STORMWATER MONITORING AND BMP DEVELOPMENT STATUS REPORT: FISCAL YEAR 2014-2015 UPDATE

Final

Document No. CTSW-RT-15-312.01.01

September 2015

California Department of Transportation
Division of Environmental Analysis
Stormwater Program MS-27
1120 N Street
Sacramento, California 95814

http://www.dot.ca.gov/hq/env/stormwater/index.htm

For individuals with sensory disabilities, this document is available in alternate formats upon request. Please call or write:

Storm Water Liaison, Caltrans Division of Environmental Analysis
MS-27, PO Box 942874, Sacramento, CA 94274-0001
(916) 653-8896 Voice, or dial 711 to use a relay service.

Contents

Section 1 Introduction and Purpose 1
Section 2 Treatment Technology Studies 2
Section 3 Source Control Studies 5
Section 4 Stormwater Quality Characterization Studies 7
Section 5 Implementation of Research Findings into Stormwater Program 10
Section 6 References 13

List of Tables

Table 2-1. Stormwater Treatment Technology Studies 4
Table 3-1. Source Control Studies 6
Table 4-1. Stormwater Quality Characterization Studies 9
Table 5-1. Implementation Category Key 11
Table 5-2. Update of Implementing Findings of Treatment Technology Studies 12
Table 5-3. Update of Implementing Findings of Source Control Studies 12
Table 5-4. Update of Implementing Findings of Characterization Studies 12

Acronyms

ASBS	Areas of Special Biological Significance
BMP	Best Management Practice
FSP	Fine Sediment Particles
FY	Fiscal Year
HES	High Efficiency Sweeper
NA	Not Applicable
NPDES	National Pollutant Discharge Elimination System
PCB	Polychlorinated Biphenyl
PPDG	Project Planning and Design Guide
RAM	Rapid Assessment Methodology
SWRCB	State Water Resources Control Board
TBD	To Be Determined
TMDL	Total Maximum Daily Load

Section 1 Introduction and Purpose

The California Department of Transportation (Caltrans) National Pollutant Discharge Elimination System (NPDES) Statewide Storm Water Permit Waste Discharge Requirements Order No. 2012-0011-DWQ requires that the Stormwater Monitoring and BMP Development Status Report (Report) be updated annually and submitted with Caltrans' Annual Report (SWRCB 2012, Section E.2.e). This Report provides an update on the status of stormwater treatment technology studies, source control studies (including erosion control studies), and stormwater quality characterization for the 2014-2015 fiscal year (FY; July 1, 2014 through June 30, 2015). The information is summarized according to the type of study as follows:

- Stormwater treatment technology studies (Section 2)
- Source control studies (Section 3)
- Stormwater quality characterization studies (Section 4)

This report also summarizes (in Section 5) how study findings are being implemented to improve Caltrans' stormwater monitoring program. These updates are provided for studies conducted during FY 2014-2015 or studies for which the implementation category has changed since this Report was last updated (Caltrans 2014).

Section 2 Treatment Technology Studies

Table 2-1 provides an update on the status of treatment technology studies for the period July 1, 2014 to June 30, 2015. The table provides the following information for each study:

- The study name
- A description of the study
- The study findings
- The year water quality monitoring began
- The study status during FY 2014-2015
- The planned activities for the next three fiscal years

During FY 2014-2015, seven treatment technology studies were underway (i.e., in the planning, construction, monitoring, or reporting phase) or were completed:

- State Route 73 Bioretention Study
- San Francisco/Oakland Bay Bridge Bioretention Study
- Tahoe Basin Highway 50 Delaware Sand Filter Study
- Tahoe Sand Vaults Retrofit Pilot Study
- District 3 Linear Filtration Pilot Study
- District 7 Linear Filtration Pilot Study
- Chollas Creek BMP Retrofit Project

The studies are presented chronologically in Table 2-1 based on the year that monitoring began. For some studies, monitoring was temporarily discontinued for a few monitoring seasons, but later resumed. The description of each study includes a summary of the type of treatment technology that is being studied and how its performance will be evaluated (i.e., whether in terms of concentration, volume, or load reductions).

