelized flow	Sheet & Swale	N	100%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

- Site is clear
- D/S end of site is covered w/ iceplant ∴ may be good place for trench.
- 6 trucks + 3 heavy vehicles + 2 employee cars -
- Tarp peaks at MS location ∴ no good to divert heavy flow



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BMP FIELD INVESTIGATION FORM

Date: 11/2 **District:** 7 **Field Representative:** TR

Location: Pomona (MS) Electrical + Landscape

Possible BMP Method(s):

- Trench

Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
1½	Yes	1%	Y	—	Sheet	Offsite curb	—

Other considerations: *Proximity to water wells, bedrock location, water table depth, distance to foundations.*

Field Notes:

- Heavy Vehicles ~ 5
- Employees ~ 5
- 15 cars parked onsite
- Dirt swale catches some runoff
- Not good Oil/Wat Sep. site
- Not much happening onsite

BMP FIELD INVESTIGATION FORM

Date: 10/9 **District:** 7 **Field Representative:** TR

Location: Rosemead (115)

Possible BMP Method(s):

- Insert
- Oil/Water Sep.

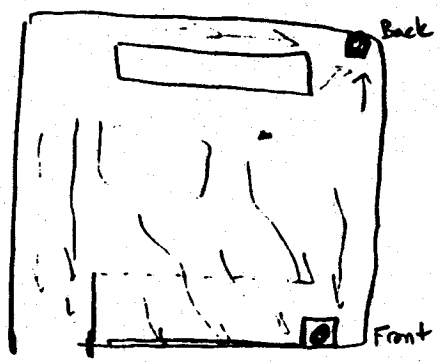
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
1 1/2	Y	1-2%	N	—	Sheet. Curb.	drop in GB (2)	2

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- lower (front) drop inlet receives ~60% of $Q_{TOT.}$
- upper (back) " " " ~20% " "
- Bad sampling site (Oil Wat)
- ≤ 5 employees
- ≤ 10 large vehicles onsite
- New, clean facility



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BMP FIELD INVESTIGATION FORM

Date: 10/30/97 **District:** 7 **Field Representative:** TR

Location: Route 47 Bridge Crossing MS (Under Vincent Thomas Bridge) (Terminal Island)

Possible BMP Method(s):

- Insert

N

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
1 acre	-	-	-	Sandy soil	1 grate drop inlet	Sheet Swale	?	90%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

- Currently under reconstruction
- 1 drop inlet located onsite
- Runoff unknown.
- Surrounded by railroads ; Industry
- Get Plans

BMP FIELD INVESTIGATION FORM

Date: 10/2/97	District: 7	Field Representative: TR
Location: San Fernando MS (Also Look @ 11/12 Notes)		

Possible BMP Method(s):

- Dil Water
- strip swale
- Trench

Multi-BMP possibilities

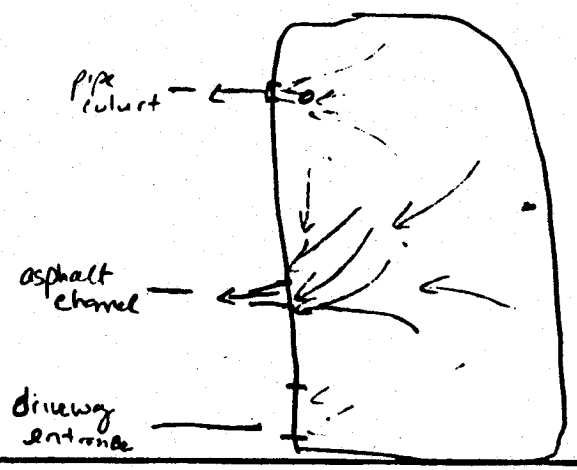
Checklist

Tributary Area (acres)	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3	Enough	1-5%	Y	—	Sheet, swale pipe	culvert outlet, sheet	—

Other considerations: ***Proximity to water wells, bedrock location, water table depth, distance to foundations.***

Field Notes:

- No d/s storm drain w/in 1000'
- 100% exposed area
- Upper area - pipe outlet to street (no curbs)
- Several Heavy wheeled eqt. (2-20)
- 3 main runoff outlets.



BMP FIELD INVESTIGATION FORM

Date: 11/12 | **District:** 7 | **Field Representative:** TR

Location: San Fernando MS

Possible BMP Method(s):

- Swale
- Trench] both

2Y

Checklist

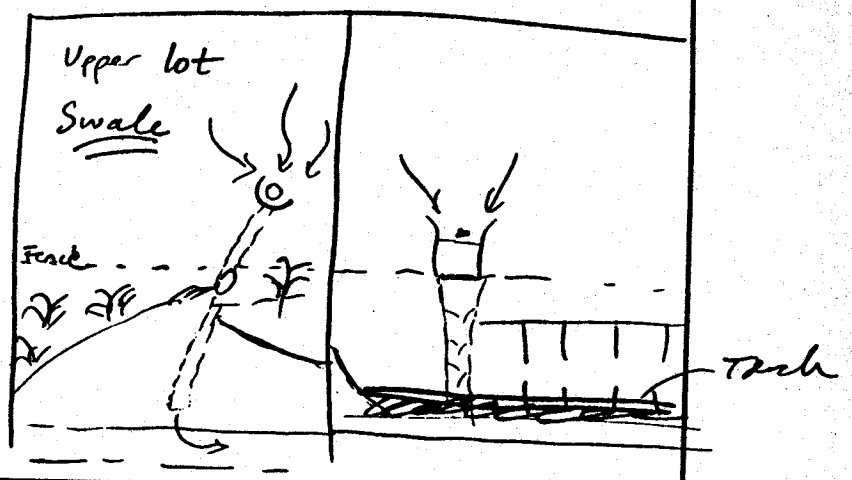
Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
T- 2½	120' x ?'	~0'	Y	Sndy Clay	Swale	—	Y	Y
S-	80' x 80'	2-1'			pipe	—		Y

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

Trench: parking lot area. Need to make
1) long trench (120' x 10') :
2) could also take parking lot out (½)
3) Need to stabilize sedimentation

Swale: 60' long inlets wind around.
- all grassed area.
- Sediment a pobin



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BMP FIELD INVESTIGATION FORM

Date: 10/3/97	**District:** 7	**Field Representative:** DR

Location: Sawtelle (MS)

Possible BMP Method(s):

- None

Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3/4	—	1%	N	—	Sheet Swale	2 Type G curb inlets	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- 90% bridge cover
- No oil spots
- Flow in all directions
- Not Good SITE FOR RETROFIT – covered, flowpaths, usage, space

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BMP FIELD INVESTIGATION FORM

Date: 10/2/97	District: 7	Field Representative: TR
Location: TAREANA. MS		

Possible BMP Method(s):

- Trench — strip or swale
- Oil Water Sep.

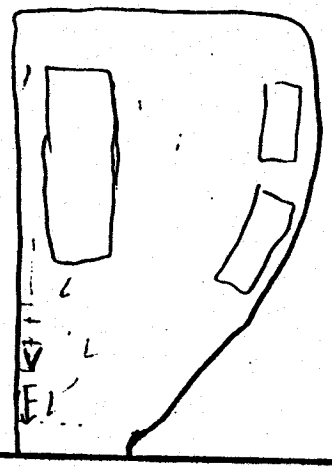
Checklist

Tributary Area	Space Available ~~(Dim.)~~	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3	OK	1%	N	?	Street + curb.	curb → street	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- 100% uncovered
- multi crew yard
- Several vehicles ~ 15
- Only outlet is through the fence



Caltrans

BMP FIELD INVESTIGATION FORM

Date: 10/30/97	**District:** 7	**Field Representative:** TR

Location: Torrance MS (1810 Baily Dr.)

Possible BMP Method(s):

- Infilt. trench

N

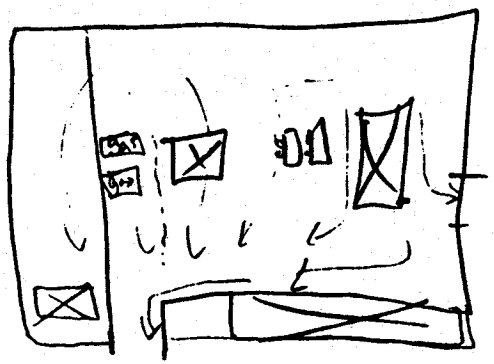
Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
2	20' x 60'	< 2%		Silty clay	curb & gutter	Sheet	Asphalt Removal	100%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

- Residential Area.
- 90% flow out front gate.
- Out flow area has room for BMP.
- Some sediment build up in Gut 1/4".
- >10 vehicles.



BMP FIELD INVESTIGATION FORM

Date: 10/3/97	District: 7	Field Representative: TR

Location: Westwood (MS) Electrical yard

Possible BMP Method(s):

- Trench (Inf.)
- Swale

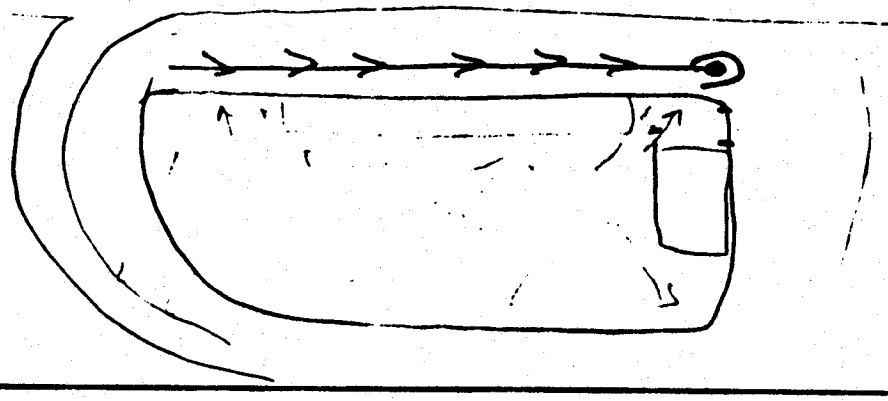
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3/4	4.	1%	N	—	Sheet	Sheet runoff to street c.i.b.	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- Swale in back of lot
- Room for construction
- Sump in mid lot
- 100% exposed



BMP FIELD INVESTIGATION FORM

Date: 10/3/97	District: 7	Field Representative: TR

Location: Westwood (MS) Electrical yard

Possible BMP Method(s):

- Trench (Inf.)
- Swale

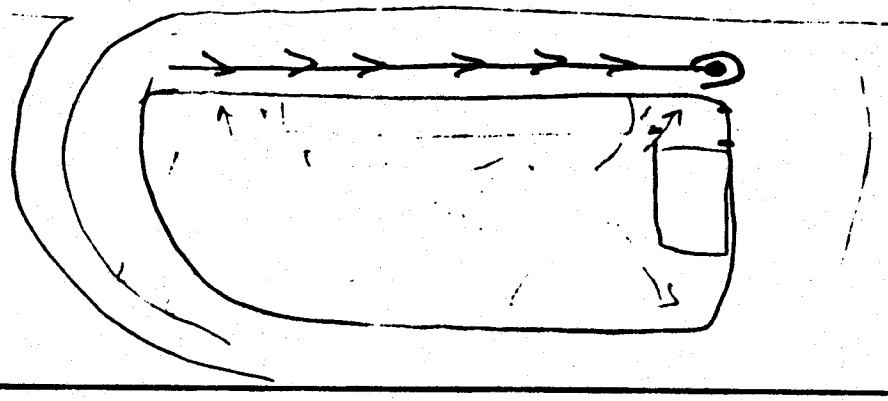
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3/4	4.	1%	N	—	Sheet	Sheet runoff to street c.i.b.	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- Swale in back of lot
- Room for construction
- Sump in mid lot
- 100% exposed



Caltrans

BMP FIELD INVESTIGATION FORM

Date: 10/2/97 **District:** 7 **Field Representative:** TR

Location: Westdale MS

Possible BMP Method(s):

- Inf. Trench + Swale
- Oil wat. Sep.

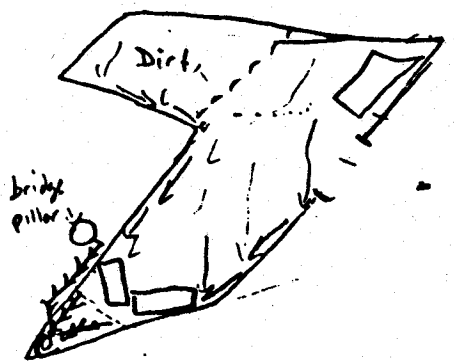
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
1½	Plenty in back of lot	1%	Y	~	Sheet Swale	offsite culvert	1

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- 80% asphalt + 20% dirt lot.
- 10% under bridge
- No apparent oil leakage
- Asphalt Emulsion drum not contained on dirt lot.
- May not always be staffed
- Good sampling possibilities



Caltrans

BMP FIELD INVESTIGATION FORM

Date: 10/30/97	District: 7	Field Representative: TR

Location: Willow Elect. MS.

Possible BMP Method(s):

- None recommended

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
1.5	—	—	—	—	N	Sheet	—	40%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

- Full electrical yard
- Under 405 Fwy, mostly covered
- No heavy equipment

Caltrans

110 | 734 BI @ 7491

BMP FIELD INVESTIGATION FORM

Date: 12/12/97 **District:** 7 **Field Representative:** R Watson

Location: Artesia Transit Center

Possible BMP Method(s): 110/91

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure 95+
10 ac	yes	2E		?	Street Cm. Swale Curb	Swale curb		

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

Drop Inlets ~~[illegible]~~ 6m+ southend ('~~fo~~ Invert TTK inlets 2m '97) + curb inlet almost empty Opened '97) separate for Bus drop off near Train stop, park & ride lot

25 Cars @ 13:57

Caltrans

105

BMP FIELD INVESTIGATION FORM

7/09/07

Date: 12/12 **District:** 7 **Field Representative:** R. Watson

Location: I 105 Avalon Park & Ride Pl

Possible BMP Method(s):

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
½ AC		2/3%	N	?	sheet	sheet over		100%

* *Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.*

3/4 AC

Field Notes:

E Lot empty (about 40 spaces
Curbed – drains to under side walk drain to st

W Lot 60 spaces 1 Veh
Some dirt

(Viewed w/ R. Horne earlier)

District 11

Maintenance Station Field Notes

Caltrans

OIL/WATER SEPARATOR FIELD INVESTIGATION FORM

Date: 10/21/97 | **District:** 11 | **Field Representative:** Tom Ryan

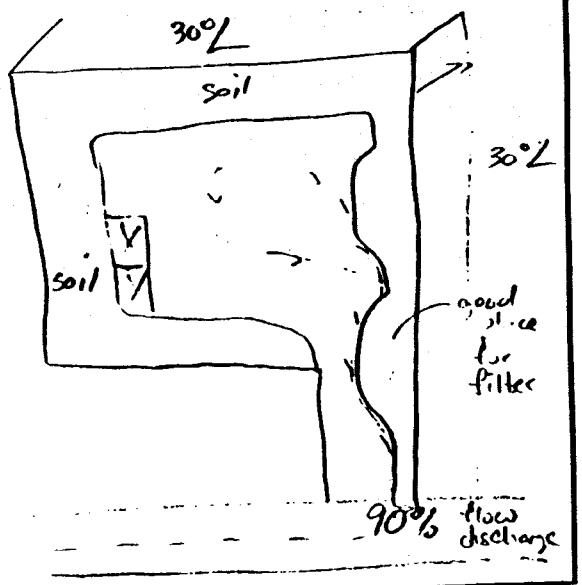
Location: CARLSBAD MS

Checklist

Est. # Heavy Vehicles	Asphalt Containment	Oil Waste Storage	Flow Path	Site Exposure	Onsite Drainage	Access	Traffic Safety
25+	Small empty tanks	no major oil Storage	gutter & street curb	100%	No	Great	OK

Field Notes:

- A = 5 acres
- ~25 employee cars
- soil => clays, cracked asphalt surface
- not much onsite slope
- tire storage observed
- Urban industrial area
- multi car yard
- gravel sump pit



Caltrans

BMP FIELD INVESTIGATION FORM

Date: 10/24/17	**District:** 11	**Field Representative:** TB

Location: Camino Del Rio E

Possible BMP Method(s):

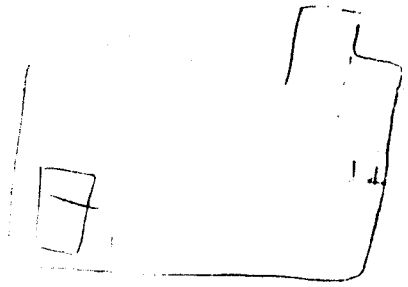
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
N/A							
1/2	✓	1-2%	✓	—	Sheet	None	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- [illegible]
- Not many large [illegible]
- No [illegible]
- No large sized [illegible]
- Landscape area



BMP FIELD INVESTIGATION FORM

Date: – **District:** 11 **Field Representative:** TR

Location: [illegible]

Possible BMP Method(s):

- [illegible]

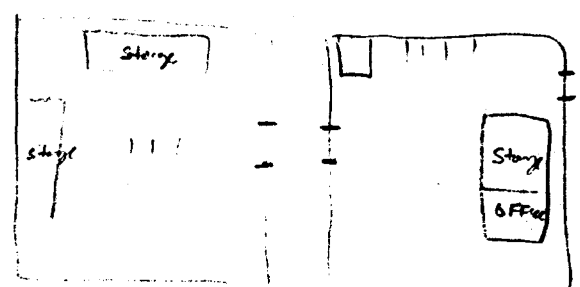
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
2	4	1-2%	—	—	[illegible]	[illegible]	—

Other considerations: ***Proximity to water wells, bedrock location, water table depth, distance to foundations.***

Field Notes:

- No large [illegible] storage
- Mostly sheet flow in [illegible] drains.
- Landscape Area
- No [illegible]
- Doesn't [illegible]



Caltrans

OIL/WATER SEPARATOR FIELD INVESTIGATION FORM

Date: 10/21/97 | **District:** 11 | **Field Representative:** TR

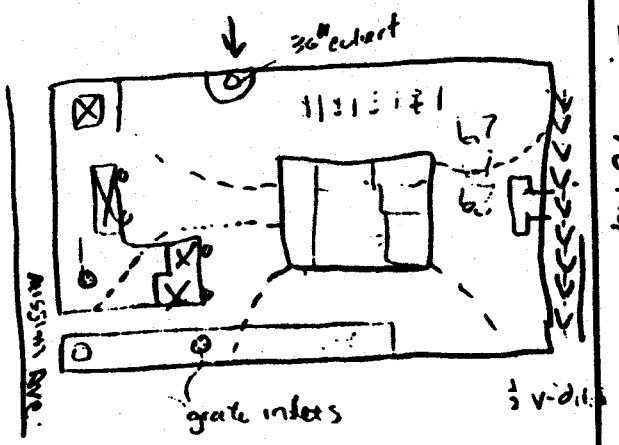
Location: Escondido MS

Checklist

Est. # Heavy Vehicles	Asphalt Containment	Oil Waste Storage	Flow Path	Site Exposure	Onsite Drainage	Access	Traffic Safety
15+	emulsion tank	No major probs.	Sheet - swale to onsite drain	100%	3 grate inlets 1 culvert inlet	OK	OK

Field Notes:

- A ≈ 4.5 acres
- ~30 employee cars
- industrial area
- multi crews
- onsite culvert takes most site flow. (1 flow from neighbors)
- great sampling possibilities (culvert, back pond)
- tire storage, exposed & not contained



78 Fwy 1

BMP FIELD INVESTIGATION FORM

Date: –	District: 11	Field Representative: TR
Location: Imperial Rd.		
Possible BMP Method(s):		

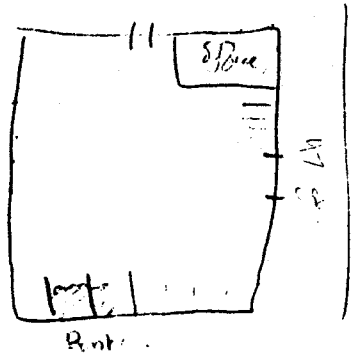
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
1	N.	1%	~~Y~~/N	—	[illegible]	[illegible]	

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- material bunkers
- No large vehicles
- Landscape area
- No vehicle maintenance area
-



BMP FIELD INVESTIGATION FORM

Date: 10/24 **District:** 11 **Representative:** TR

Location: Otay MS

Possible BMP Method(s):

- ?