Monitoring for the Tahoe Basin Highway 50 Delaware Sand Filter Study was completed in FY 2013-14 and a final study report was issued in FY 2014-15. The study results indicated that Delaware filters can effectively reduce concentrations and loads of fine sediment particles (FSP), TSS, turbidity, total phosphorous, and total nitrogen from Caltrans highway runoff in cold climates, but not necessarily dissolved phosphorous (Caltrans 2014d). FSP refers to particles ranging in size from 0.5 to 16 µm.

Initial tests performed for the Tahoe Sand Vaults Retrofit Pilot Study indicated infiltration may be a feasible enhancement to these treatment BMPs. Additional water quality monitoring will be conducted during FY 2015-2016.

For the other studies, some type of activity (monitoring or further study planning) will continue during FY 2015-2016, so there are no findings to report at this time. The findings will be included in subsequent status reports once the respective studies have been completed.

Table 2-1. Stormwater Treatment Technology Studies

Study Name	Description	Finding	FY Monitoring Began	FY 2014-2015 Status	FY 2015-2016 Plan	FY 2016-2017 Plan	FY 2017-2018 Plan
State Route 73 Bioretention Study	Evaluate the pollutant removal effectiveness of one bioretention basin on State Route 73 with respect to concentration.	TBD[1]	FY 2006-2007[2]	Conduct monitoring	Evaluate results and plan future activities	TBD[3]	TBD[3]
San Francisco/Oakland Bay Bridge Bioretention Study	Evaluate the pollutant removal effectiveness of two bioretention basins at the San Francisco/Oakland Bay Bridge with respect to concentration.	TBD[1]	FY 2009-2010[4]	Infiltration testing[5]	Evaluate results and plan future activities	TBD[3]	TBD[3]
Tahoe Basin Highway 50 Delaware Sand Filter Study	Evaluate the performance of a Delaware filter in cold-climate regions with respect to concentration, volume, and load reduction effectiveness.	Delaware filters can effectively reduce concentrations and loads of fine sediment particles, TSS, turbidity, total phosphorus, and total nitrogen in cold climates, but not necessarily dissolved phosphorus.[6]	FY 2012-2013	Develop report	No action planned (study complete)	No action planned (study complete)	No action planned (study complete)
Tahoe Sand Vaults Retrofit Pilot Study	Determine load and volume reduction by infiltration through weep holes in existing traction sand vaults along SR 28. Compare results with those predicted by Tahoe PLRM model.	TBD[1,7]	FY 2012-2013[8]	Plan future activities[7]	Conduct monitoring	Evaluate results and plan future activities	TBD[3]
District 3 Linear Filtration Pilot Study	Evaluate performance of various linear filtration designs in terms of concentration, volume, and load reduction.	TBD[1]	FY 2014-2015	Conduct monitoring	Conduct monitoring	Conduct monitoring	Conduct monitoring
District 7 Linear Filtration Pilot Study	Evaluate performance of various linear filtration designs in terms of concentration, volume, and load reduction.	TBD[1]	FY 2015-2016	Construct BMPs	Conduct monitoring	Conduct monitoring	Conduct monitoring
Chollas Creek BMP Retrofit Project	Evaluate performance of modular infiltration basins and bio-infiltration swales in terms of reducing pollutant concentrations associated with the Chollas Creek TMDL WLAs.	TBD[1]	FY 2015-2016	Construct BMPs	Conduct monitoring	Conduct monitoring	TBD[3]

[1] *Study is ongoing. Findings will be summarized once final study report is completed.*

[2] *Water quality monitoring for State Route 73 began FY 2006-2007. Monitoring discontinued FY 2008-2009. Monitoring restarted FY 2013-2014.*

[3] *Future activities will be determined after evaluating previous years' monitoring results.*

[4] *Water quality monitoring for San Francisco/Oakland Bay Bridge began FY 2009-2010. Monitoring discontinued FY 2010-2011, but resumed FY 2011-2012. Mercury and PCB characterization began in FY 2012-2013. Monitoring was completed in FY 2012-2013.*

[5] *Subsurface bioretention soil substrate testing was conducted in response to a RWQCB request. Results are currently being evaluated.*

[6] *Caltrans Delaware Sand Filter Study final report (Caltrans 2014d).*

[7] *Previous infiltration testing indicated good volume reductions. Water quality monitoring will be conducted in the future to assess load reductions.*

[8] *Infiltration monitoring only (no water quality monitoring).*

Section 3 Source Control Studies

Table 3-1 provides an update on the status of source control and erosion control studies for the period July 1, 2014 to June 30, 2015. The table provides the following information for each study:

- The study name
- A description of the study
- The study findings
- The year water quality monitoring began
- The study status during FY 2014-2015
- The planned activities for the next three fiscal years

Three source control studies were underway during FY 2014-2015:

- Tahoe Abrasives Study – Identification of New Abrasives
- Tahoe Abrasives Study – Performance of New Abrasives
- Road Rapid Assessment Methodology (RAM) Verification and Traction Sand Monitoring

One source control studies that was being planned during FY 2013-2014 was put on hold for further consideration:

- High Efficiency Sweeper Study

The studies are presented chronologically in Table 3-1 based on the year that monitoring began. The Tahoe Abrasives Study – Identification of New Abrasives was completed during FY 2014-2015. The results identified new traction abrasives which can reduce total phosphorous and fine sediment particle loads in stormwater runoff discharged from Caltrans roadways (Caltrans 2014c). Total nitrogen loads were not evaluated, as traction abrasives are generally not a source of total nitrogen. Monitoring will be conducted in FY 2015-2016 for the Tahoe Abrasives Study – Performance of New Abrasives to evaluate stormwater quality resulting from the application of new abrasives.

Planning for the Road RAM Verification and Traction Sand Monitoring study began in FY 2014-2015, and monitoring is scheduled to begin during FY 2015-2016. The study is intended to verify the accuracy and validity of the Lahontan Regional Water Quality Control Board (RWQCB) mandated Road-RAM field observation and data management tool, and is replacing the High Efficiency Sweeper study that Caltrans considered during previous fiscal years. The findings will be included in future status reports once the study has been completed.

Table 3-1. Source Control Studies

Study Name	Description	Finding	FY Monitoring Began	FY 2014-2015 Status	FY 2015-2016 Plan	FY 2016-2017 Plan	FY 2017-2018 Plan
Tahoe Abrasives Study – Identification of New Abrasives	Identify new abrasives with potential for reducing fine sediment particles and nutrients in stormwater runoff.	Newly identified traction abrasives can reduce total phosphorous and fine sediment particle loads in stormwater runoff from Caltrans roadways. Traction abrasives are generally not a source of total nitrogen and changing to a different material will not likely affect total nitrogen loads in stormwater runoff from Caltrans roadways.[1] Stockpile analysis results led to development of new traction sand procurement specification.	FY 2013-2014	Develop report	No action planned (study complete)	No action planned (study complete)	No action planned (study complete)
Tahoe Abrasives Study – Performance of New Abrasives	Evaluate stormwater quality resulting from application of newly identified abrasives in interest of reducing fine sediment particles and nutrients.	TBD[3]	FY 2015-2016	Plan future activities	Conduct monitoring	Evaluate results and plan future activities	TBD[4]
Road RAM Verification and Traction Sand Monitoring[2]	Verify the accuracy and validity of the Lahontan Regional Water Quality Control Board mandated Road-Rapid Assessment Methodology (Road RAM) field observation and data management tool.	TBD[3]	FY 2015-2016	Plan future activities	Conduct monitoring	Conduct monitoring	Evaluate results and plan future activities
High Efficiency Sweeper Study	Evaluate stormwater quality (fine sediment particles and nutrients) and cost implications of using high efficiency sweeper technology over the more conventional, mechanical type, sweepers that are typically used by Caltrans.	NA[2]	NA[2]	NA[2]	TBD[2]	TBD[2]	TBD[2]

[1] *Caltrans Alternative Abrasives Assessment Report – Phase III (Caltrans 2014c).*

[2] *High Efficiency Sweeper Study was replaced by Road Rapid Assessment Methodology Verification and Traction Sand Monitoring.*

[3] *Study is ongoing. Findings will be summarized once final study report is completed.*

[4] *Future activities will be determined after evaluating previous years' monitoring results/evaluations.*

Section 4 Stormwater Quality Characterization Studies

Table 4-1 provides an update on the status of stormwater characterization studies for the period July 1, 2014 to June 30, 2015. The table provides the following information for each study:

- The study name
- A description of the study
- The study findings
- The year water quality monitoring began
- The study status during FY 2014-2015
- The planned activities for the next three fiscal years

Stormwater quality characterization studies conducted during FY 2014-2015 consisted of Areas of Special Biological Significance (ASBS) and TMDL monitoring:

- ASBS Special Protections Monitoring – South, Central, and North Regions
- TMDL Monitoring – Clear Lake
- TMDL Monitoring – Chollas Creek
- TMDL Monitoring – Rainbow Creek
- TMDL Monitoring – Tahoe Basin
- TMDL Monitoring – Coachella Valley Storm Water Channel
- TMDL Monitoring – Los Angeles River
- TMDL Monitoring – Malibu Creek
- TMDL Monitoring – Sacramento/San Joaquin River Delta
- TMDL Monitoring – San Diego Creek
- TMDL Monitoring – San Francisco Bay
- TMDL Monitoring – Walnut Creek

The studies in Table 4-1 are categorized by ASBS or TMDL monitoring and are then listed chronologically according to the year monitoring began. Caltrans completed TMDL monitoring for Clear Lake in FY 2012-2013 and finalized a report during FY 2014-2015. The results indicated that Caltrans annual average total phosphorous load to Clear Lake (84 kg) is compliant with its TMDL load allocation (100 kg), although additional maintenance practices (timely cleaning of ditches) are necessary during years with above average rainfall (Caltrans 2014a).

TMDL monitoring for the Tahoe Basin was discontinued in FY 2014-2015. The monitoring had included two stations which were influents to vault-type BMPs, and are considered inappropriate for characterizing runoff discharges from Caltrans right-of-ways. A third station previously monitored for the Tahoe Basin TMDL was an effluent station for Caltrans' Tahoe Basin Highway 50 Delaware Sand Filter Study. This study was completed in FY 2014-2015 with approval from the Lahontan RWQCB (see Section 2).

Caltrans' FY 2014-2015 Monitoring Results Report (Caltrans 2015a) summarizes the data collected during the past FY.

Table 4-1. Stormwater Quality Characterization Studies

Study Name	Description	Finding	FY Monitoring Began	FY 2014-2015 Status	FY 2015-2016 Plan	FY 2016-2017 Plan	FY 2017-2018 Plan
ASBS Special Protections Monitoring - South, Central, and North Regions	Conduct monitoring to comply with the monitoring requirements for discharging stormwater into ASBS[1].	TBD[2]	FY 2012-2013[3] and FY2013-2014[3]	Conduct monitoring	Conduct monitoring[4]	TBD[4]	TBD[4]
TMDL Monitoring – Clear Lake	Conduct characterization monitoring for TMDL.[5]	Caltrans annual average total phosphorous load to Clear Lake (84 kg) is compliant with its TMDL load allocation (100 kg), although additional maintenance practices (timely cleaning of ditches) are necessary during years with above average rainfall.[6]	FY 2010-2011	Develop report	No action planned (study complete)	No action planned (study complete)	No action planned (study complete)
TMDL Monitoring – Chollas Creek	Conduct characterization monitoring for TMDL.[5]	TBD[2]	FY 2011-2012	Conduct monitoring	TBD[7]	TBD[7]	TBD[7]
TMDL Monitoring – Rainbow Creek	Conduct characterization monitoring for TMDL.[5]	TBD[2]	FY 2011-2012	Conduct monitoring	TBD[7]	TBD[7]	TBD[7]
TMDL Monitoring – Tahoe Basin	Conduct characterization monitoring for TMDL.[5]	See finding for Tahoe Basin Highway 50 Delaware Sand Filter Study in Table 2-1.	FY 2012-2013	Develop report[8]	No action planned (study complete)	No action planned (study complete)	No action planned (study complete)
TMDL Monitoring – Coachella Valley Storm Water Channel	Conduct characterization monitoring for TMDL.[5]	TBD[2]	FY 2013-2014[9]	Conduct monitoring	TBD[7]	TBD[7]	TBD[7]
TMDL Monitoring – Los Angeles River	Conduct characterization monitoring for TMDL.[5]	TBD[2]	FY 2013-2014[9]	Conduct monitoring	TBD[7]	TBD[7]	TBD[7]
TMDL Monitoring – Malibu Creek	Conduct characterization monitoring for TMDL.[5]	TBD[2]	FY 2013-2014[9]	Conduct monitoring	TBD[7]	TBD[7]	TBD[7]
TMDL Monitoring – Sacramento/San Joaquin River Delta	Conduct characterization monitoring for TMDL.[5]	TBD[2]	FY 2013-2014[9]	Conduct monitoring	TBD[7]	TBD[7]	TBD[7]
TMDL Monitoring – San Diego Creek	Conduct characterization monitoring for TMDL.[5]	TBD[2]	FY 2013-2014[9]	Conduct monitoring	TBD[7]	TBD[7]	TBD[7]
TMDL Monitoring – San Francisco Bay	Conduct characterization monitoring for TMDL.[5]	TBD[2]	FY 2013-2014[9]	Conduct monitoring	TBD[7]	TBD[7]	TBD[7]
TMDL Monitoring – Walnut Creek	Conduct characterization monitoring for TMDL.[5]	TBD[2]	FY 2013-2014[9]	Conduct monitoring	TBD[7]	TBD[7]	TBD[7]