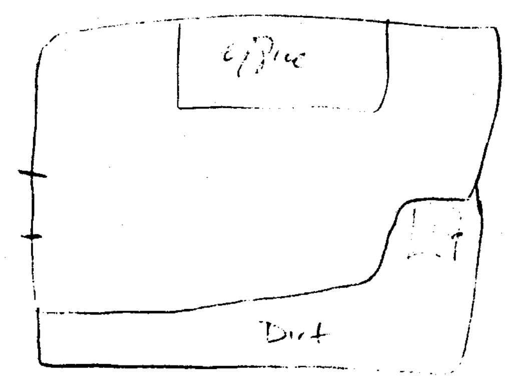
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
1 1/2	Y	<1%	Y	–	Sheet	—	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- Too [illegible]
- [illegible]
- Landscape [illegible]



Caltrans

OIL/WATER SEPARATOR FIELD INVESTIGATION FORM

Date: 10/24/97 **District:** 11 **Field Representative:** TR

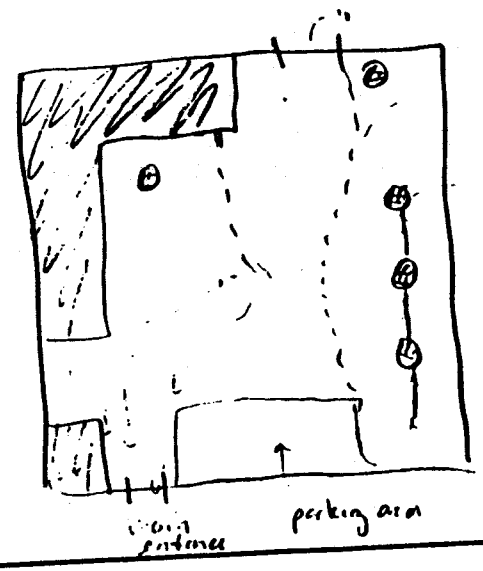
Location: SANTEE

Checklist

Est. # Heavy Vehicles	Asphalt Containment	Oil Waste Storage	Flow Path	Site Exposure	Onsite Drainage	Access	Traffic Safety
25+	Not much	Not much	curb - 40% Swale Sheet	100%	5 grate drains 2 curb [illegible]	Not Good	OK

Field Notes:

- ~40 employees
- New wash racks
- Sampling possibilities, not great
- Clean site.
- Toxic Storage - exposed
- Some curb diversion in flow paths



OIL/WATER SEPARATOR FIELD INVESTIGATION FORM

Date: 10/24/97 | **District:** 11 | **Field Representative:** TR

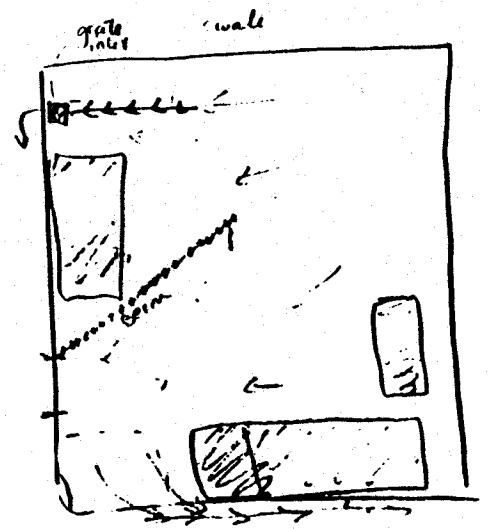
Location: Chula Vista

Checklist

Est. # Heavy Vehicles	Asphalt Containment	Oil Waste Storage	Flow Path	Site Exposure	Onsite Drainage	Access	Traffic Safety
15 +	No heavy containment	Not much	Sheet 80% curb	100%	None, 20% flow to one drain to street curb	OK	OK

Field Notes:

- A = 1.2 acres
- ~30 employees
- Good house keeping (covering oil leaks etc.)
- Mostly sheet flow - not good site to sample
- 70% drainage out front gate
  20% to drain (grate) → street curb
- No asphalt (cold)
- toxic waste storage is exposed



OIL/WATER SEPARATOR FIELD INVESTIGATION FORM

Date: 10/21/97 **District:** 11 **Field Representative:** TR

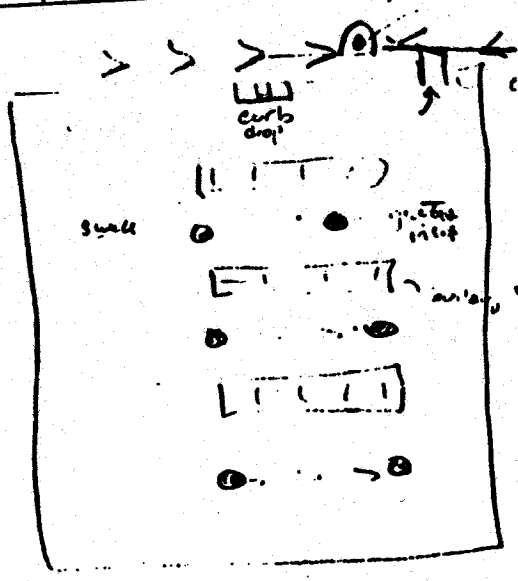
Location: Kearny Mesa MS.

Checklist

Est. # Heavy Vehicles	Asphalt Containment	Oil Waste Storage	Flow Path	Site Exposure	Onsite Drainage	Access	Traffic Safety
50+	Emulsion Stage	· Yes! · Waste barrel Storage	· Swale - curb	100%	90% curb = 2 grate = 8	Not great	onsite = not great

Field Notes:

- Operation HQ for Dist. 11.
- A = 16.9 acres
- descent sampling possibilities @ curb inlets
- ~200 employees
- Housekeeping could be improved
- Multi use yard
- 4 wash racks, incl. indoor steam wash.
- No cold asphalt
- No 2ndary environment containment
- Room for construction



District 7

Park & Ride Field Notes

Caltrans

91

BMP FIELD INVESTIGATION FORM

735507

Date: 12/12 **District:** 7 **Field Representative:** R. Watson

Location: Butler (under 91)

Possible BMP Method(s):

—

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
		2%	N	?	Sheet	NO Shown		

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

Down Drain for Fence ended

- No Cars 11:13

Caltrans

110

BMP FIELD INVESTIGATION FORM

769, B6

Date: 12/12/97 **District:** 7 **Field Representative:** R. WATSON

Location: Carson P & R (Carson at I10)

Possible BMP Method(s):

Media Filter

Checklist

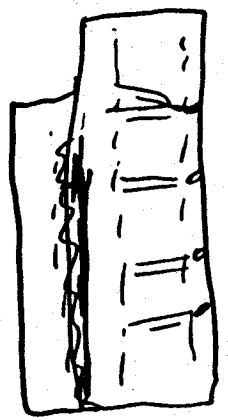
Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
2 ac		varies 2% Cross Fall	little	?	Sheet flow Curb	Concrete Swale Curb		100%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

4 drop inlets (1m to invert)

9 cars at 15:24 (almost empty



Caltrans

105

BMP FIELD INVESTIGATION FORM

703, F7

Date: 12/12/97	District: 7	Field Representative: R Watts
Location: Crenshaw / I-105		
Possible BMP Method(s): Strip ?		

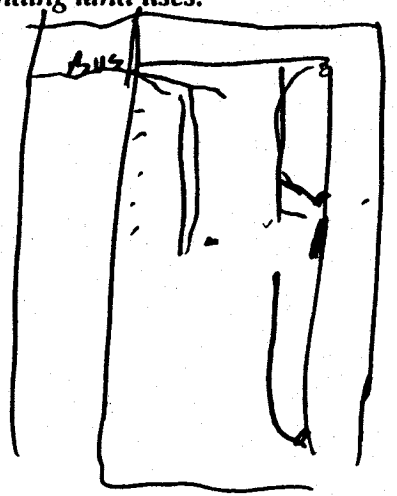
Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
5 ac		3-5%	Y		sheet swale			

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

possible silt for freeway slope
92 cars @ 15:00 (at east end)
Sheet flow to swales which outlet under walk to street
Bus loading area inside too (no buses)



Caltrans

BMP FIELD INVESTIGATION FORM

640, BC

Date: 12/13/97 **District:** 7 **Field Representative:** R. WATSON

Location: Diamond Bar East

Possible BMP Method(s):

Checklist

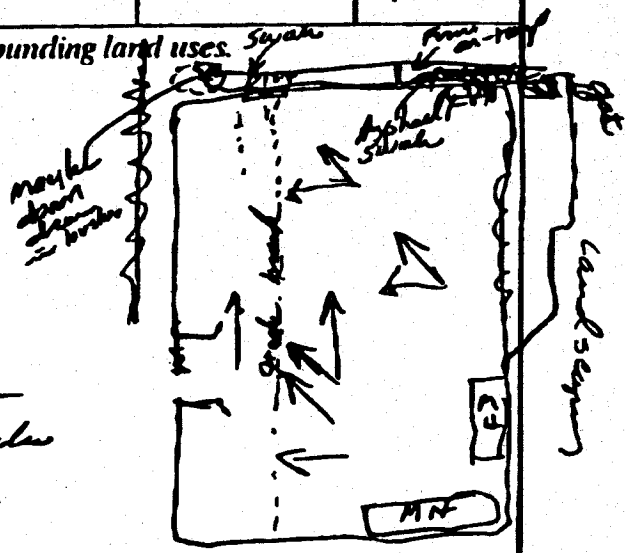
Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
1,5	200' x 20	3% Cross Slope	N	?	Sheet	Sheet Swale		100%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

25 Vehicle incl 5 HOV Carpool Vans
Two motor homes occupied
Bus Stop on street outside lot

- Maybe actually a site for Swale for freeway drain (how to remove oil etc landscape - could take end of P&R also
- plus 1 enclosed bike Racks



Caltrans

BMP FIELD INVESTIGATION FORM

640,067

Date: 12/13/97	District: 7	Field Representative: R. WATSON

Location: Diamond Bar West

Possible BMP Method(s):

Media Filter

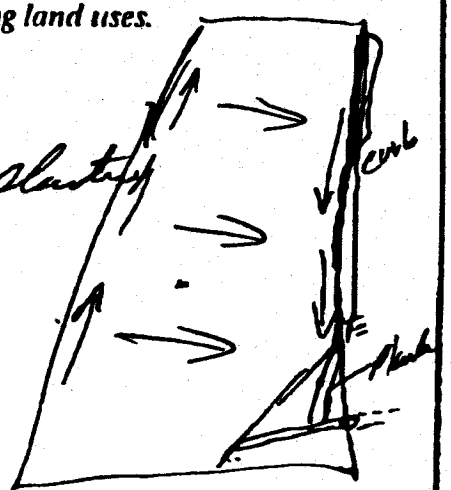
Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
1 Ac		3% → 4% ↓ 2% ←	Y	7	sheet curb swale	sheet to curb to swale to 24" pipe		100%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

13 vehicle end of van pool vehicle
Appears to drain to city drainage SE corner planter



Caltrans

BMP FIELD INVESTIGATION FORM

600 J6

Date: 12/13/97 **District:** 7 **Field Representative:** R. WATSON

Location: Garey / Route 10

Possible BMP Method(s):

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
1		2%	N	?	Sheet			6%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

- Sheet flow to adjacent street and alley
- 3 bike racks
- Under I10
- Bus boarding on Sheets
- 9 cars @ 15:18

Caltrans

210

BMP FIELD INVESTIGATION FORM

569, C7

Date: 12/13/97 **District:** 7 **Field Representative:** R. Watson

Location: Grand Ave

Possible BMP Method(s):

?

Local?

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
2?		3% over 50'	Y little	?	Sheet	sheet curb		100

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

30 Vehicles @ 15:58 and 5 ~~Cars~~ Vans pass thru

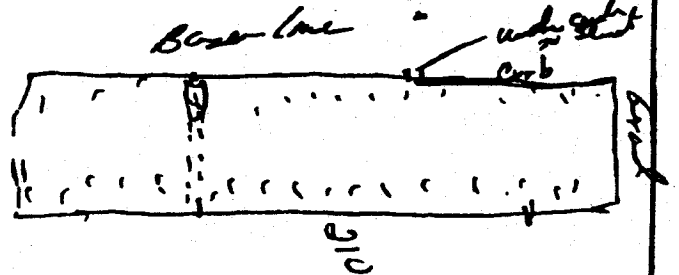
1 Spot where Freeway drain dumps onto lot

1 Spot where Freeway planter drain goes under lot

2 Mobile homes See

Bike Racks

Sheet flow walkways and driveways



Caltrans

110

BMP FIELD INVESTIGATION FORM

799, C9

Date: 12/12/97	District: 7	Field Representative: R. WATSON

Location: Harbor Park P&R (PCH) Near 110

Possible BMP Method(s):

Median Filter (But few cons)

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
2.5	yes	2% to Swale	Y from Planter	?		Concrete Swale to Drop Inlets		

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

9 Cons at 13:14

Construction - Maybe gas leaving

5 drop Inlets 1.25M to invert

Very little used despite proximity to Freeway entrance.

Planters w/ wood chips.

Caltrans

105

BMP FIELD INVESTIGATION FORM

704, C7

Date: 12/12/97	District: 7	Field Representative: R Watson
Location: I105 / Harbor Freeway Park and Ride		
Possible BMP Method(s):		

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
3.5ac		3% 2%	Y silt	?	sheet shall	swale		50%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

Drain to N/S swale that outlets under side walk to street.

Plants

30 Cars @ 14:41

Bus stop on adjacent street

Caltrans

105

BMP FIELD INVESTIGATION FORM

703, BC

Date: 12/12/97	District: 7	Field Representative: R Watson
Location: Hawthorn NW (111th)		
Possible BMP Method(s): —		

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
½ ac		2+	¼ acre	?	Sheet Swale			

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

9 Cars
Swale to to under walk drain to Stmt (111th)
Sheet out end to Hawthorn

Caltrans

105

BMP FIELD INVESTIGATION FORM

703, C6

Date: 12/12	District: 7	Field Representative: R Water
Location: Hawthorne NE (111th)		
Possible BMP Method(s): —		

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
3+		2			Sheet swale	swales to outlet		100%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

2 Cars at 15:24
Sheet to concrete swale to through curb to sheet

Caltrans

105

BMP FIELD INVESTIGATION FORM

703,C6

Date: 12/12/97 **District:** 7 **Field Representative:** Ry Watson

Location: I105/ Hawthorne Park and Ride (S) Main St?

Possible BMP Method(s):

Media Filter

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
B+Ac		2%	N	?	Sheet Swale	Swale to Drop Inlet		

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

9 cars @ 15 ill

1 deep inlet 1 Meter to culvert

1 thick cut outlet to Street

Caltrans

105

BMP FIELD INVESTIGATION FORM

736 A2

Date: 12/12/97	District: 7	Field Representative: R. Watson
Location: I 105 Lakewood South		

Possible BMP Method(s):

Media Filter

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
3ac		2±	N	?	sheet curb flow			100%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

60-70% Full

Plants (Ivy)

Drop Inlet on E Side (Covered) w/ Ivy

105

BMP FIELD INVESTIGATION FORM

736, Az

Date: 12/12/97 **District:** 7 **Field Representative:** R. Watson

Location: Lakewood I 105 (North)

Possible BMP Method(s):

Media Filter

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
.75± Ac		2%	N	?	Sheet Curb Flow			

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

10:06 14 cars

Planters

Inlet to Back of City Drive

Caltrans

5

BMP FIELD INVESTIGATION FORM

706.02

Date: 12/12/97	District: 7	Field Representative: R. WATSON
Location: Cakewood W. P.S. R		New JS

Possible BMP Method(s):
Trench (1) ~~Bat~~

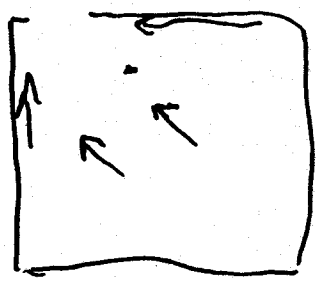
Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
.8ac	—	2/3%	Y low	?	Sheet Curb Flow	NW-out Driveway (also can		~~Full~~ 100%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

- Could construct Trench but would have 2 rows of can
- 9:15 — 38 Can
- New planter on the side
- Curbed — 4 side
- leaves from plants



Caltrans

5

BMP FIELD INVESTIGATION FORM

706 D2

Date: 12/12/97 **District:** 7 **Field Representative:** R. WATson.

Location: Lakewood East P½R New I-5

Possible BMP Method(s):

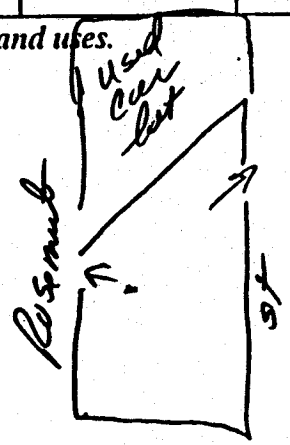
Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
.25ac	—	#71	N	?	Sheet Curb Flow			100%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

- Goodwill trailer
9:23 - 10 cars (incl 1 at Goodwill)
Curbed
oil stain, but clean



210

BMP FIELD INVESTIGATION FORM

569,57

Date: 12/13/97 **District:** 7 **Field Representative:** R. WATSON

Location: Cone Hill

Possible BMP Method(s):

Local?

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
1ac	yes	2% ca	Y	?	Sheet			60-70%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

5 Yds ind one va pan pls goodwill trailer
Sheet flow to area F.C. maint. Road to
FC Chanel
Trans. Road partly overlaid

Caltrans

105

BMP FIELD INVESTIGATION FORM

705, 87

Date: 12/12/97 **District:** 7 **Field Representative:** R. WATSON

Location: I-105 Long Beach

Possible BMP Method(s):

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
	Plenty	2% ±	N (Less)	?	sheet curb flow	~~sheet~~ curb flow		75%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

4/8 Cans at 10:40
- Drain out found 5#.
Under walk
Maybe can to back of City drain.

Caltrans

105

BMP FIELD INVESTIGATION FORM

705, 37

Date: 12/12	District: 7	Field Representative: R. WATSON
Location: Long Beach East I 105		
Possible BMP Method(s):		

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
		2± %	N	7	street curb			65-70%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

45 cars at 10:47

not enough cars

210

BMP FIELD INVESTIGATION FORM

509,07

Date: 12/13/97	District: 7	Field Representative: R. WATSON

Location: Lowell

Possible BMP Method(s):

Media Filter

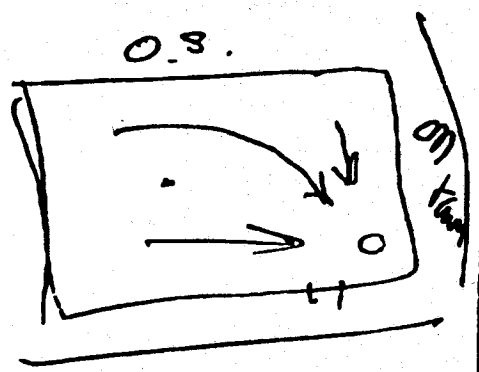
Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
		Varies ~3%	Y	?	Sheet			

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

Two vehicles @ 16:51
Drop inlet less than 1m to invert
Space but not enough head



Caltrans

110 **BMP FIELD INVESTIGATION FORM** 704, 9c2

Date: 12/12/97 **District:** 7 **Field Representative:** R. Watson

Location: Manchester Park & Ride

Possible BMP Method(s):

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

2 lots

Empty except man changed oil in an

ad 2 vehicle (Concrete works) in other

E lot 2 curb inlets w/ manhole

W lot curb inlets + ?

Caltrans

BMP FIELD INVESTIGATION FORM

Date: 11/12	District: 7	Field Representative: TR

Location: Newhall P:R

Possible BMP Method(s):

- Media Filter

N

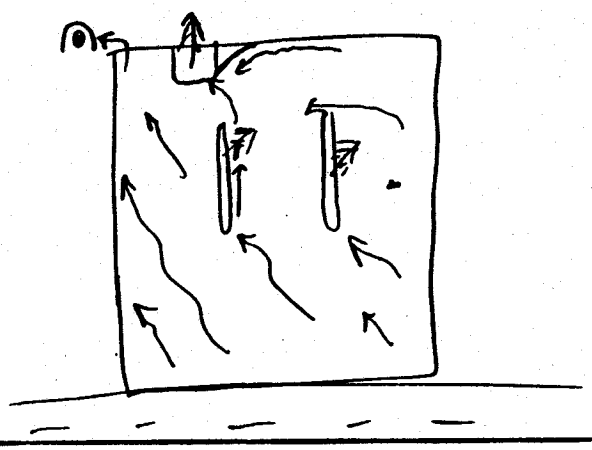
Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
1	~~8'~~ x 8'x40'	~0	N	?	Sheet curb	—	Y	100%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

- May have problems w/ leaves in Fall.
- Cut away asphalt cover in corner
- Neighboring yard has a curb inlet.



57

BMP FIELD INVESTIGATION FORM

679, H5

Date: 12/13/97 **District:** 7 **Field Representative:** R. WATSON

Location: Pathfinder Rd

Possible BMP Method(s):
Swale or median filter

Checklist

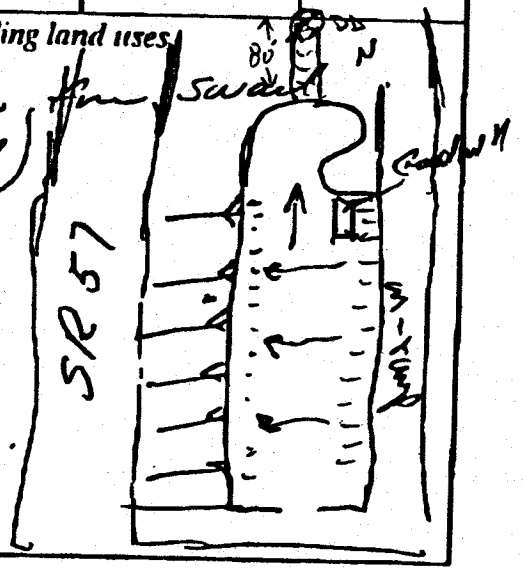
Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
1.5±	Yes 80' x 20'	6-6.5% 3% Cross Gut	N	?	Sheet & Concentrated	Sheet Conc. Flow to Cen. Swale		100%

Drainage ?

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses

Field Notes:
Check for mon. station beyond downdrain
9 Cars plus Goodwill Trailer (unmanned)
Incl 1 car pool van

- Down drain beyond swale (80') still on Caltrans property.
- Swale takes 90%+ total runoff.



Caltrans

210

BMP FIELD INVESTIGATION FORM

48267

Date: 12/13/97	**District:** 7	**Field Representative:** R. Watson
Location: Paxton		
Possible BMP Method(s): Media Filter		

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
		3%		7	Sheet Curb			95

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

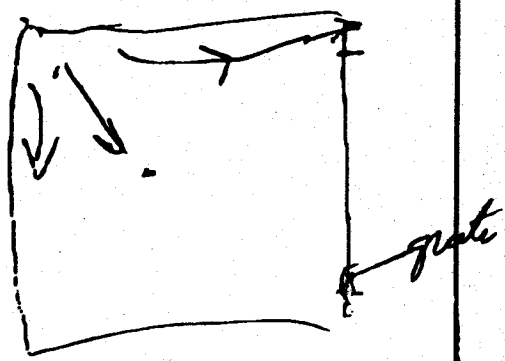
Field Notes:

8 vehicles a 17:06

Sheet and Curb Flow

Oil Stains

Curb/Grate Inlet to inlet



Caltrans

110

BMP FIELD INVESTIGATION FORM

734, 43

Date: 12/12/97 **District:** 7 **Field Representative:** R. WATSON

Location: ~~Anaheim~~ Park & Ride

Possible BMP Method(s):

Media Filter

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
3.5	Yes	2+%	Y Plenty		Sheet Separate Curb	Swale		

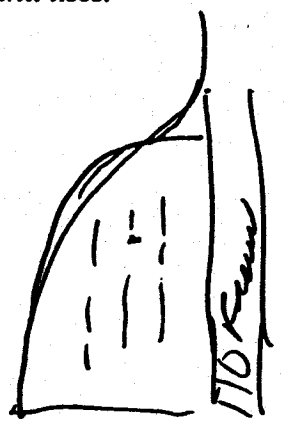
Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

~~4~~ 3 drop Inlets 2m to invert

Empty at 14:06

new



Caltrans

110

BMP FIELD INVESTIGATION FORM

824, CH CH

Date: 12/12/97	**District:** 7	**Field Representative:** R. Watson

Location: San Pedro II Beacon St Harbor

Possible BMP Method(s):

—

Checklist

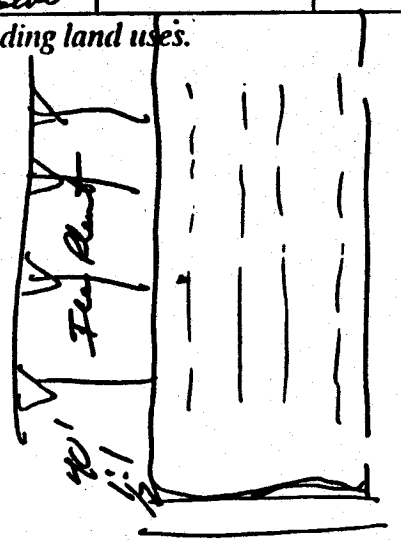
Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
2.5+ Ac	—	3 % 2 cm	N	?	Sheet curb	curb to outlet at storm		100

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

80 Trucks/day - mostly related to construction traffic at N. end of lot otherwise almost empty

Planters



Caltrans

110

BMP FIELD INVESTIGATION FORM

8 24 04

Date: 12/12/97	District: 7	Field Representative: R. WATSON

Location: San Pedro

Possible BMP Method(s):

Bench

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
1 ac	Yes	2±%	Y/N	?	Sheet			

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses

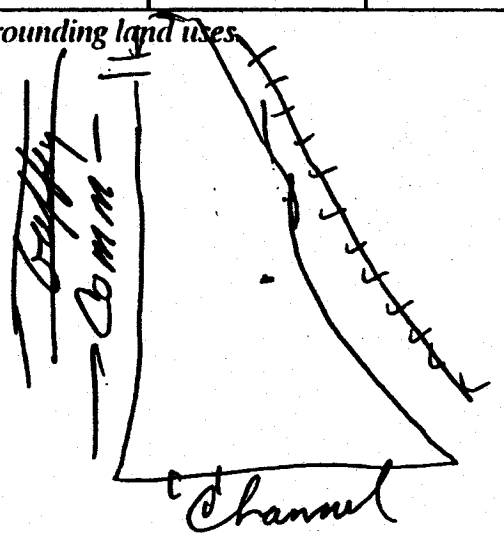
Field Notes:

18 Cen 12:51

under 110

Sheet to Street or RR ROW

down Drain for Freeway



Caltrans

110

BMP FIELD INVESTIGATION FORM

8 24 04

Date: 12/12/97	District: 7	Field Representative: R. WATSON

Location: San Pedro

Possible BMP Method(s):

Bench

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
1 ac	Yes	2±%	Y/N	?	Sheet			

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses

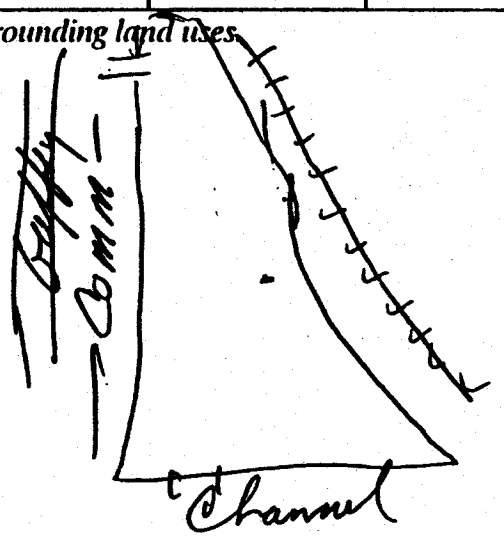
Field Notes:

18 Cen 12:51

under 110

Sheet to Street or RR ROW

down Drain for Freeway



405

BMP FIELD INVESTIGATION FORM

591, G1

Date: 12/13/97 **District:** 7 **Field Representative:** R. WATSON

Location: SR 1ball & Mulholland

Possible BMP Method(s):

?

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
		2+%		?	Sheet	curb		100%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

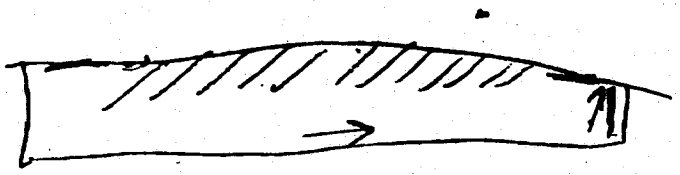
Field Notes:

3 Cars @ 17:40

Narrow

Drain glen curb to street

(DARK)



Caltrans

10

BMP FIELD INVESTIGATION FORM

674, dc 5

Date: 12/12/97 **District:** 7 **Field Representative:** R. Wuten

Location: Stanton Park and Ride

Possible BMP Method(s):

Media Filter

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
E 3/4 Ac		3-4%	Y Mainte	?	Sheet curb catch	swale curb		100%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

E 1 dropt inlet (2m to inlet)
1 curb inlet w/ manhole
Empty at 14:26

W also empty

Caltrans

105

BMP FIELD INVESTIGATION FORM

736, EZ

Date: 12/12	District: 7	Field Representative: R. WATSON

Location: I/05 Terminal Park & Ride

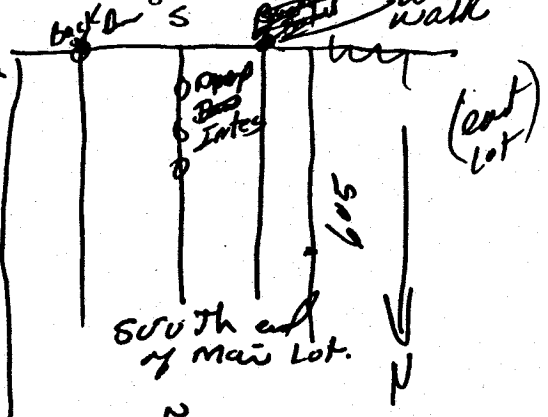
Possible BMP Method(s):
Media Filter

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
		Varies 2-3%				Sheet to curb & swale		98%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes: 10 undeals 7 cars
Bess Pick up area
Graded to drain to N/S swales
To back of city drain inlets at S. end
and under sidewalk to city curb flow
- south end has fewer cars
- Center swales at S. end has 3 deep inlets about 1.25M deep
- SW. lot add stand w/ swale, but some inflow for freeway drain
Drain to other lot channel along culdesac
- New lot to drop new path to Mesa



Caltrans

105

BMP FIELD INVESTIGATION FORM

704,A7

Date: 12/12/97 | **District:** 7 | **Field Representative:** R. Watson

Location: I105 / Vermont Park & Ride

Possible BMP Method(s):

—

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
2.5 Ac		2%+	[illegible]	?	Sheet	curb		

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

3 cars + 3 tow trucks in corner
under sidewalk drain to street

Caltrans

210

BMP FIELD INVESTIGATION FORM

600, 86

Date: 12/13/97	District: 7	Field Representative: R. Watson

Location: Via Verde (?)

Possible BMP Method(s):

Media Filter

Local ?

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
1 Ac	Yes	Vario 2-3%	Y Clists		Sheet Down Drain	Sheet		100%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

11 Cars at 15:51

Sheet Flow to down drain (1in to INVert

3 bike Racks

12/13/1997 12:19 714-855-0483 RICHARD WATSON PAGE 06

210

BMP FIELD INVESTIGATION FORM

600,66

Date: 12/13/97	District: 7	Field Representative: R. Watson

Location: Via Verde

Possible BMP Method(s):

Media Filter

Checklist

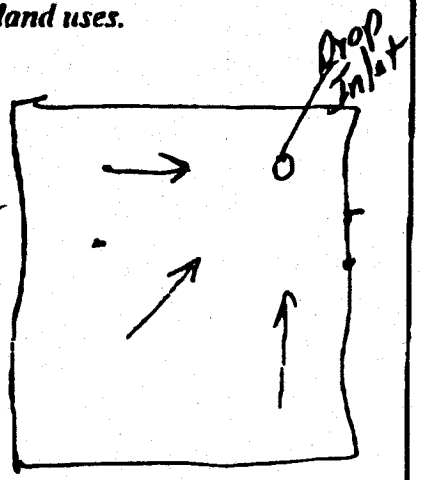
Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
1 Ac	Yes	Varies 2-3%	Y. Cuttle		Sheet			100%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

11 Cars at 15:31
Sheet Flow to down drain (1in to INVert

3 bike Racks



Caltrans

BMP FIELD INVESTIGATION FORM

Imperial Century East of Willowbrook

Date: 12/6	District: Wilmington 7	Field Representative: TP DN
Location: Willowbrook (I-105)		
Possible BMP Method(s): IT		

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
25		2%	Y	?	flow over curb	sheet + curb flow		

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

60 cars

all flow focused into 1 area

no pillars, no bridge

temporary office construction downstream of I.T.

CALL TO SEE IF CALTRANS OWNED

Caltrans

105

BMP FIELD INVESTIGATION FORM

704, 61, 47

Date: 12/12/97	District: 7	Field Representative: R. WATSON
Location: I105 Wilmington		
Possible BMP Method(s):		

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes: - Interrupted by phone call

(F)

District 11

Park & Ride Field Notes

Caltrans

BMP FIELD INVESTIGATION FORM

Date:	District: 7	Field Representative: TQ
Location: SR-78/I-5 P&R		
Possible BMP Method(s): • DF		

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
1	yes	1-4	—	—				

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

- 2 inlets connected to same storm system.
- Outflow scarring 4" in longitudinal.
- Good # cars in 1-4; 95% full = 45 cars.
- Good headroom in 1-4.

Caltrans

BMP FIELD INVESTIGATION FORM

Date:	**District:** 11	**Field Representative:** TR
Location: Birmingham Dr. I/S		
Possible BMP Method(s): • Trash		

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
1	yes	1%	—	—	sheet	Sheet + Concentrated	Yes!	100%

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

- 20 cars → day. 50% used
- relatively small lot
- runoff = sheet only
- not good place for BMP.

Caltrans

BMP FIELD INVESTI[illegible] FORM

Date:	District: 11	Field Representative: TA
Location: La Costa Ave [illegible] I-5		
Possible BMP Method(s): • MF • Trench		

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
12'+	yes	1 [illegible] 2	Y	—	[illegible]	[illegible]	[illegible]	[illegible]

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

- 2pm working → 35 [illegible]
- Natural reserve adjacent to lot.
  - ↳ species [illegible]
- 3' to head from [illegible]
- [illegible] for MF.

Caltrans

BMP FIELD INVESTIGATION FORM

Date: | **District:** 1 | **Representative:** TR

Location: Carmel Valley N. P&R I-5

Possible BMP Method(s):

- MF

Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
1/2	not much	1-4	N	—	[illegible] street	[illegible]	yes!!	[illegible]

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

- 3pm weekday => [illegible]
- flow runs directly [illegible] draining to street
- possible MF site, but might construct CB first.

District 7

Highway Field Notes

Caltrans

BMP FIELD INVESTIGATION FORM

Date: 12/28/97 **District:** 7 **Field Representative:** TR

Location: 210 - FWY @ Evergreen Overcrossing. com # 210-59

Possible BMP Method(s):

• TCB

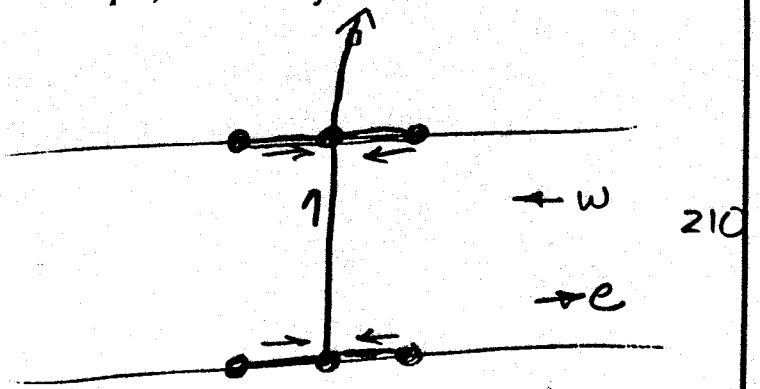
Checklist

Tributary Area ac	Space Available (Dim.)	Site ~~Slope~~ OUTLET	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
1.1	—	0.29	—	—	—	C-2	6

Other considerations: *Proximity to water wells, bedrock location, water table depth, distance to foundations.*

Field Notes:

- Small tributary area
- Step outlet
- CSP
- 3 drains of both sides facing
- nice site, but too small trib. area.
- need to dissipate energy



Caltrans

BMP FIELD INVESTIGATION FORM

Date: 12/27/97 | **District:** 7 | **Field Representative:** TR

Location: 210-6 (1) CDM 210-6 (1)

Possible BMP Method(s):

- TCB

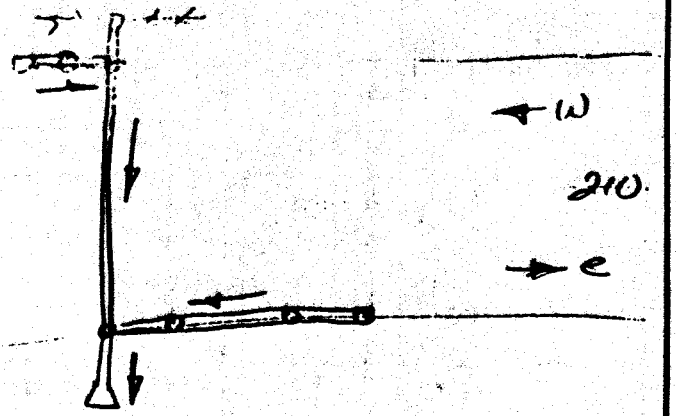
Checklist

Tributary Area	Space Available (Dim.)	~~Site~~ Slope 0.1+	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3.~~5~~	—	0.0171	—	—	—	F2	7 Grate 1 open

Other considerations: *Proximity to water wells, bedrock location, water table depth, distance to foundations.*

Field Notes:

- Great outlet criteria for monitor
- One inlet takes ~~off~~ hillside flow
  ∴ may be better for 'control' system
- Drains through back alley or open field lot.