[1] *Under the General Exception to Prohibiting Storm Water Discharges in the California Ocean Plan.*

[2] *Study is ongoing.*

[3] *South Region monitoring began in FY 2012-2013. Central Region and North Region monitoring began in FY 2013-2014.*

[4] *Monitoring will continue during FY 2015-2016. A request was submitted to SWRCB to discontinue monitoring in ASBS33 where required sampling has been completed. Future activities will be determined pending compliance determination in accordance with Caltrans' NDPES permit (SWRCB 2012 and 2014).*

[5] *Monitoring is being/was conducted in compliance with TMDL requirements (Attachment IV) and Tier 1 monitoring requirements of Caltrans' NPDES Permit (SWRCB 2012 and 2014).*

[6] *Caltrans Final Monitoring Report 2010-2013 Storm Seasons Clear Lake Nutrient Data Collection (Caltrans 2014a).*

[7] *Future activities will be determined pending compliance determination in accordance with Caltrans' NPDES permit (SWRCB 2012 and 2014).*

[8] *TMDL monitoring was discontinued in FY 2014-2015. Monitoring had included two influent stations for vault-type BMPs, which are inappropriate for characterizing runoff discharges from Caltrans right-of-ways. A third station previously monitored for the Tahoe Basin TMDL was an effluent station for Caltrans' Tahoe Basin Highway 50 Delaware Sand Filter Study, which was completed in FY 2014-2015 (see Section 2).*

[9] *Monitoring for TMDL compliance with Caltrans' NPDES Permit Attachment IV (SWRCB 2012 and 2014) began FY 2013-2014.*

Section 5 Implementation of Research Findings into Stormwater Program

This section provides a summary of the current implementation status for the efforts listed in Table 2-1, Table 3-1, and Table 4-1 followed by studies that have been completed in previous years. Table 5-1 provides a key to the implementation categories that are assigned to Caltrans' stormwater studies. Table 5-2, Table 5-3, and Table 5-4 present the most recent implementation category for each treatment technology, source control, and water quality characterization study, respectively. Implementation updates are only provided for studies conducted during FY 2014-2015 or previous studies for which the implementation category has changed since the Status Report Update was last submitted.

Table 5-1. Implementation Category Key

Implementation Category	Explanation
A	Study findings resulted in changes to maintenance program.
B	Study findings resulted in changes to PPDG or other supplemental design guidance.
C	Study is complete and results did not justify changes to program based on the information generated.
D	Study is ongoing.
E	Study findings resulted in approval of BMP for statewide use (i.e. inclusion in Caltrans' BMP tool box).
F	Study findings resulted in changes to construction practices/management.
G	Study is long-term and the management implications have yet to be determined.
H	Study findings provided information for regulatory compliance or BMP planning.
I	Study's field/laboratory effort is complete, but incorporation into program is still under assessment.
J	Study findings led to full-scale field studies or follow-up study.
K	Study was postponed for further consideration.