BMP FIELD INVESTIGATION FORM

Date: 10/27/97	**District:** 7	**Field Representative:** TR
Location: 210 - east of Filaree St ; CDM 210-5 (1)		CDM 210-5 (3)

Possible BMP Method(s):

• TCB

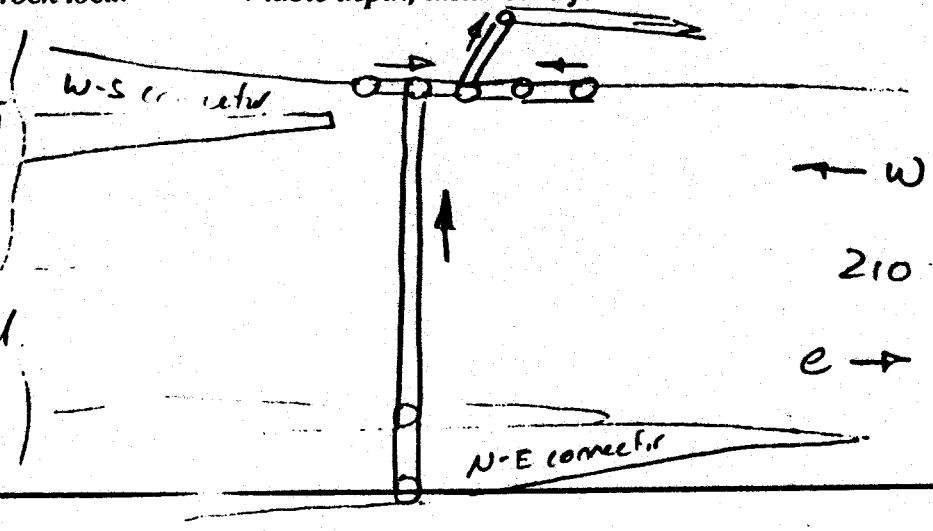
Checklist

Tributary Area	Space Available (Dim.)	Site Slope at Lot	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
2.1	—	30%	—	—	—	(CCP) G-2	7

Other considerations: *Proximity to water wells, bedrock locati... water table depth, distance to foundations.*

Field Notes:

- lots of room @ outlet for energy dissipater + monitor station
- easy access
- Brent local
- drains into concrete rectangular channel



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BMP FIELD INVESTIGATION FORM

Date: 12/27/92 **District:** 7 **Field Representative:** TR

Location: I-210 east of Fillmore St. PM 210-5 (1)

Possible BMP Method(s):

• TCB

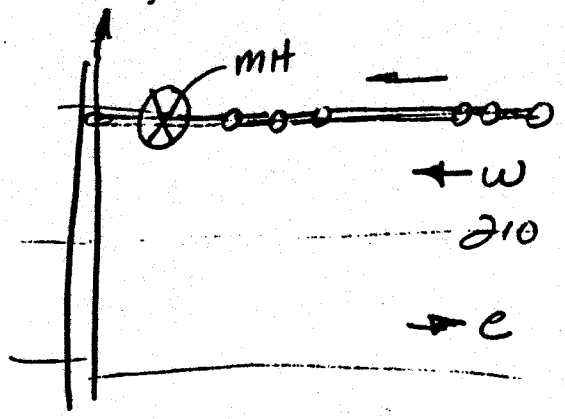
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
1.5	—	20% outlet	—		—	G2	6

Other considerations: *Proximity to water wells, bedrock location, water table depth, distance to foundations.*

Field Notes:

- Only on westbound side
- must tie into Natural before it ties into main.
- Need to Construct MH for + energy dissipator



BMP FIELD INVESTIGATION FORM

Date: 12/27/97	**District:** 7	**Field Representative:** TR
Location: I-210 east of Azusa Ave		CDM # 210-13 (2)

Possible BMP Method(s):

- TCB

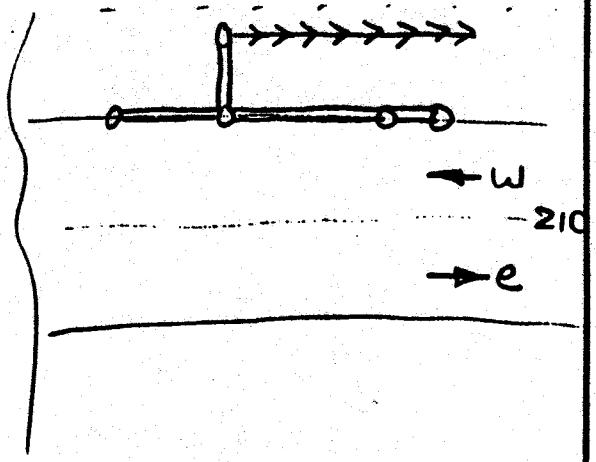
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
2+	—	40%	—	—	—	GD-1	4

Other considerations: *Proximity to water wells, bedrock location, water table depth, distance to foundations.*

Field Notes:

- Steep slope into a 90° elbow at bottom of slope
- elbow drains into a v-ditch.
- plenty of room to construct energy dissipater + monitoring station @ outlet.
- Good local for TCB.
- Easy access.



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BMP FIELD INVESTIGATION FORM

Date: 12/27/97	District: 7	Field Representative: TB
Location: I-210 west of Occas Ave.		CDM # 210-13 (1)

Possible BMP Method(s):

: TCB

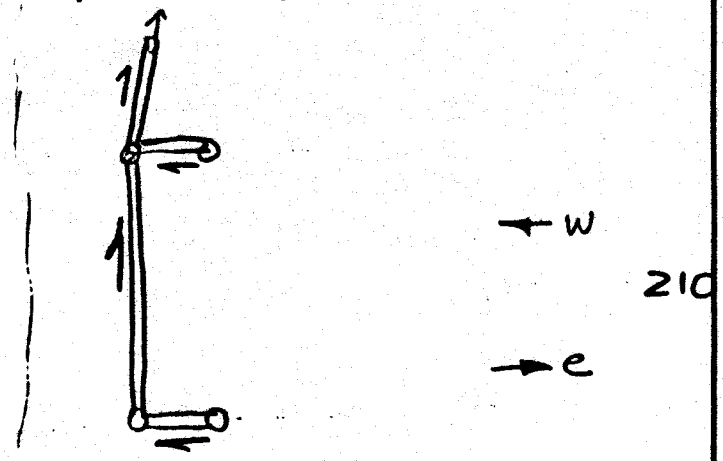
Checklist

Tributary Area (Acre)	Space Available (Dim.)	~~Site~~ Slope Outlet 20% ~~Inlet~~	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3.2	—		—	—	—	CD-1	4

Other considerations: ***Proximity to water wells, bedrock location, water table depth, distance to foundations.***

Field Notes:

- Outlet hangs about 5' over invert of riparian channel.
- May access
- runoff runs into riparian channel w/ plenty of room for modification?, energy dissipation



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BMP FIELD INVESTIGATION FORM

Date:	District: 7	Field Representative: TR

Location: Marin 605 (6), between 9W & 91-605 Exp.

Possible BMP Method(s):

- Swale
- I Basin

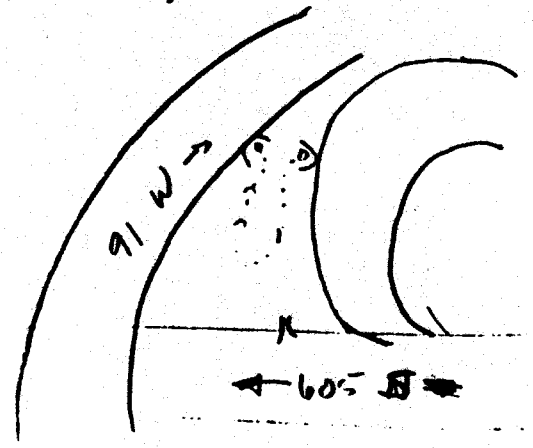
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3	yearly (?)	1% (+)	—	Sdy	—	—	-

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- Lot of area to construct swale or basin
- meandering swale - good percolation



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BMP FIELD INVESTIG FORM

Date:	District: 7	Field Representative: TR
Location: I605 (S) South of Telegraph Rd.		

Possible BMP Method(s):

- Swale
- Strip

Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
4	4	cross = 5% 1%	—	—	—	—	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- Caltrans Fence is too close, may cause problem.
- Concrete v-ditch drains to San Gabriel R.
- 50' of 5% cross section.

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BMP FIELD INVESTIGATION FORM

Date: | **District:** 7 | **Field Representative:** TR

Location: 605 (N) between Del Amo Blvd and [illegible]

Possible BMP Method(s):

- Strip *
- swale

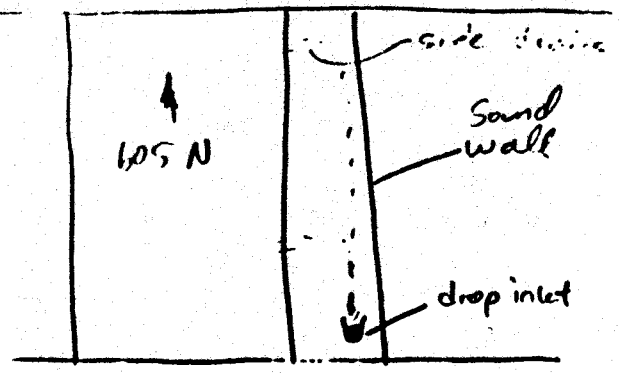
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
5	400m x 10m	cross - 5% long - 1%	—	Sandy	—	—	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- ice plant covered 100%
- Some other vegetation
- Moderate slope
- Great for strip.
- Knock out curb!



Caltrans

BMP FIELD INVESTIGATION FORM

Date:	District: 7	Field Representative: TR

Location: Behind Cerritos MS - Between

Possible BMP Method(s):

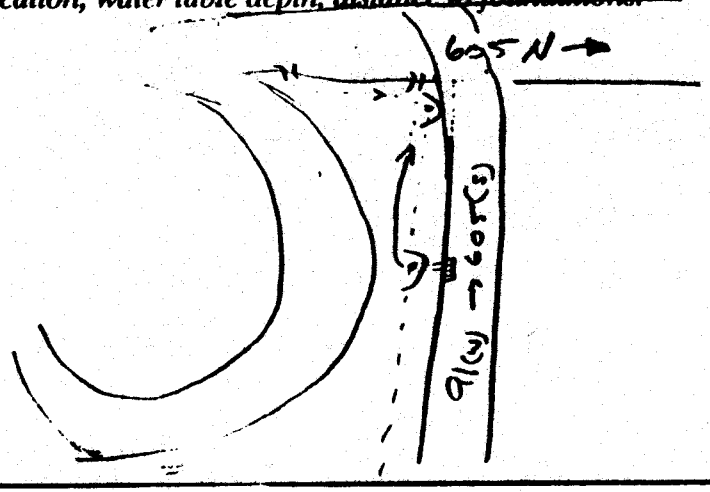
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
2+	Strip – 300'	- 1-2%	—	Sandy	—	24+" culvert	—
2	Swale – 350'	– 3-4%	—				

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- Strip along 605!
- Swale from 91 connector drain to outlet culvert!



BMP FIELD INVESTIGATION FORM

Date:	District: 7	Field Representative: TR

Location: Corridos MS (Behind along 91 westbound)

Possible BMP Method(s):

- Swale

Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
2	100'	2%+	—	Sandy	V-ditch	culvert	1

Other considerations: *Proximity to water wells, bedrock location, water table depth, distance to foundations.*

Field Notes:

- Runoff from 91 westbound, downdrains to a v-ditch to a 24" culvert.
- Project for swale

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BMP FIELD INVESTIGATION FORM

Date:

District: 7

Field Representative: TR

Location: I-605 (South), Whittier Overcrossing. Cloverleaf

Possible BMP Method(s):

- Swale
- Basin

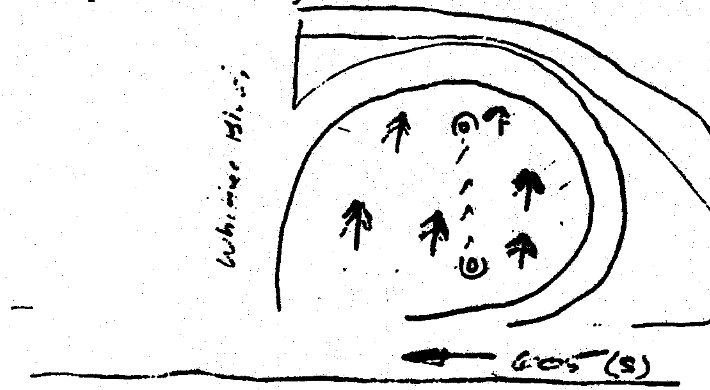
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
1	Ø = 100'	3-5%	—	Sandy	—	culvert 24"	Inlet culvert outlet culvert

Other considerations: ***Proximity to water wells, bedrock location, water table depth, distance to foundations.***

Field Notes:

- Possible access pts.
- Several large trees.
- Concrete lined v-ditch already there
- Close (adjacent to Santa Ana river)
- Soil seems OK for infilt.



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#9

BMP FIELD INVESTIGATION FORM

Date:	District: 7	Field Representative: TR
Location: I-605 South of SR-91 [illegible] (Far [illegible])		

Possible BMP Method(s):

- swale
- strip
- IB
- EDB

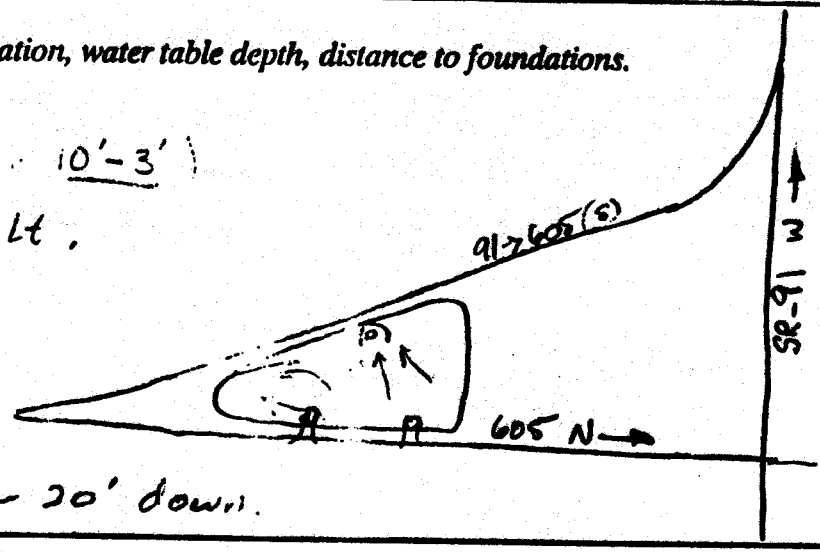
Checklist

Tributary Area (acres)	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
4+	1 acre	1%	Y	Sandy!	—	Culvert out	—

Other considerations: *Proximity to water wells, bedrock location, water table depth, distance to foundations.*

Field Notes:

- huge basin
- Grading depth for [illegible] 10'-3'
- Soil is probably ✕ desert for infiltration.
- Easy maint. access
- No immediate structures
- plenty of available space
- From Freeway, basin is excavated ~ 20' down.



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BMP FIELD INVES[illegible]N FORM

Date: | **District:** 7 | **Representative:** TR

Location: I-605 (South) Between 91-605 [illegible] 605N → 91E connector

Possible BMP Method(s):

- Swale
- Strip
- EDB
- IB

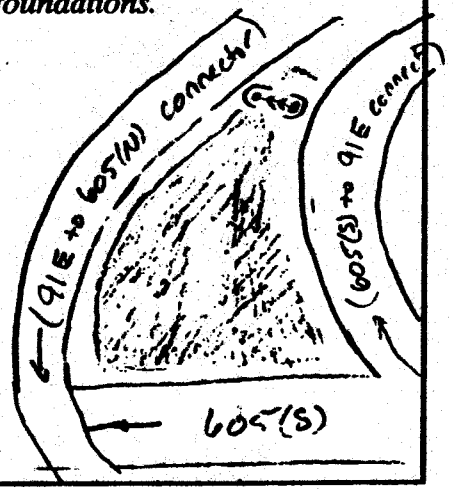
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3	1 acre	1%	—	Sandy?	—	2 24" culvert pipes	2

Other considerations: ***Proximity to water wells, bedrock location, water table depth, distance to foundations.***

Field Notes:

- Plenty of available space
- Not good slope possibilities
- Not great maintenance access.
- Not great location for Basin due to limited funding availability



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BMP FIELD INVESTIGATION FORM

Date:	District: 7	Field Representative: TR

Location: I-605 (N) → SR-91 (W) connector (Clearwater)

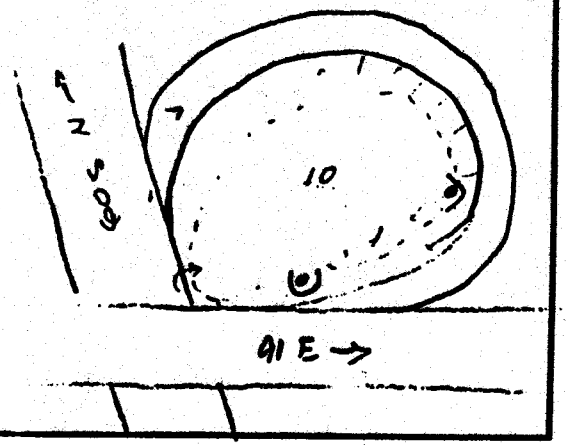
Possible BMP Method(s):
- I. Basin
- FDB

Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
6+	~2 Ac. Ø = 250'	1%	—	Sandy	—	1 culvert inlet 1 culvert outlet 1 curb drain	X 2

Other considerations: ***Proximity to water wells, bedrock location, water table depth, distance to foundations.***

Field Notes:
- Huge basin with decent inflows
- Easy access off 605 N.
- No major structure around
- Pass 5B from (N) Westbound, Carson Mesa, + 605 N.



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BMP FIELD INVESTIGATION FORM

Date:	**District:** 7	**Field Representative:** TR

Location: I-5 (South), I-605 (S) & Ramp

Possible BMP Method(s):

:

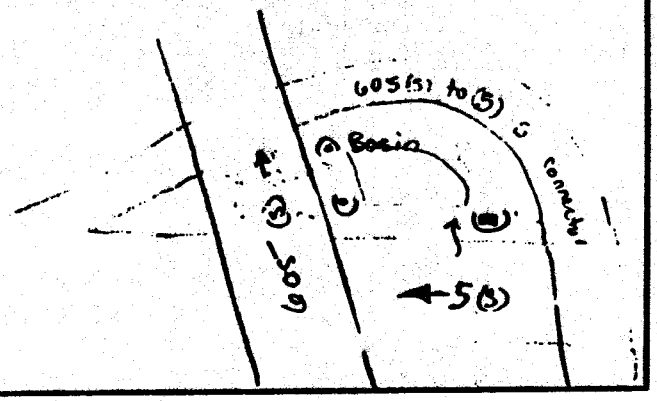
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
5+	100' x 300' → away from bridge columns.	1-2%	—	Clayey, Sandy	—	36" corr.	

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- Drills ~(3-10')
- 2 inlets from other basins
- need drainage plans to decifer trib. area.
- One culvert outlet
- down drains from (5) south
- Easy Maintenance access. (Maint. road)



BMP FIELD INVESTIGATION FORM

Date:	District: 7	Field Representative: TR
Location: I-5 Southbound, I-605 (S) overcrossing.		

Possible BMP Method(s):

- IB
- EDB
- Strip
- Swale

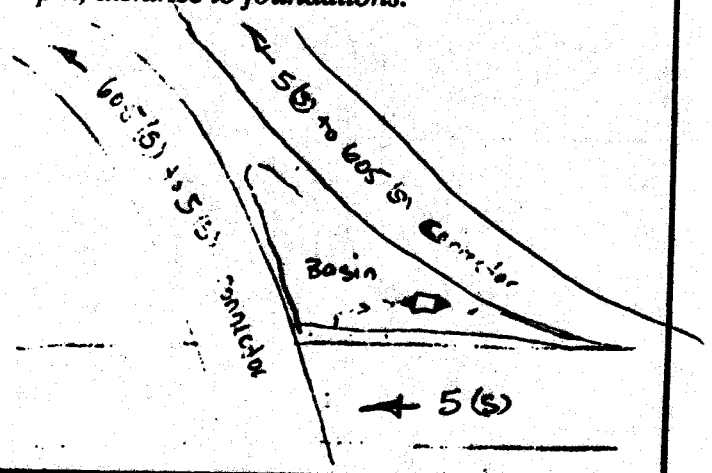
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3 ac±	Triangle B = 40', H = 150'	1-2%	—		—	Drop drain inlet	1

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- Quite small basin
- Drop-drain inlet in middle of basin
- 1 down drain from (5) (S) freeway
- Best for swale or strip
- Semi-easy maintenance access



(6)

District 11

Highway Field Notes

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BMP FIELD INVESTIGATION FORM

Date: | **District:** 11 | **Field Representative:** TR

Location: I-5, La Costa Blvd (East)

Possible BMP Method(s):

- Infiltration Basin
- EDB
- Wet Pond.

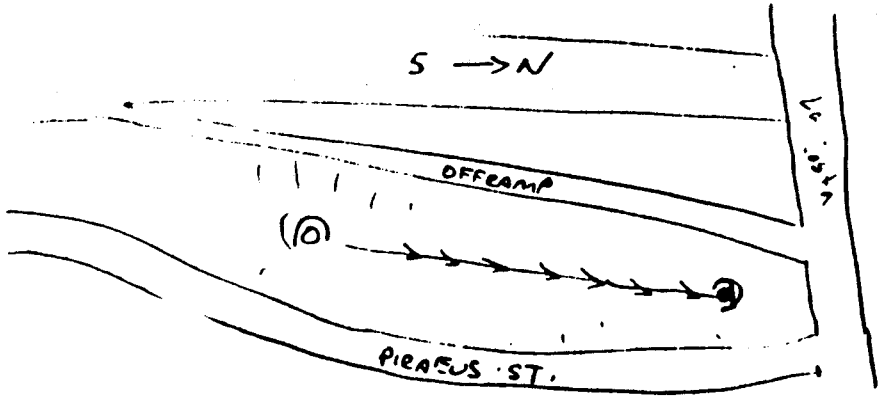
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
2	100' x 30'	5% +	N	? Sandy	Towards Channel	Inlet - 24" culvert Outlet - 24" culvert	—

Other considerations: ***Proximity to water wells, bedrock location, water table depth, distance to foundations.***

Field Notes:

- already a wet pond
- Inlet flow comes from?
- May not be enough room on sides of basin
- Some vegetation may have been wild or planted.



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BMP FIELD INVESTIGATION FORM

Date:	District: 11	Field Representative: TR
Location: I-5, La Costa (West)		

Possible BMP Method(s):

- IB
- FDR
- Wet Pond

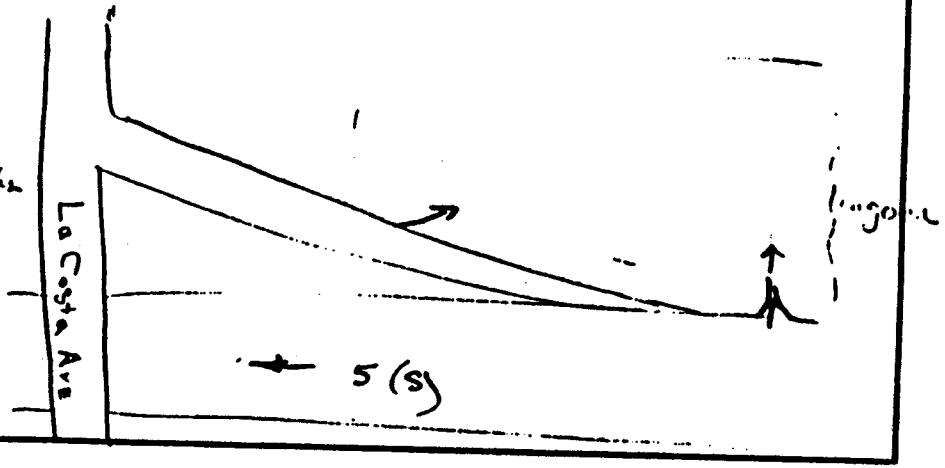
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3+	2 acre	2-4%	—	Sandy	—	sheet + rock	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- Current drainage includes gas station + some street flow. Need to reroute
- Huge basin with good infil potential
- Sheet flow out to lagoon
- Possible to connect bio-swale?



BMP FIELD INVESTIGATION FORM

Date:	District: 11	Field Representative: JR

Location: I-5 / SR-56

Possible BMP Method(s):

- Wet basin
- EDB

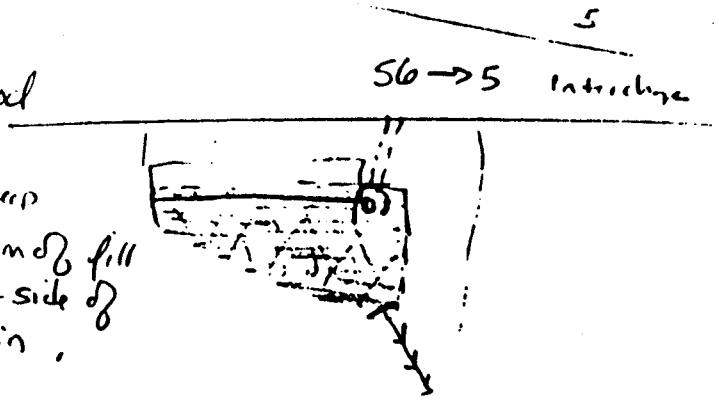
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3	50' x 100'	—	—	Clays	—	—	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- Holding rain water from 5 day before
- Currently takes water from above pass and sends it out via drainage overflow channel
- doesn't look good for infilt
- Need to dig deep
- Can move bins of fill on East side of basin.



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BMP FIELD INVESTIGATION FORM

Date:	District: 11	Field Representative: TR
Location: I-5 / Manchester Road		
Possible BMP Method(s): • IB • EDB • WP		

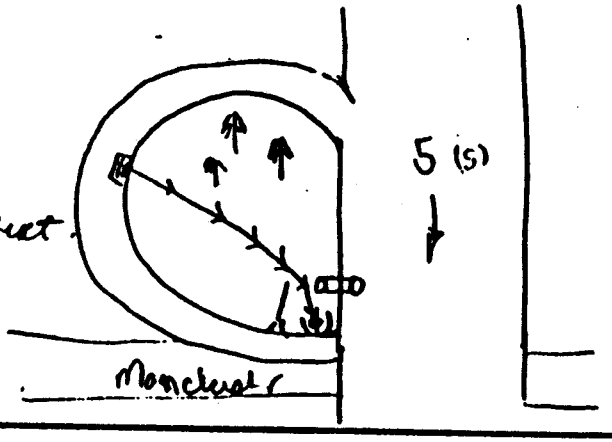
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3	Ø = 100'	1-3%	—	Sandy?	to Swale	culvert inlet	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- Existg swale, grate inlet on offramp
- Drop drain from 5 (S), curb side drain from Manchester.
- Culvr outlet directs flow to lagoon across street.
- Several trees.
- Good wet pond.
- WT could be high.



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BMP FIELD INVESTIGATION FORM

Date:	District: 11	Field Representative: TR
Location: I-5 / Manchester Road		
Possible BMP Method(s): • IB • EDB • WP		

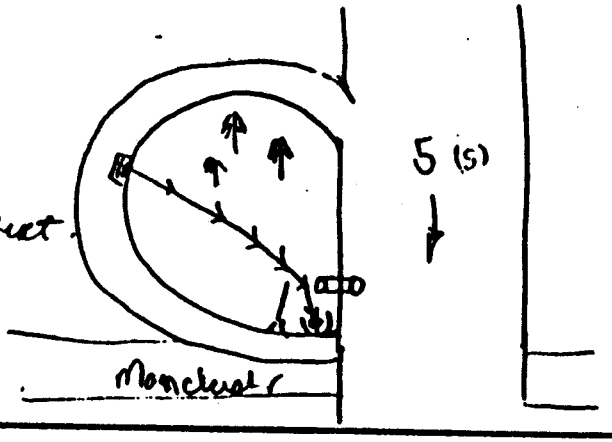
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3	Ø = 100'	1-3%	—	Sandy?	to Swale	culvert inlet	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- Existg swale, grate inlet on offramp
- Drop drain from 5 (S), curb side drain from Manchester.
- Culvr outlet directs flow to lagoon across street.
- Several trees.
- Good wet pond.
- WT could be high.



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BMP FIELD INVESTIGATION FORM

Date: | **District:** 11 | **Field Representative:** TR

Location: I-5, Manchester (West)

Possible BMP Method(s):

- IB
- EDB
- WP

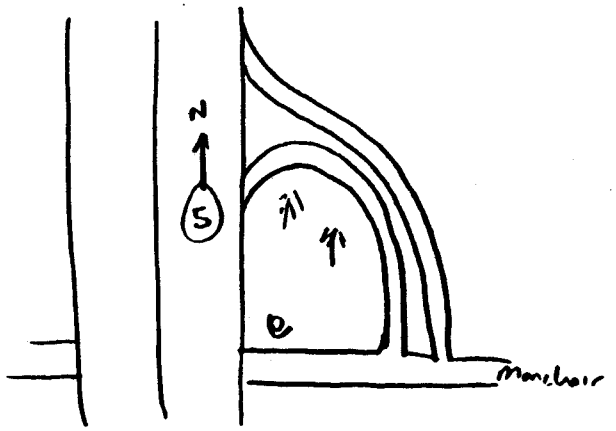
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
4	∅ = 200'	2-5%	—	Sandy [illegible]	[illegible]t	culvert	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- WT could be high @ low points.
- May need to reroute water from (5)N under the onramp.
- Good size site for basin
- Lagoon just accross street



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BMP FIELD INVESTIGATION FORM

Date:	**District:** 11	**Field Representative:** TE

Location: T5, San Dieguito River

Possible BMP Method(s):

- IB
- UP
- SDB

o Swale

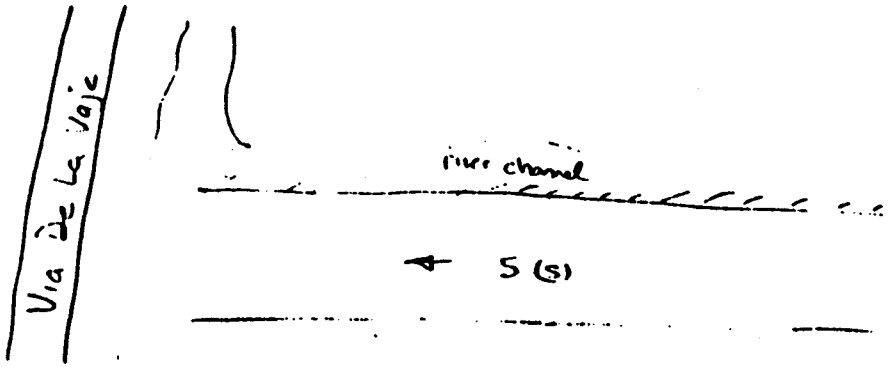
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
6	1000' x 50	1-4%	—	Sand	Natural	—	—

Other considerations: ***Proximity to water wells, bedrock location, water table depth, distance to foundations.***

Field Notes:

- Long natural channel
- No maintenance possibilities (Access)
- Plenty of room for any BMP.
-



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BMP FIELD INVESTIGATION FORM

Date:	District: 11	Field Representative: TR

Location: SR-78 Melrose

Possible BMP Method(s):

- Swale
- Strip
- Swale 1B
- Trench

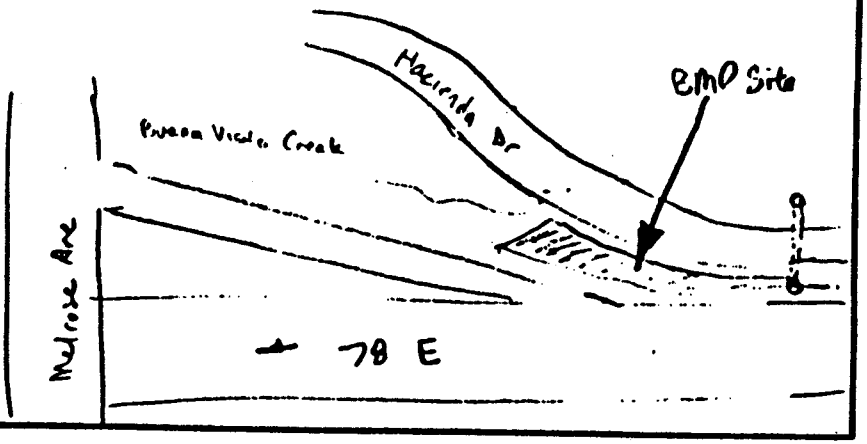
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
5	100' x 30'	1-3%	—	Sandy clay	Swale	grate drain	— 1

Other considerations: *Proximity to water wells, bedrock location, water table depth, distance to foundations.*

Field Notes:

- Natural swale location
- Wide enough at East end for trench or small basin
- Currtly has pipe inlet to creek.
-



BMP FIELD INVESTIGATION FORM

Date:	District: 11	Field Representative: TR

Location: SR78 / I-75

Possible BMP Method(s):

- EDB
- WP
- IB

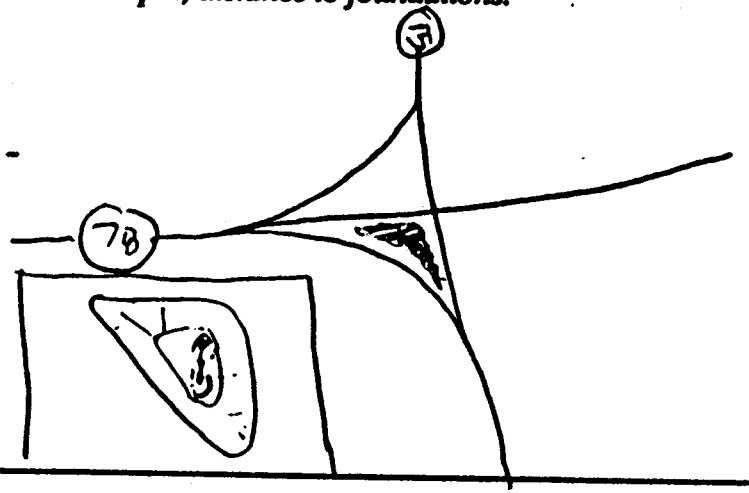
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
8+	Ø = 200'	—	—	Pelunized Granular	—	24" culvert	—

Other considerations: ***Proximity to water wells, bedrock location, water table depth, distance to foundations.***

Field Notes:

- Huge basin, maybe best for IB, EDB.
- Inlet culvert is low, ∴ may need to adjust system
- 20+ ft deep in center basin
- Excess flow from 78(W) from other side of street.



Caltrans

BMP FIELD INVESTIGATION FORM

Date: | **District:** 11 | **Field Representative:** TR

Location: Along (5) N before San Onofre Power Station

Possible BMP Method(s):

- strip!
- swale

Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
5	(?) 1 mile	1-3%	—	Sandy	—	—	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- Wide shoulder w/ no berm.
- flat ± 5% cross slope.
- Not in target ws.

Caltrans

BMP FIELD INVESTIGATION FORM

Date:	District: 11	Field Representative: TR

Location: I-5 (N) shoulder (South of San Onofre Power Plant)

Possible BMP Method(s):

- Swale
- Strip

Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
10 ac	50' x 2 mile	1-2%	Sandy Soil/Stone	—	—	—	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- No brine, = good for sheet → Strip flow
- very flat shoulder w/ slight cross slope ~ 5%
- Runoff collects in swale.
- Out of Target WS.

Caltrans

BMP FIELD INVESTIGATION FORM

Date: | **District:** 11 | **Field Representative:** TR

Location: I-5 (S) shoulder before Palomar Airport Rd

Possible BMP Method(s):

- wall
- filter

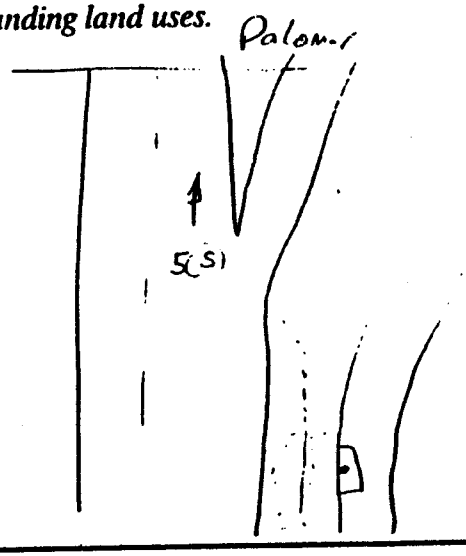
Checklist

Tributary Area	Space Available (Dim.)	Slope	Sediment Possible (Y/N)	Estimated Soil Type	Drainage Type	Flow Path	Construction Needed	Exposure
3	60' x 200'	1%	—	SAND	—	—	—	—

Other considerations: Proximity to water wells, bedrock location, water table depth, surrounding land uses.

Field Notes:

- Very flat & wide.
- good slip location.
- Current outlet is on the other side of the Caltrans fence on the street.



Caltrans

BMP FIELD INVESTIGATION FORM

Date:	District: 11	Field Representative: -IR

Location: SR78 (E) shoulder before Melrose Ave.

Possible BMP Method(s):

- swale
- [illegible]

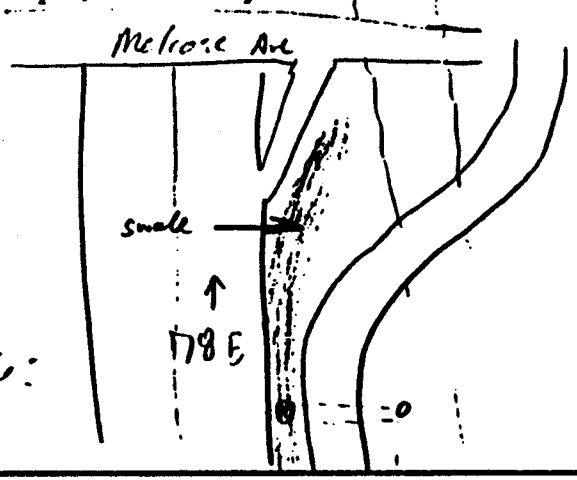
Checklist

Tributary Area	Space Available (Dim.)	Site Slope	Sediment Possible (Y/N)	Estimated Soil Type	Flow Path	Drainage Type	# of Connected Inlets
3	25' x 200	1-3%	—	[illegible]	—	—	—

Other considerations: Proximity to water wells, bedrock location, water table depth, distance to foundations.