Table 5-2. Update of Implementing Findings of Treatment Technology Studies

Study Title	2014 Implementation Category
State Route 73 Bioretention Study	D[1]
San Francisco/Oakland Bay Bridge Bioretention Study	D[1]
Tahoe Basin Highway 50 Delaware Sand Filter Study	H
Tahoe Sand Vaults Retrofit Pilot Study Test	D[1]
District 3 Linear Filtration Pilot Study	D[1]
District 7 Linear Filtration Pilot Study	D[1]
Chollas Creek BMP Retrofit Project	D[1]

Table 5-3. Update of Implementing Findings of Source Control Studies

Study Title	2014 Implementation Category
Tahoe Abrasives Study – Identification of New Abrasives	A,J
Tahoe Abrasives Study – Performance of New Abrasives	D[1]
High Efficiency Sweeper Study	K
Road RAM Verification and Traction Sand Monitoring	D[1]

Table 5-4. Update of Implementing Findings of Characterization Studies

Study Title	2014 Implementation Category
ASBS Special Protections Monitoring – South, Central, and North Regions	D[1]
TMDL Monitoring – Coachella Valley Storm Water Channel	D[1]
TMDL Monitoring – Chollas Creek	D[1]
TMDL Monitoring – Clear Lake	H
TMDL Monitoring – Los Angeles River	D[1]
TMDL Monitoring – Malibu Creek	D[1]
TMDL Monitoring – Rainbow Creek	D[1]
TMDL Monitoring – Sacramento/San Joaquin River Delta	D[1]
TMDL Monitoring – San Diego Creek	D[1]
TMDL Monitoring – San Francisco Bay	D[1]
TMDL Monitoring – Tahoe Basin	H
TMDL Monitoring – Walnut Creek	D[1]

[1]*Study was ongoing during FY 2014-2015.*

Section 6 References

California Department of Transportation (Caltrans). 2014a. Final Monitoring Report 2010-2013 Storm Seasons Clear Lake Nutrient Data Collection. August 2014. CTSW-RT-14-228.03-2

California Department of Transportation (Caltrans). 2014b. Stormwater Monitoring and BMP Development Status Report Fiscal Year 2013-2014. September 2014. CTSW-RT-14-312.01.02

California Department of Transportation (Caltrans). 2014c. Alternative Abrasives Assessment Report – Phase 3, Sampling and Analysis of Alternative Abrasives. September 2014. CTSW-RT-14-289.8.1

California Department of Transportation (Caltrans). 2014d. Final Monitoring Report. Delaware Sand Filter Stormwater Monitoring in a Cold Climate Region Monitoring Seasons 2012-13 and 2013-14. October 2014. CTSW-RT-14-289.9.1

California Department of Transportation (Caltrans). 2015a. California Department of Transportation Stormwater Management Program Annual Report Fiscal Year 2014-15. September 2015. CTSW-RT-15-316.10.1

California State Water Resources Control Board (SWRCB). 2012. Order No. 2012-0011-DWQ National Pollutant Discharge Elimination System (NPDES) Statewide Storm Water Permit Waste Discharge Requirements (WDRS) for State of California Department of Transportation.

California State Water Resources Control Board (SWRCB). 2014. Order 2014-XXXX-DWQ Amending National Pollutant Discharge Elimination System (NPDES) Statewide Storm Water Permit for State of California Department of Transportation Order 2012-0011-DWQ NPDES No CAS000003.

Year-End Performance Report
A Summary of Construction Compliance Reviews – July 1, 2014 – June 30, 2015

CTSW-RT-15-321.04.2

September 2015

California Department of Transportation
Division of Environmental Analysis, Water Quality Program
1120 N Street, MS 27
Sacramento, California 95814
http://www.dot.ca.gov/hq/env/stormwater/index.htm

For individuals with sensory disabilities, this document is available in alternate formats upon request. Please call or write to Stormwater Liaison, California Department of Transportation Division of Environmental Analysis, PO Box 942874, MS-27, Sacramento, CA 94274-0001, (916) 653-8896 Voice, or dial 711 to use a relay service.

Table of Contents

List of Figures i
List of Tables i
Acronyms, Abbreviations and Definitions ii
1.0 Introduction 6
2.0 Elements of Construction Compliance Evaluation Plan 6
2.1 CCEP Process 6
2.2 Project Selection and Ranking Process 7
2.3 IQA Review Process 7
2.4 Elements of the Review Report 7
3.0 IQA Review Results 8
3.1 Total Numbers of Findings 8
3.2 Administrative Findings 9
3.3 Field BMP Findings 10
3.4 Field BMP Findings by Field BMP Type and IQA Reviewer Observation 11
4.0 Trends 16
5.0 Conclusion 17