Field Notes:

- one grate drain 24" pipe water to nearby receiving water
- 200' long [illegible] swale
- 20-60' wide
- can place drain & route runoff down swale



Appendix C

Criteria Rating System

Appendix C: Criteria Rating System

For the purposes of this study, the site selection criteria are defined as follows for each retrofit pilot program:

Trapping Catch Basins (Chapter 2)

Site Monitoring Feasibility refers to the system's downstream flow characteristics. If a system's outlet piping possesses subcritical flow conditions and smooth pipe surfaces, it would receive a 10. If the area around the system outlet was large enough to construct an energy dissipater, to slow down the runoff to allow for monitoring, it would receive an upper midrange score, less than 10 depending on the scope of modifications required. Areas with supercritical flow, corrugated metal pipes, and restricted areas for construction or modification to allow for safe monitoring would receive a low score.

Maintenance Feasibility indicates whether a site location contains enough space to safely and efficiently clean and maintain the catch basins and monitoring devices. Sites containing inlets along narrow, busy shoulders with no safe place to turn out or construct a maintenance pull-out would receive a low score. Sites with large shoulders and ample space to maintain the equipment would receive a high or 10 score.

Equipment Security refers to the possibility of theft of the monitoring equipment. Sites located in high crime areas, easily accessible to pedestrians will score low. Sites located in low crime areas in rural places or areas where pedestrian traffic is low would receive a high score or 10.

Sampling Safety and Access describes maintenance vehicle access for monitoring the site as well as safety with respect to traffic. A site that scored a 10 would have ample space for monitoring of the BMP including additional space for a maintenance safety buffer area and the construction of guard rails and paved access. A site with a score of 0 would not have enough space to monitor the BMP.

Catch Basin Inserts (Chapter 3)

The selection criteria for this study were similar to the other studies. However, due to the limited availability of potential sites, no matrix rating system was developed. The criteria for selecting the catch basin insert sites were:

The **Number of Existing Drain Inlets** required for the study was two. If a site did not contain at least two drains, it was not considered for the study.

The **Vehicles and Heavy Equipment** category includes the type of equipment and vehicles on the site. The catch basin inserts primarily treat petroleum hydrocarbons runoff constituents, therefore the more vehicles and heavy equipment onsite would indicate a better research opportunity.

Extended Detention Basins (Chapter 4)

Space Available includes both the space available to construct the BMP within safety and operational constraints and vehicle access for monitoring the site. A site that scored a 10 would have ample space for construction and monitoring of the BMP including additional space for a safety buffer area (clear zone). A site with a low score would have no or very little space to construct and/or monitor the BMP.

Site Stormdrain Configuration refers to the arrangement of inlets, outlets, and conveyance routes. These may influence the design of the extended detention basin. The optimal drain inlet/outlet structure is an in-line system where the inlet and outlet are located at opposite ends of the basin. A generally longer flow length between the inlet and the outlet will provide the opportunity for a greater constituent removal capacity. A score of 10 indicates a long flow length and an in-line drain system. A low score indicates poor drainage configuration.

Maintenance Access refers to the ability for maintenance workers and vehicles to enter the site, perform necessary maintenance, and exit the site with little safety hazard. This criterion is especially important to extended detention basins because the outlet may need to be regularly cleared of debris and sediment. A score of 10 means that the site provides safe and good access for maintenance off of public right-of-way and that all weather access roads can be constructed to the basin at grades compatible with heavy equipment. A low score refers to inadequate access for maintenance work.

Infiltration Basin (Chapter 5)

Estimated Soil is based on field observations and not on geotechnical testing. If a site was close to a river or appeared to be in an area containing predominately coarse alluvium, the site would score higher in this criterion based on the assumption that the soils would exhibit a higher infiltration rate. A site receiving a low score would likely be in an area with known bedrock or in terrace areas high in clay content.

Space Available includes both the space available to construct the BMP within safety and operational constraints and the vehicle access for monitoring the site. A site that scored a 10 would have ample space for construction, maintenance and monitoring of the BMP including additional space for a safety buffer area (clear zone). A site with a low score would not have enough space to construct, maintain, or monitor the BMP.

Proximity to Structures is the distance from the basin site to buildings, edge of pavement, or footings of bridge abutments or columns. A site that rated a 10 would not be near any structures. A site that rated low would be less than about 10 feet from a building , less than 20 feet for the edge of roadway paving, or less than 100 feet from footings for bridge abutments or columns. Further discussion on the siting of infiltration BMPs adjacent to bridge structures is contained in Appendix D.

Maintenance Access includes the ability for maintenance workers and vehicles to enter the site, perform necessary maintenance, and exit the site with little safety hazard. This criterion is especially important to infiltration basins because they are maintenance intensive. All weather access with grades compatible with heavy equipment must be feasible for the site to receive a relatively high score.

Infiltration Trench (Chapter 6)

Type of Activities include the type of maintenance activities and equipment storage at a maintenance station or the level of use and the presence of secondary activities at park and ride lots. Sites with extensive vehicle maintenance or equipment storage or other secondary activities, which are more likely to increase pollutant loading, would be scored a 10. A site fewer of these activities (heavy equipment, vehicle fueling, storage of petroleum products) would receive a low score.

Drainage Pattern includes the amount of tributary area to the inlet and the type of flow pattern (i.e. sheetflow versus well-defined concentration flow). These two factors are combined so that the overall factor becomes the percentage of tributary flow that can be directed to the trench. In order for a site to score a 10, the trench would have to intercept 100% of the tributary flow to the existing outlet. Conversely, a low score would indicate that little or none of the site flow could be directed to the filter location.

Space Available/Access includes both the space available to construct the BMP within safety and operational constraints and the maintenance vehicle access for monitoring the site. A site that scored a 10 would have ample space for construction, maintenance and monitoring of the BMP without unduly compromising safety or the operation of the maintenance facility. A site with a low score would not have enough space to construct, maintain, or monitor the BMP.

Proximity to Structures is the distance from the trench site to buildings, edge of pavement, or footings of bridges abutments or columns. A site that rated a 10 would not be near any structures. A site that received a low score would be less than 10 feet from a building , less than 20 feet for the edge of roadway paving, or less than 100 feet from footings for bridge abutments or columns.

Biofiltration Strips and Swales (Chapter 7)

Estimated Soil Type is based on field observations. If a site was located in alluvial soils, the site would score higher in this criterion based on the assumption that higher infiltration rates would predominate. A site with a low score would likely be in a an area with terrace deposits and high clay content, or exposed bedrock.

The **Estimated Tributary Area** selection criterion is a function of the amount of tributary watershed area relative to the area available to construct the BMP. A site that scored a 10 would have a tributary area of several acres and enough BMP construction area to safely convey the runoff. The area would allow for maintenance access. A site that scored relatively low would not have enough tributary watershed area or no space to construct the BMP and provide for maintenance and monitoring access.

The **Length** criterion considers whether there is enough room to construct the BMP given the width of the site. This criterion provides for a suitable residence time in the buffer strip or swale (for strips, both gross width and length are an important characteristic, ensuring that sheet flow, rather than concentrated flow occurs across the strip). A site with a score of 10 would have a large length to width ratio, such as 50. A site that scored relatively low would not have enough space to construct the BMP.

Slope is the change in elevation compared to the length of the strip or swale. A site scoring a 10 would have a longitudinal slope of about 0.02 percent. A site scoring relatively low would have a slope of over 6 percent with no practical method available to decrease the slope.

Media Filter (Chapter 8)

Drainage Pattern includes the amount of tributary area to the inlet and the type of flow pattern (i.e. sheetflow versus well-defined concentration points). These two factors are combined so that the overall factor becomes the percentage of tributary flow that can be directed to the filter. In order for a site to score a 10, the filter would have to intercept 100% of the tributary flow to the outlet. Conversely, a relatively low score would indicate that none of the tributary flow could be directed to the filter. An ideal site might be a sump area with a filter inlet that could capture 100% of the site tributary flow.

Vehicles and Heavy Equipment includes the relative number of pieces of heavy equipment, light-duty vehicles, or cars in comparison to the tributary area. For instance, a site with a score of 10 would have the highest percentage of vehicle coverage over the tributary area for the longest amount of time. A site that scored relatively low might be a park & ride that had a small volume of usage.

Space Available/Access includes both the space available to construct the BMP within safety and operational constraints and the maintenance vehicle access for monitoring and maintaining the site. A site that scored a 10 would have ample space for construction, maintenance, and monitoring of the BMP including enough space to ensure that site operations and safety and not unduly compromised. A site with a low score would not have enough space to construct, maintain, or monitor the BMP.

Oil Water Separator (Chapter 9)

Heavy Vehicles includes the relative number of pieces of heavy equipment, light-duty vehicles, and cars in comparison to the tributary area. For instance, a site with a score of 10 would have the highest percentage of vehicle coverage over the tributary area for the longest amount of time. A site that received a relatively low score might be a park & ride that had a low percentage of traffic relative to the available number of parking spaces.

Asphalt Containment refers to liquid asphalt crack sealant and solids storage containment and cover. A 10 means the containment is secure, allowing no runoff or leaching during rain events, while a lower score means the containment is poor.

Oil/Waste Storage refers to the storage of waste fuels. A 10 indicates good containment practices with no visual oil spills or stains in the immediate area. A lower score indicates the potential for materials to come in contact with storm water.

Flow Path includes on-site curb, swale, or sheet flow, which is relevant to having good sampling conditions. A 10 refers to concentrated flow and a lower value refers to shallow or a sheet flow condition.

Site Exposure refers to the amount of cover over the site, e.g. for 100% bridge coverage a low score would be given. No bridge cover would score a 10.

Onsite Drainage describes the existence of catch basins on-site. A low score means there are no catch basins within site boundaries and no opportunity to construct them as a part of the retrofit project. A 10 indicates 100% of the site runoff is captured on site where it is routed to an offsite drainage system.

Access refers to site accessibility for sample couriers. A low score was given for sites difficult to access by car. A 10 was scored for sites with no access restrictions.

Traffic Safety refers to location safety with respect to traffic. A low score means the site was dangerous, exposed to traffic hazards and a 10 means the site was safe with respect to traffic.

District 11

Criteria Rating System

Appendix C: Criteria Rating System, District 11

For the purposes of this study, the site selection criteria are defined as follows for each retrofit pilot program:

Extended Detention Basins (Chapter 2)

Target Watershed refers to the primary target watershed for locating and constructing the five retrofit pilot projects. Caltrans has proposed the Carlsbad Hydrologic Unit, as defined by San Diego Regional Water Quality Control Board, as primary watershed. The Penasquitos Hydrologic Unit was considered as a first alternative or secondary watershed for locating the remaining pilot projects. If detailed site investigation of Caltrans right-of-way within the primary target watershed proved that no adequate sites for any of the five pilot projects could be found, some of the projects were located in other watersheds. A site that scores a 10 is located in the target watershed. A site in the secondary watershed scored a 5. A site located in neither watersheds received a score of 0.

Space Available includes both the space available to construct the BMP within safety and operational constraints and vehicle access for monitoring the site. A site that scored a 10 would have ample space for construction and monitoring of the BMP including additional space for a safety buffer area (clear zone). A site with a low score would have no or very little space to construct and/or monitor the BMP.

Proximity to Structures is the distance from the extended detention basin site to buildings, edge of pavement, or footings of bridges abutments or columns. A site that rated a 10 would not be near any structures. A site that received a low score would be less than 10 feet from a building , less than 20 feet for the edge of roadway paving, or less than 100 feet from footings for bridge abutments or columns.

Proximity to Receiving Waters refers to the distance between BMP sites and receiving waters. A score of "10" refers to drainage to a sensitive receiving water. A "0" refers to a site that has a long flow path before draining to receiving waters.

Site Stormdrain Configuration refers to the arrangement of inlets, outlets, and conveyance routes. These may influence the design of the extended detention basin. The optimal drain inlet/outlet structure is an in-line system where the inlet and outlet are located at opposite ends of the basin. A generally longer flow length between the inlet and the outlet will provide the opportunity for a greater constituent removal capacity. A score of 10 indicates a long flow length and an in-line drain system. A low score indicates poor drainage configuration.

Maintenance Access refers to the ability for maintenance workers and vehicles to enter the site, perform necessary maintenance, and exit the site with little safety hazard. This criterion is especially important to extended detention basins because the outlet may need to be regularly cleared of debris and sediment. A score of 10 means that the site provides safe and good access for maintenance off of public right-of-way and that all

weather access roads can be constructed to the basin at grades compatible with heavy equipment. A low score refers to inadequate access for maintenance work.

Infiltration Trench (Chapter 3)

Type of Activities include the type of maintenance activities and equipment storage at a maintenance station or the level of use and the presence of secondary activities at park and ride lots. Sites with extensive vehicle maintenance or equipment storage or other secondary activities, which are more likely to increase pollutant loading, would be scored a 10. A site fewer of these activities (heavy equipment, vehicle fueling, storage of petroleum products) would receive a low score.

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Space Available/Access includes both the space available to construct the BMP within safety and operational constraints and the maintenance vehicle access for monitoring the site. A site that scored a 10 would have ample space for construction, maintenance and monitoring of the BMP without unduly compromising safety or the operation of the maintenance facility. A site with a low score would not have enough space to construct, maintain, or monitor the BMP.

Proximity to Structures is the distance from the trench site to buildings, edge of pavement, or footings of bridges abutments or columns. A site that rated a 10 would not be near any structures. A site that received a low score would be less than 10 feet from a building , less than 20 feet for the edge of roadway paving, or less than 100 feet from footings for bridge abutments or columns.

Proximity to Receiving Waters refers to the distance between BMP sites and receiving waters. A score of "10" refers to drainage to a sensitive receiving water. A "0" refers to a site that has a long flow path before draining to receiving waters.

Biofiltration Strips and Swales (Chapter 4)

Estimated Soil Type is based on field observations. If a site was located in alluvial soils, the site would score higher in this criterion based on the assumption that higher infiltration rates would predominate. A site with a low score would likely be in a an area with terrace deposits and high clay content, or exposed bedrock.

The **Estimated Tributary Area** selection criterion is a function of the amount of tributary watershed area relative to the area available to construct the BMP. A site that scored a 10 would have a tributary area of several acres and enough BMP construction area to safely convey the runoff. The area would allow for maintenance access. A site that scored relatively low would not have enough tributary watershed area or no space to construct the BMP and provide for maintenance and monitoring access.

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Slope is the change in elevation compared to the length of the strip or swale. A site scoring a 10 would have a longitudinal slope of about 0.02 percent. A site scoring relatively low would have a slope of over 6 percent with no practical method available to decrease the slope.

Proximity to Receiving Waters refers to the distance between BMP sites and receiving waters. A score of "10" refers to drainage to a sensitive receiving water. A "0" refers to a site that has a long flow path before draining to receiving waters.

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Infiltration Basin (Chapter 5)

Estimated Soil is based on field observations and not on geotechnical testing. If a site was close to a river or appeared to be in an area containing predominately coarse alluvium, the site would score higher in this criterion based on the assumption that the soils would exhibit a higher infiltration rate. A site receiving a low score would likely be in an area with known bedrock or in terrace areas high in clay content.

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Space Available includes both the space available to construct the BMP within safety and operational constraints and the vehicle access for monitoring the site. A site that scored a 10 would have ample space for construction, maintenance and monitoring of the BMP including additional space for a safety buffer area (clear zone). A site with a low score would not have enough space to construct, maintain, or monitor the BMP.

Proximity to Structures is the distance from the basin site to buildings, edge of pavement, or footings of bridge abutments or columns. A site that rated a 10 would not be near any structures. A site that rated low would be less than about 10 feet from a building , less than 20 feet for the edge of roadway paving, or less than 100 feet from footings for bridge abutments or columns. Further discussion on the siting of infiltration BMPs adjacent to bridge structures is contained in Appendix D.

Maintenance Access includes the ability for maintenance workers and vehicles to enter the site, perform necessary maintenance, and exit the site with little safety hazard. This criterion is especially important to infiltration basins because they are maintenance intensive. All weather access with grades compatible with heavy equipment must be feasible for the site to receive a relatively high score.

Proximity to Receiving Waters refers to the distance between BMP sites and receiving waters. A score of "10" refers to drainage to a sensitive receiving water. A "0" refers to a site that has a long flow path before draining to receiving waters.

Wet Basins (Chapter 6)

Target Watershed refers to the primary target watershed for locating and constructing the five retrofit pilot projects. Caltrans has proposed the Carlsbad Hydrologic Unit, as defined by San Diego Regional Water Quality Control Board, as primary watershed. The Penasquitos Hydrologic Unit was considered as a first alternative or secondary watershed for locating the remaining pilot projects. If detailed site investigation of Caltrans right-of-way within the primary target watershed proved that no adequate sites for any of the five pilot projects could be found, some of the projects were located in other watersheds. A site that scores a 10 is located in the target watershed. A site in the secondary watershed scored a 5. A site located in neither watersheds received a score of 0.

Space Available includes both the space available to construct the BMP within safety and operational constraints and the vehicle access for monitoring the site. A site that scored a 10 would have ample space for construction, maintenance and monitoring of the

BMP including additional space for a safety buffer area (clear zone). A site with a low score would not have enough space to construct, maintain, or monitor the BMP.

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Proximity to Receiving Waters refers to the distance between BMP sites and receiving waters. A score of "10" refers to drainage to a sensitive receiving water. A "0" refers to a site that has a long flow path before draining to receiving waters.

Oil Water Separator (Chapter 7)

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Heavy Vehicles includes the relative number of pieces of heavy equipment, light-duty vehicles, and cars in comparison to the tributary area. For instance, a site with a score of 10 would have the highest percentage of vehicle coverage over the tributary area for the longest amount of time. A site that received a relatively low score might be a park & ride that had a low percentage of traffic relative to the available number of parking spaces.

Asphalt Containment refers to liquid asphalt crack sealant and solids storage containment and cover. A 10 means the containment is secure, allowing no runoff or leaching during rain events, while a lower score means the containment is poor.

Oil/Waste Storage refers to the storage of waste fuels. A 10 indicates good containment practices with no visual oil spills or stains in the immediate area. A lower score indicates the potential for materials to come in contact with storm water.

Flow Path includes on-site curb, swale, or sheet flow, which is relevant to having good sampling conditions. A 10 refers to concentrated flow and a lower value refers to shallow or a sheet flow condition.

Site Exposure refers to the amount of cover over the site, e.g. for 100% bridge coverage a low score would be given. No bridge cover would score a 10.

Onsite Drainage describes the existence of catch basins on-site. A low score means there are no catch basins within site boundaries and no opportunity to construct them as a part of the retrofit project. A 10 indicates 100% of the site runoff is captured on site where it is routed to an offsite drainage system.

Access refers to site accessibility for sample couriers. A low score was given for sites difficult to access by car. A 10 was scored for sites with no access restrictions.

Traffic Safety refers to location safety with respect to traffic. A low score means the site was dangerous, exposed to traffic hazards and a 10 means the site was safe with respect to traffic.

Media Filter (Chapter 8)

Vehicles and Heavy Equipment includes the relative number of pieces of heavy equipment, light-duty vehicles, or cars in comparison to the tributary area. For instance, a site with a score of 10 would have the highest percentage of vehicle coverage over the tributary area for the longest amount of time. A site that scored relatively low might be a park & ride that had a small volume of usage.

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Space Available/Access includes both the space available to construct the BMP within safety and operational constraints and the maintenance vehicle access for monitoring and maintaining the site. A site that scored a 10 would have ample space for construction, maintenance, and monitoring of the BMP including enough space to ensure that site operations and safety and not unduly compromised. A site with a low score would not have enough space to construct, maintain, or monitor the BMP.

Proximity to Receiving Waters refers to the distance between BMP sites and receiving waters. A score of "10" refers to drainage to a sensitive receiving water. A "0" refers to a site that has a long flow path before draining to receiving waters.

Site Storm Drain refers to the presence of an onsite drainage facility and receive a score of "y." Sites containing no drainage facility and allowing sheet flow to an offsite drainage facility would receive a "n."

Drainage Pattern includes the amount of tributary area to the inlet and the type of flow pattern (i.e. sheetflow versus well-defined concentration points). These two factors are combined so that the overall factor becomes the percentage of tributary flow that can be directed to the filter. In order for a site to score a 10, the filter would have to intercept 100% of the tributary flow to the outlet. Conversely, a relatively low score would indicate that none of the tributary flow could be directed to the filter. An ideal site might be a sump area with a filter inlet that could capture 100% of the site tributary flow.

Structural Setback

M E M O R A N D U M

To: Scott Taylor, MS 140 JN 34122

From: Paul Young, Vice President, Structural Engineering

Date: January 27, 1998

Subject: Storm Water Quality BMP - Infiltration Basin or Trench Siting

This memorandum addresses the potential impact of infiltration percolation basins and trenches being located in the vicinity of bridge foundations as part of the implementation of the Pilot Retrofit Best Management Practices program.

Our understanding is that storm water run-off collected in the vicinity of the bridge would be collected and discharged to either an infiltration basin or trench. The trenches would have approximate dimensions of 5 feet wide, 5 to 7 feet deep and a length possibly up to 100 feet, basins would be up to about 5 feet deep and cover an area sufficient to store the computed storm water infiltration volume. Final dimensions would be sized to accommodate the expected runoff. The percolation trench would be filled with sand and gravel. The purpose of each system is to allow storm water to percolate into the ground at the location it is collected, rather than discharge the water to a storm drain system.

The concern with respect to the bridges which would be in the vicinity is whether the percolation into the ground would impact the bridge foundation capacity and at what distance could the basin or trench be situated from the foundation such that no impact from the percolation would be expected at the bridge foundation.

First, it is reasonable to assume that discharging run-off immediately adjacent to the bridge foundation could impact the soil and foundation capacity, especially in the case of spread footings. It is therefore prudent to locate the percolation basin or trench some reasonable distance from the foundation.
As water percolates through the sides and bottom of the basin or trench the general tendency would be for the water to percolate downwards due to gravity as it also migrates laterally, especially if the natural ground water level is not near the surface. For this case (with somewhat deep ground water level) it would seem reasonable that the groundwater would not migrate at shallower than a 1 horizontal to 1 vertical slope. It would be unusual for the piles of a bent footing supported on piles to extend deeper than about 70 feet below the existing grade. Therefore, allowing for some additional factor of safety, a lateral distance of 100 feet from the foundation to any point along the infiltration trench or basin should sufficiently avoid any impact to the bridge foundation.

For the case where the natural ground water table is near the surface and percolation may be somewhat lateral, rather than downward, it is likely the presence of ground water has already been considered in the design of the bridge foundation.

Based upon this empirical reasoning a distance of 100 feet between the bridge edge of footing and the percolation basin or trench should avoid any detrimental impact to the bridge foundations. The placement of an infiltration BMP closer than 100 feet would require a more detailed geotechical and bridge structural evaluation.

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Safety Setback

For additional information, see Design Information Bulletin Number 75, "Geometric Design Criteria for Resurfacing, Restoration, and Rehabilitation (RRR) Projects.

Topic 308 - Cross Sections for Roads Under Other Jurisdictions

308.1 City Streets and County Roads

The width of local roads and streets that are to be reconstructed as part of a freeway project should conform to AASHTO standards if the local road or street is a Federal-aid route. Otherwise the cross section should match the width of the city street or county road adjoining the reconstructed portion, or the cross section should satisfy the local agency's minimum standard for new construction.

Where a local facility within the State right of way crosses over or under a freeway or expressway but has no connection to the State facility, the minimum design standards for the cross section of the local facility within the State's right of way shall be those found in AASHTO. If the local agency has standards that exceed AASHTO standards, then the local agency standards shall apply.

AASHTO standards for local roads and streets are given in "A Policy on Geometric Design of Highways and Streets", AASHTO, 1990.

It is important to note that "A Policy on Geometric Design of Highways and Streets", AASHTO, 1990, standards are based on functional classification and not on a Federal-aid System.

Chapters V, VI and VII of the "A Policy on Geometric Design of Highways and Streets", AASHTO, 1990, list standards for the following six functional classes:

- o Local rural roads
- o Local urban streets
- o Rural collectors
- o Urban collectors
- o Rural arterials
- o Urban arterials

"A Policy on Geometric Design of Highways and Streets", AASHTO, 1984, gives minimum lane and shoulder widths. When selecting a cross section, the effects on capacity of commercial vehicles and grades should be considered as discussed under Topic 102 and in the "Highway Capacity Manual", 1985.

The minimum width of 2-lane overcrossing structures shall not be less than 28 feet curb to curb. Also see Index 208.1(2) and Index 307.3.

If the local agency has definite plans to widen the local street either concurrently or within 5 years following freeway construction, the reconstruction to be accomplished by the State should generally conform to the widening planned by the local agency. Stage construction should be considered where the planned widening will occur beyond the 5-year period following freeway construction or where the local agency has a master plan indicating an ultimate width greater than the existing facility. Where an under crossing is involved, the initial structure construction should provide for ultimate requirements.

Where a local facility crosses over or under a freeway or expressway and connects to the State facility (such as ramp terminal intersections), the minimum design standards for the cross section of the local facility shall be at least equal to those for a conventional highway with the exception that the outside shoulder width shall match the approach roadway, but not less than four feet (shoulder width should not be less than five feet where curbs with two-foot gutter pans are proposed and bicycle use is expected). **The minimum width for two-lane overcrossings at interchanges shall be 40 feet curb-to-curb.**

Topic 309 - Clearances

309.1 Horizontal Clearances

(1) General. The horizontal clearance to all fixed roadside objects including bridge piers, abutments, retaining walls, and noise barriers should be based on engineering judgment with the objective of maximizing the distance between fixed objects and the edge of traveled way. Engineering judgment should be exercised in order to balance the achievement of horizontal clearance objectives with the prudent expenditure of available funds.

Certain yielding objects, such as sand filled barrels, metal beam guard rail, breakaway wood posts, etc. may encroach within the clear recovery zone (see Index 309.1(2)). While these objects are designed to reduce the likelihood of serious injury to vehicle occupants, collisions can be severe and efforts should be made to maximize the distance between the object and the edge of traveled way.

Clearances are measured from the edge of the traveled way to the nearest point on the obstruction (usually the bottom). **Horizontal clearances greater than those cited below under**

subsection (3) - "Minimum Clearances" shall be providedwhere necessary to meet horizontal stopping sight distance requirements to median barriers, bridge rails, bridge columns, retaining walls, cut slopes, and noise barriers. See discussion on ".. technical reductions in design speed .." under Topic 101.

(2) Clear Recovery Zone. A clear recovery zone is an unobstructed, relatively flat or gently sloping area beyond the edge of the traveled way which affords the drivers of errant vehicles the opportunity to regain control.

The following clear recovery zone widths are the minimum desirable for the type of facility indicated. Consideration should be given to increasing these widths based on traffic volumes, operating speeds, terrain, and costs associated with a particular highway facility:

- o Freeways and Expressways - 30 feet
- o Conventional Highways (no curbs) - 20 feet
- o Conventional Highways (with curbs)* -1.5 feet

*This clear zone is measured from the face of curb to the obstruction.

Fixed objects which are closer to the edge of traveled way than the distances listed above should be eliminated, moved, redesigned to be made yielding, or shielded in accordance with the following guidelines:

(a) Fixed objects should be eliminated or moved outside the clear recovery zone to a location where they are unlikely to be hit.

(b) If sign posts six inches or more in any dimension or light standards cannot be eliminated or moved outside the clear recovery zone, they should be made yielding with a breakaway feature.

(c) If a fixed object cannot be eliminated, moved outside the clear recovery zone, or modified to be made yielding, it should be shielded by guardrail or a crash cushion.

Where compliance with the above stated clear recovery zone guidelines is impractical, the minimum horizontal clearance cited below shall apply to the unshielded fixed object.

(3) Minimum Clearances. **The following minimum horizontal clearances shall apply to fixed objects that are closer to the edge of traveled way than the clear recovery zone distances listed above:**

(a) The minimum horizontal clearance to fixed objects such as bridge rails, safety-shaped concrete barriers, abutments, retaining walls or noise barriers on all freeway and expressway facilities, including auxiliary lanes, ramps, and collector roads shall be equal to the standard shoulder width of the highway facility as stated in Table 302.1. A minimum clearance of four feet shall be provided where the standard shoulder width is less than four feet. Approach rail connections to bridge rail may require special treatment to maintain the standard shoulder width.

(b) On two-lane highways, frontage roads, city streets and county roads (all without curbs), the minimum horizontal clearance shall be the standard shoulder width as listed in Tables 302.1 and 307.2, or as determined from Table 307.3, except that a minimum clearance of four feet shall be provided where the standard shoulder width is less than four feet.

On curbed highway sections, a minimum clearance of three feet should be provided along the curb returns of intersections and near the edges of driveways to allow for design vehicle off tracking (see Topic 404). Where sidewalks are located immediately adjacent to curbs, fixed objects should be located beyond the back of sidewalk to provide an unobstructed area for pedestrians.

A safety shaped barrier face should be constructed integrally at the base of any retaining, pier, or abutment wall which faces traffic and is 15 feet or less from the edge of traveled way (right or left of traffic and measured from the face of wall). See Index 1102.4 for the treatment of noise barriers.

The minimum width of roadway openings between temporary K-rail on bridge deck widening projects should be obtained from the District Permits Engineer.

See Chapter 7 of the Traffic Manual for other requirements pertaining to clear recovery zone, guardrail at fixed objects and embankments, and crash cushions.

Appendix E

Infiltration Trench Calculations

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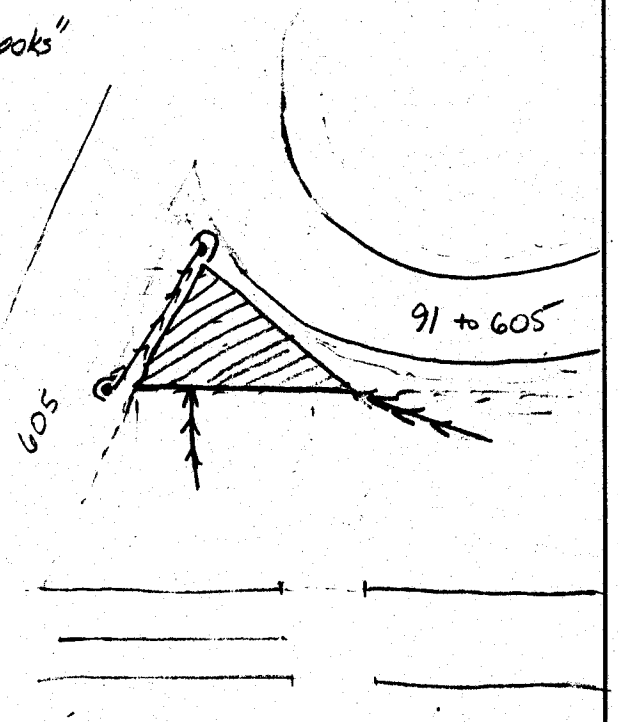
Preliminary Infiltration Trench Design Calculations.

Reference: "Caltrans Storm Water Quality Handbooks"

SITE (1): Cerritos MS : A ≈ ¾ acre

Approx Surface Area: ½ bh

$\frac{1}{2}(60)(40) = 1200\ ft^2$



Depth	Volume Max Hold
2	.840 ft³
3	1260
4	1680
5	2100
6	2520
7	2940
8	3360
9	3780
10	4200

*NOTE: Assuming aggregate has a 35% void space.

From the Caltrans Storm Water Quality Handbook, PDIIB(1): Storm Volume computation chart:

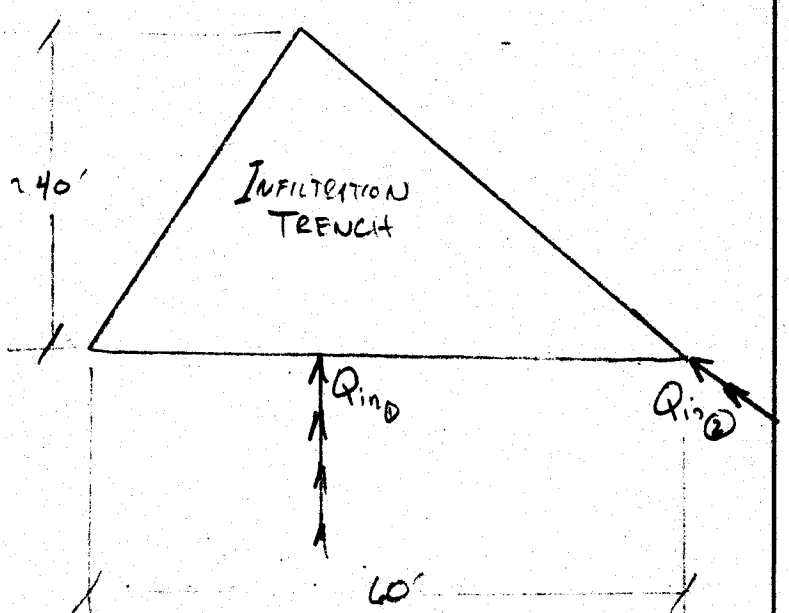
Zone: Los Angeles
Using 80%-100% Impervious Area.

$Q_{(1yr\text{-}24hr)} \triangleq 180\ m^3/ha \Rightarrow 2574\ \frac{ft^3}{acre}$.

$V = QA_{tot} = 1980\ ft^3$

Approximation of expected config.

So depth ≈ 4½'



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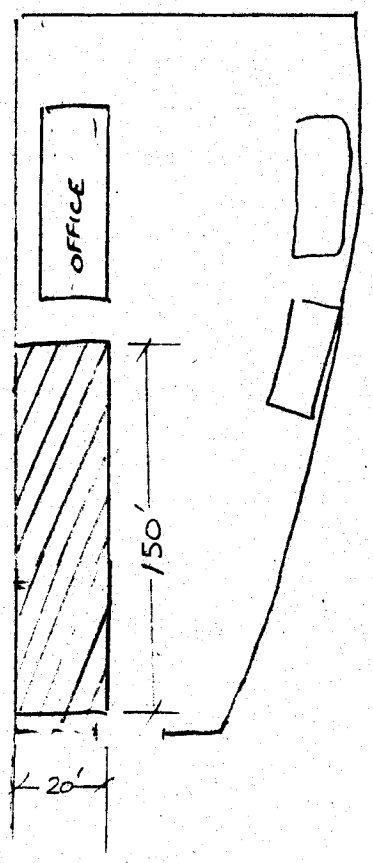
SITE (2): TARZANA MS : $A_{tributary} \doteq 3\frac{1}{2}$ acres.

Approx. Surface Area:
$(150)(20) = \underline{\underline{3000}}\ ft^2$

Depth	Volume Max Head
2	2,100
3	3,150
4	4,200
5	5,250
6	6,300
7	7,350
8	8,400
9	9,450
10	10,500

NOTE: Assuming aggregate has a 35% void space.



$Q_{(1yr-24hr)} \doteq 180\ m^3/ha \approx 2574\ ft^3/acre$

$V = QA = 9000\ ft^3$

∴ depth ≥ 8½' V = 180 m^3/ha 8000

* NOTE: The dimensions used in these calculations for trench sizes are only rough approximations.

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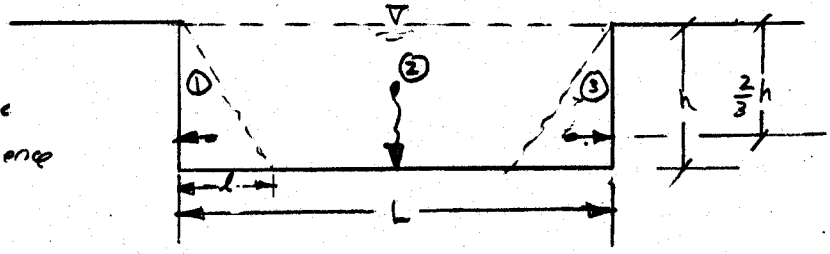
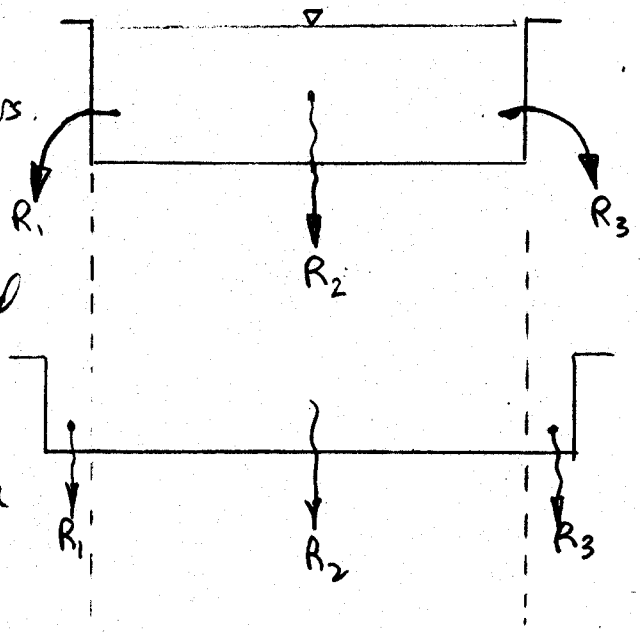
Carritos MS Trench.

- Looking @ hydrostatic pressures that influence exfiltration.



- Since the hydrostatic pressure decreases as the water level lowers, the rate of exfiltration also lowers.

- To estimate an average Hyd. Pressure, the midpoint or $(\frac{h}{2})$ level was considered for calcs on all R values.



-fig 2. Resultant hydrost forces.

-fig 3. Equivalnt hydr. forces.

- Since the side exfiltration is near vertical, it was approximated by the following:

$Q_{TOT} = IA$ where Q = capacity of basin discharge / day
I = Vertical Infiltration rate $(2.5 \times 10^{-6}$ ft/sec)
A = Area of basin

$Q_{TOT} = Q_1 + Q_2 + Q_3$

$Q_{TOT} = I(A_1 + A_2 + A_3)$

$Q_{TOT} = I(1200 + 430)$

$A_2 \Rightarrow$ (Floor area) $\triangleq$ 1200 ft²

$A_1 = A_3 \Rightarrow$ (effective side areas) triangular & distributed

$\therefore \Rightarrow$ (height/2)(perimeter) $\hat{=} (\frac{4\frac{1}{2}}{2})(190') \hat{=}$ 430 ft²

↓ c.g. @ sidewall

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$\therefore t = \frac{Vol}{Q_{TOT}} = \frac{1930\ ft^3}{(2.5 \times 10^{-4}\ ft/s)(1630\ ft^2)}$

$t \hat{=} 5.48$ days. $\sim 5\frac{1}{2}$ days.