List of Figures

Figure 3-1 Number of Findings by Field BMP Type in Descending Order 13

List of Tables

Table 3-1 Summary of Findings 9
Table 3-2 Summary of Administrative Findings 10
Table 3-3 Summary of Field BMP Findings 11
Table 3-4 Findings by Field BMP Type 12
Table 3-5 Number of Findings by IQA Reviewer Observation 14
Table 4-1 Comparison of the BMPs with the Most Findings (in descending order) between the 2014 and 2015 YEPR 16

Acronyms, Abbreviations and Definitions

ACCRP	Annual Construction Compliance Review Plan
ASBS	Areas of Special Biological Significance
ATS	Active Treatment System
BMP	Best Management Practice
Caltrans	State of California, Department of Transportation
Caltrans Statewide Permit	National Pollutant Discharge Elimination System (NPDES) Statewide Storm Water Permit Waste Discharge Requirements (WDRs) for the State of California Department of Transportation (Order No. 2012-0011-DWQ, NPDES No. CAS000003)
CCEP	Construction Compliance Evaluation Plan
CFR	Code of Federal Regulations
CGP	Construction General Permit
Construction Activity	Any construction or demolition activity, clearing, grading, grubbing, excavation, or other activity that results in land disturbance. Construction does not include emergency construction activities required to immediately protect public health and safety or routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of the facility.
Construction Site	Location where construction activity is performed.
CSMP	Construction Site Monitoring Program.
C/EP SWAT	Construction - Encroachment Permit Stormwater Advisory Team
CWA	Clean Water Act
DCSWC	District Construction Stormwater Coordinator
DEA-WQP	Division of Environmental Analysis - Water Quality Program
Discharge	When used without qualification, means the discharge of a pollutant
Discharge of a pollutant	The addition of any pollutant or combination of pollutants to waters of the United States from any point source, or any addition of any pollutant or combination of pollutants to the waters of the contiguous zone or the ocean from any point source other than a vessel or other floating craft which is being used as a means of transportation. The term includes additions of pollutants to waters of the United States from: surface runoff which is collected or channeled by man; discharges through pipes, sewers, or other conveyances owned by a State, municipality, or other person which do not lead to a treatment works; and discharges through pipes, sewers, or other conveyances, leading into privately owned treatment works.
DSA	Disturbed Soil Area
IQA	Independent Quality Assurance (IQA). The independent third party conducts the IQA construction project reviews for the Caltrans Statewide Permit-required self-audit program.

Non-compliance	Failure to meet any field and administrative requirement of the SWMP or Caltrans Statewide Permit or to meet any applicable water quality standard. This includes failure to install required BMPs or conduct required monitoring or maintenance. It also includes discharges or prohibited non-storm water that do not meet the definition of emergency incidents. It does not include determinations by Caltrans or a RWQCB Executive Officer that a discharge is causing or contributing to exceedances of an applicable water quality standard.
Non-stormwater	Discharges that are not induced by precipitation events and are not composed entirely of stormwater. These discharges include, but are not limited to, discharges of process water, air conditioner condensate, non-contact cooling water, vehicle wash water, concrete washout water, paint wash water, irrigation water, pipe testing water, lawn watering overspray, hydrant flushing, and firefighting activities.
NPDES	National Pollutant Discharge Elimination System
PLACS	Permits, Licenses, Agreements, Certifications and Approvals
Pollutant	Dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials (except those regulated under the Atomic Energy Act of 1954, as amended [42 U.S.C. 2011 et seq.]), heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water (Permit Attach. VII).
QA	Quality Assurance
RE	Resident Engineer
Review Report	Construction Project Site Stormwater Compliance Review Report used in the self-audit program for construction activities.
RWQCB	Regional Water Quality Control Board
Sediment	Soil, sand, and minerals washed from land into water, usually after rain.
Sensitive water body	As defined in the CCEP, includes water bodies listed for Areas of Special Biological Significance in the Permit Attachment III and listed water bodies pursuant to CWA Section 303(d).
SMARTS	Storm Water Multiple Application and Record Tracking System
Stormwater	Stormwater runoff, snowmelt runoff, and surface runoff and drainage, as defined in 40 CFR 122.26.b.13.
Surface water	Collectively includes Waters of the State, Waters of the U.S. and sensitive water bodies.
SWMP	Storm Water Management Plan
SWPPP	Stormwater Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TMDL	Total maximum daily load
U.S.	United States
U.S.C.	United States Code