TARZANA MS
Trench #1

$Q_{TOT} = IA$ $\quad (I = 1.1 \times 10^{-7}\ ft/sec.)$

$Q_{TOT} = I(A_{BOT} + A_{SIDE})$

$A_{BOTTOM} = 3000\ ft^2$

$A_{SIDE} = \frac{1}{2}(\text{height})(\text{perimeter}) \Rightarrow \frac{1}{2}(8\frac{1}{2})(340') = 1445\ ft^2$

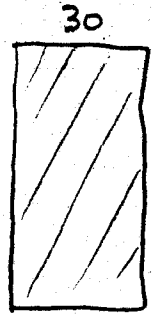
$Q_{TOT} = (1.1 \times 10^{-7}\ \frac{ft}{sec})(3000 + 1445)$

$Q_{TOT} = 4.8895 \times 10^{-4}\ ft^3/s$

$t = \frac{Vol}{Q_{TOT}} = \left(\frac{9000\ ft^3}{4.8895 \times 10^{-4}\ ft^3/s}\right) \hat{=}$ **213 days = t**

TARZANA MS
Trench #2

Try: L = 200', w = 30'



V = 9000
$\therefore h = 1.5$

$\therefore Q_{TOT} = I(A_B + A_S) = I(6000 + \frac{1}{2}(1\frac{1}{2} \cdot 460)) = 6.7518 \times 10^{-4}$

$t = \frac{Vol}{Q_{TOT}} = \left(\frac{9000}{6.7518 \times 10^{-4}}\right) =$ **154 days = t**

Caltrans Proposal for

San Diego Retrofit Projects,

October 23, 1997

Retrofit Pilot Program, Caltrans District 11

Background

Caltrans will undertake five retrofit pilot projects in District 11, comprised of eight types of Best Management Practices (BMPs). Caltrans will develop and implement a coordinated pilot program to test the feasibility and effectiveness of designing, constructing and maintaining the selected BMPs. The program will be implemented in a single watershed in District 11 and integrated with existing Caltrans facilities; however, some projects may be located outside of the selected 'target' watershed if a suitable number of sites cannot be located within the target watershed area. The five proposed retrofit projects and estimated construction costs are described in Table 1.

Table 1

Project	Description	# Sites	Construction Cost
1	Biofilter* and Infiltration Basin	2	$882,344
2	Biofilter* and Infiltration Trench	2	$281,516
3	Extended Detention/Infiltration Basins	2	$634,608
4	Wet Basin	1	$352,196
5	Oil/Water Separator/Media Filter	3	$368,551
	Construction Total – All Projects		$2,519,215

*One site will be constructed using a biofilter swale; the second site will be constructed using a biofilter strip.

General Project Criteria

For each project defined above, Caltrans will design, construct, maintain and monitor the BMP system. The objectives of the program will be as follows:

1. Determine the feasibility of design, construction and maintenance of the selected BMPs;
2. Evaluate the performance of the selected BMPs in removing constituents of concern in highway stormwater runoff;
3. Evaluate the frequency and magnitude of operational problems associated with maintenance of the structures and maintenance and safety concerns specific to transportation facilities.

Complete records of design, construction, operation, maintenance and monitoring will be kept as a part of the pilot study program for use in the development of a final report as to the feasibility, performance and operational characteristics of the defined projects.

Project Descriptions

Project 1 – Biofilter and Infiltration Basin

Project 1 consists of identifying 2 sites along a Caltrans freeway or highway to construct combination biofiltration swales/strips and downstream infiltration basins. The biofilter/basin combinations will be constructed at locations where sheet flow occurs from highway pavement, and where a downstream infiltration basin may be constructed. Runoff from the biofilter may be piped to the infiltration basin location if sufficient right-of-way is not available adjacent to the edge of pavement for construction of the infiltration basin in close proximity. One site will be constructed using a biofilter swale upstream of an infiltration basin. The second site will be constructed using a biofilter strip upstream of an infiltration basin. The infiltration basins will be constructed to intercept and infiltrate the selected design storm. The vegetated swale/strip will be constructed upstream from the basin to remove particulates that could potentially clog the infiltration basin. The biofilter/basin combinations will be visually monitored over a two year period using the following criteria:

- Maintenance frequency of the basin to maintain adequate infiltration rate;
- Rate of infiltration under the typical storm condition;
- Problems associated with disposal of material that accumulates in the basin;
- Potential for groundwater contamination and associated regulatory implications.

The project will establish procedures and schedules for maintenance of the swales, strips and basins. Influent and effluent to the biofilter shall also be monitored for water quality parameters using automatic samplers. Groundwater will be sampled using a well, or pressure-vacuum lysimeter in the case where the groundwater table is relatively deep. Rate of percolation to the basin will be monitored, and testing of the basin sediments will be performed at the end of the established monitoring period. The construction cost for each component of Project 1 is estimated to be $426,804 for the swale/basin location and $455,540 for the vegetated strip/basin combination for a total construction cost for Project 1 of $882,344.

Project 2 – Biofilter and Infiltration Trench

Project 2 is similar to Project 1 except an infiltration trench is substituted for the infiltration basin. Project 2 may be more practically implemented in areas where right-of-way is limited and the tributary area is smaller. Design and monitoring criteria will be as indicated above except that sediments will not be monitored. Infiltration trenches will be equipped with monitoring wells to allow computation of infiltration rates, and observations relative to declining infiltration performance.

Biofilter/infiltration trenches will be constructed at two sites at Caltrans maintenance facilities, park and ride lots and/or District office parking areas. One site will be

constructed with a vegetated swale and infiltration trench combination, the second site will be constructed with a vegetated strip/infiltration trench combination. The construction cost for each component of Project 2 is estimated to be $126,390 for the swale/trench location and $155,126 for the vegetated strip/trench combination for a total construction cost for Project 2 of $281,516.

Project 3 – Basin Investigation – Extended Detention and Infiltration

Two basins will be constructed at locations along an existing freeway or highway serving a Caltrans storm drain outfall. The project will consist of constructing one extended detention basin, and one infiltration basin to determine the feasibility of constructing these types of BMPs within the highway right-of-way, and to assess their performance relative to the removal of highway constituents of concern. The extended detention basin will be designed with a detention time of 48 hours for the selected design storm. The infiltration basin will be designed to capture and infiltrate the selected design storm. Larger storm events will exceed the capacity of the basins and discharge through the facility overflow weir. Water quality will be sampled using automated equipment for the extended detention basin inflow and outflow to determine basin efficiency in the removal of highway stormwater runoff constituents. Sampling for the infiltration basin will be as described for Project 1.

The construction cost for each component of Project 3 is estimated to be $282,412 for the extended detention basin and $352,196 for the infiltration basin, for a total Project 3 construction cost of $634,608.

Project 4 – Wet Pond

Project 4 will consist of the construction of a wet pond serving a Caltrans freeway or highway. The pool volume shall be equal to the runoff volume from the design storm, and additional volume will be provided above the permanent pool to provide a 24 hour drain time for the design storm event. Emergent vegetation will be planted around the pond periphery to enhance constituent removal and improve aesthetics. A perennial water source will be a key component of the siting of this BMP. Possible water sources include locations where there is groundwater infiltration to the Caltrans storm drain system, or where the pond may be excavated to intersect the groundwater table. It will be important to sample this 'source' water to document the constituents it contains. It is anticipated that such baseline sampling can be completed early in the evaluation process.

Monitoring of the pond stormwater influent and effluent will be accomplished using automatic samplers, flowrate will also be monitored and pond sediments will be sampled at the termination of the monitoring period.

The construction cost for the wet pond is estimated to be $352,200.

Project 5 – Oil/Water Separators and Media Filters

Project 5 consists of identifying 1 site for the installation of an oil/water separator and 2 sites for the installation of media filters. The separators will be constructed at Caltrans maintenance facilities or truck scales/immigration check points where vehicles are parked for long periods of time. The separators shall be the coalescing-plate (CPI) type and installed in locations where gravity flow may be used. The separator shall have a forebay to collect floatables and the larger settleable solids, and shall also have an afterbay in which oil-absorbent pillows or similar material may be placed.

The separators shall be monitored to ensure they are clean and operating properly, with the oil absorbent pads replaced prior to each season. Influent and effluent will be monitored using 'grab' sampling. Samples will be monitored for total oil and grease.

Two sites will also be selected for the installation of sand or compost filters. The filters will be constructed at maintenance stations, park and ride lots, or immigration/border check points and/or truck scale facilities where large vehicles are parked for continuous periods. The media filters will be designed using established procedures and manufacturers recommendations. Water quality monitoring will be performed following construction to determine the performance of the filter in removing constituents in highway runoff. Inflow and outflow will be monitored using automatic sampling equipment. The filters will also be monitored relative to maintenance requirements, with specific attention given to the frequency of maintenance required to maintain the effectiveness of the filter.

The total construction cost for the oil/water separator is estimated to be $71,565, and the total construction cost for the media filters is estimated to be $296,986, for a total construction cost of Project 5 of $368,551.

Project Outline

The general steps in the implementation of the District 11 retrofit project will be as shown in the following project outline:

1. **Project Site Selection**
   - A. Preliminary Site Selection
     1. Identify Candidate Sites
     2. Refine to Preliminary Sites
     3. Develop Preliminary Site Reports
     4. CT/EPA/NRDC Review/Field Review
   - B. Final Site Selection

2. **Project Design**
   - A. Site Survey
   - B. Site Topography Compilation

C. Plan Preparation
D. Plan Check
E. Plan Revisions
F. Plans Signed/Released for Construction

3. Bid Projects

A. Advertise
B. Award
C. Construction Begins

4. Construction

A. Project 1
B. Project 2
C. Project 3
D. Project 4
E. Project 5

5. Monitoring

A. Visual Monitoring
B. Stormwater Quality Monitoring

6. Report

A. Write Final Report
B. Review by CT/EPA/NRDC
C. Revisions
D. Final Report

Water Quantity

Mitigation Paper

Background

San Diego Consent Decree requires Caltrans to implement Retrofit Pilot Program in District 11. The Retrofit Pilot Program is designed to determine the appropriateness of retrofitting at Caltrans' existing facilities and rights-of-way. One of the criteria used to determine appropriateness is "potential for improvements in water quality, including without limitation water quantity effects". This paper examines the issue of "water quantity effects".

Issue

A stream is defined as 'stable' if it is in equilibrium with the flow it carries and with the characteristics of the bed and bank material. The term 'dynamic equilibrium' is often used to characterize geomorphic equilibrium which Lane (1955) developed as:

$$Q_S, D_{50} \propto Q, S$$

where Q_s is the sediment discharge
D_{50} is the median sediment size
Q is the water discharge
S is the channel slope

The above relation states that flow moves sediment downstream at a rate proportional to the slope and discharge of the stream. Urbanization can impact both Q_s and Q, in turn impacting the channel slope. For example, given an increase in discharge commonly associated with urbanization, and assuming that the supply of sediment remains constant, the channel slope will flatten through a degradation process. Conversely, when flow decreases the slope of the waterway will increase, reflecting the aggradation process.

As pointed out by Urbonas and Benik (1995), general degradation of urban waterways occurs as a result of urbanization, resulting in changes to the stream cross section and the transport of sediment to downstream receiving waters. Further, it is the annual (bankfull) and smaller storms that shape the waterway and dominate the shape of the stream.

Leopold (1994) has studied the principal of bankfull discharge in detail. The bankfull discharge is considered to be the discharge that dominates the channel cross section and slope. The bankfull discharge is the flow that has a recurrence interval of about 1.5 years. Leopold did extensive study of a small stream in Maryland over the span of 20 years. He noted that the number of times that the channel exceeded bankfull increased dramatically as urbanization occurred in the watershed with associated changes in the channel cross section.

Urbanization changes not only the water discharge in a stream, but the sediment discharge as well. Suspended load can be reduced as a result of the construction of impervious surfaces. The primary source of suspended load in most locations is from sheet erosion. In the absence of this mechanism, bank erosion may become more pronounced. Consequently, the impact to a given stream course from urbanization is not easily assessed through an examination of peak flow rates only, although it is clear that the dominate (1.5-year) discharge plays an important role in such an analysis. Rather, a comprehensive assessment would include an examination of sediment load to a particular reach as well as review of hydrologic parameters.

Stormwater Management

Storm water management is based on the premise of replacing natural retention that is lost as a result of urbanization (depression storage, infiltration) with constructed detention storage. However, unlike natural retention, constructed detention volume is only temporarily stored. While this system may reduce downstream flooding, timing of the various detention structures in the watershed becomes of critical importance. Dendrou and Delleur (1982) note that various investigators have examined this problem and conclude that the planning of stormwater control must be done on a watershed basis as opposed to a sub-area or piecemeal approach. Others also note that unplanned placement of multiple detention reservoirs may aggravate flood hazards (Lumb, et.al, 1974) (Abt and Grigg, 1978). Further, McCuen (1978) arrived at a similar conclusion based on a watershed study in Montgomery County, Maryland where a stormwater management scheme increased both peak flow and the bedload transport rates and the duration of bankfull flow in the channel downstream of the facility.

The problem with onsite detention lies in the fact that flow from the subject site may be retained until the peak flow a larger upstream area arrives, resulting in increased discharges. Alternatively, on-site detention may simply have little or no net benefit in reducing peak flow in the receiving stream. Consequently, on-site detention is indicated in cases where the flows in the receiving stream will be significantly impacted through development of the site. This would generally exclude cases where the site discharges directly to a municipal storm drain system sized to convey the site flow. Where the municipal storm drain system discharges to the regional channel there may still be an opportunity for detention depending on the relative size of the sub-watershed to the receiving stream watershed and location within the receiving stream watershed.

Another issue that must be kept in mind is the common practice of single-recurrence-interval design. Detention facilities that are designed to mitigate the peak 25-year discharge will have little, if any benefit for storms with more frequent recurrence intervals, which have previously been shown to be the events transporting the largest volume of sediment and responsible for channel cross section shape and alignment.

Review of San Diego BMP Retrofit Sites

As discussed above, the benefits of on-site detention may be achieved for small watersheds that will undergo significant change in discharge as a result of development. The sites at Manchester Avenue (east and west), La Costa Boulevard and at the I-5/SR 78 park and ride and at the I-5/SR 56 interchange each discharge directly to a storm drain system that subsequently discharges directly to a lagoon. Peak flow mitigation would be without benefit in these cases.

The sites at SR 78/I-15, Escondido Maintenance Station, Melrose at SR 78, Palomar Airport Road, Kearny Mesa Maintenance Station and the Carlsbad Maintenance Station all discharge through municipal systems to receiving streams with comparatively large watershed areas. On-site detention in these instances would reduce the peak discharge from the site, but would maintain the reduced discharge for a longer period, thus potentially increasing the peak flow in the receiving stream. This is due to the fact that the watershed lag time for the site is substantially shorter than the watershed lag time for the receiving stream. The watershed lag time is defined as the time from the center of mass of the effective rainfall to the center of mass of the discharge hydrograph. The lack of benefit from on-site detention will be demonstrated through a case study.

Case Study – SR 78 at Melrose Avenue

The Pilot Program site at Melrose place on SR 78 is selected as representative of the cases listed above. The site area is 2.3 acres and discharges directly to Buena Vista Creek. Buena Vista Creek has a watershed of about 5825 acres at the confluence point with the discharge from the Pilot site. Discharge hydrographs were computed for the 2-year storm for both the Pilot Program Site and the Creek watershed, the results of this analysis, along with some of the hydrologic parameters used, are given in Table 1.

Table 1

Watershed	Area (ac.)	Lag Time (hrs)	CN	Q_2 (cfs)
Buena Vista	5825	0.6	68	186.97
Pilot Site	10	0.16	84	2.0

Note that the watershed area used for the Pilot site is 10 acres, which is the minimum allowed by the computer program for the hydrograph procedure. For the purpose of this analysis, such an approximation will not be significant. As shown in Table 1, the lag time for Buena Vista Creek is much larger than that for the pilot site. The lag time for Buena Vista Creek was calculated using the Corps of Engineers Lag formula, the lag time for the Pilot site was estimated as 10 minutes following Caltrans procedure for inlet times on freeways. The Corps formula for watershed lag is:

$$Lag(hrs) = 24n\left(\frac{L(L_{ca})}{\sqrt{s}}\right)^{m}$$

where:

n = Basin factor
m = Constant (0.38)
L = Length along the longest waterscourse, in miles
L_{ca}= Length along the longest watercourse, in miles, meassured upstream to a point opposite the center of area.
S = Watershed slope

The Curve Number (CN) for the Buena Vista site was estimated using land use information from the USGS Quad and adjusted for Antecedent Moisture Condition (AMC) I consistent with a 2-year analysis. The CN for the Pilot site was estimated to be 94 (AMC II) assuming an impervious fraction of 80 percent for the roadway and shoulder area and subsequently adjusted to AMC I.

The Pilot Site hydrograph was subsequently routed through a hypothetical on-site detention structure which reduced the peak flow by one-half to 1 cfs, a flow that could be considered consistent with the natural condition from the site. Combining the routed flow from the site with the hydrograph from Buena Vista Creek, and keeping reference to an established time base, the peak discharge downstream of the site with the on-site detention was determined to be 187.23 cfs. This 'mitigated' flow rate is 0.2 cfs higher than the non-mitigated flow rate due to the effect of delaying the discharge from the pilot project site at a higher level than would otherwise occur under a no-detention scenario. The detention results in the case where no net benefit occurs to the receiving stream. It is clear that a more regional solution is imperative to achieve a net beneficial impact in the receiving stream. Detailed hydrograph calculations are contained in the Appendix for reference. However, this appendix was omitted in the Composite Siting Study.

This example may be generalized for the remaining Pilot Project sites which discharge to the streams. At each site, the lag time is substantially less than the receiving water lag time, making on-site detention ineffective. Such a conclusion is expected where a relatively small site is located well downstream of the larger watershed's headwaters. In general, on site detention would be beneficial only for those sites where the project site is closer in size and computed lag time to the receiving stream watershed.

References

Abt, S.R., and Grigg, N.S., *An Approximate method for Sizing Detention Reservoirs,* Water Resources Bulletin, 14, 4, pp. 956-965, 1978.

Dendrou, S., and Delleur, J., *Stormwater Detention Facilities,* Proceedings of the Conference on Stormwater Detention Facilities, Henniker, New Hampshire, August 2-6, 1982.

Lane, E.W., "Design of Stable Channels," *Transactions,* ASCE, Vol. 120, Paper No. 2776, 1955, pp. 1234-1279.

Leopold, L., *A View of the River,* Harvard University Press, MA, 1996

Lumb, A.M., Wallace, J.k. and James, D.L. *Analysis of Urban Land Treamtne Measures for Flood Peak Reduction*, Report prepared fro OWRR-14-31-0001-3359, 1974

McCuen, R. H., *Downstream Effects of Stormwater Managemetn Basins,* Journal of Hydraulic Division., ASCE, 105(HY11), pp 1343-1356, 1979.

Urbonas, B., and Benik, B, *Stream Stability Under a Changing Environment,* Stormwater Runoff and Receiving Systems, Impact Monitoring and Assessment, CRC Press, 1995