U.S. EPA	United States Environmental Protection Agency
U.S. EPA R-9 A.O	United States Environmental Protection Agency – Region 9 Administrative Order
Waters of the State	Any surface water or groundwater, including saline waters, within boundaries of the state as defined in California Water Code §13050(e).
Waters of the U.S.	All waters that are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters subject to the ebb and flow of the tide. Waters of the United States [as defined in 40 CFR §230.3(s)] include all interstate waters and intrastate lakes, rivers, streams (including intermittent streams), mudflats, sand flats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds the use of which would affect or could affect interstate or foreign commerce. The definition also applies to tributaries of the aforementioned waters. See 40 CFR §122.2 for the complete definition, which is hereby incorporated by reference.
WDRs	Waste Discharge Requirements. “NPDES Permits” as used in the federal Clean Water Act (33 U.S.C. §1251 et seq.; Permit Finding 4).
WPCM	Water Pollution Control Manager
WPCP	Water Pollution Control Program
WQSWAT	Water Quality Stormwater Advisory Team
YEPR	Year-End Performance Report

This page intentionally left blank.

1.0 Introduction

This Year-End Performance Report – September 2015 (2015 YEPR) summarizes the Independent Quality Assurance (IQA) reviews conducted between July 1, 2014 and June 30, 2015 by the independent assurance portion of the self-audit program implemented by the State of California, Department of Transportation (Caltrans) for evaluating construction activities at construction sites. This document reports the data necessary to ascertain whether the appropriate level of stormwater pollution control was achieved at Caltrans construction projects statewide during the 2014-2015 reporting period.

In July 2008, Caltrans adopted the *Construction Compliance Evaluation Plan CTSW-PL-08-999.54.1* (2008 CCEP). Since the 2008 CCEP was implemented, Caltrans has modified the construction compliance evaluation procedures to be responsive to subsequent regulatory drivers, including the California State Water Resources Control Board (SWRCB) Order No. 2012-0011-DWQ, NPDES No. CAS000003, Statewide Storm Water Permit Waste Discharge Requirements for State of California Department of Transportation (Caltrans Statewide Permit) and Order No. 2010-0014-DWQ, NPDES No. CAS000002, General Permit for Storm Water Discharges Associated With Construction and Land Disturbance Activities (CGP).

In April 2015, Caltrans adopted a revised approach to assess the appropriate level of stormwater pollution control at construction projects. This revised approach is described in the *Stormwater Program - Construction Compliance Evaluation Plan CTSW-PL-15-321.03.1* (CCEP). This 2015 YEPR reports the data gathered during IQA Reviews at Caltrans construction projects statewide during the reporting period.

2.0 Elements of Construction Compliance Evaluation Plan

Section 2.0 presents an overview of the CCEP. This section is organized by presenting the following:

- A summary of the CCEP process;
- Project selection and ranking process;
- A summary of The IQA Review Process; and
- Elements of the Project Stormwater Review Report (Review Report).

2.1 CCEP Process

The CCEP process includes the following activities to evaluate the implementation of stormwater pollution prevention measures at construction projects:

- Developing and maintaining a list of construction projects for review;
- Providing 24-hour notification of IQA site review to the resident engineer (RE), Senior RE, Construction Manager, and District construction Stormwater Coordinator (DCSWC);
- Conducting the site review;
- Completing the Construction Review Report; and
- Initiating the Corrective Action process

The corrective actions are not an element of the third-party consultant IQA review process. As described in Construction Procedure Directive 15-1 dated March 25, 2015, the RE is responsible for coordinating with the DCSWC.

The CCEP process also provides feedback procedures and a method for program improvement by reporting the following:

- Best management practice (BMP) implementation based upon the observed trends detected in the data collected from IQA reviews; and
- The adequacy of guidance documents and contract documents

The above reporting facilitates program improvements, including Storm Water Management Plan (SWMP) improvements, training, research, updates to guidance documents, updates to specifications and updates to the CCEP.

2.2 Project Selection and Ranking Process

The Division of Environmental Analysis - Water Quality Program (DEA-WQP) compiled and maintained a comprehensive list of construction projects by drawing from active construction projects presented in Storm Water Multiple Application and Report Tracking System (SMARTS) and cross checked this list with the following two information sources:

- Headquarters Division of Construction statement of ongoing construction projects; and
- District information on oversight projects

Review priority was given to construction projects "based on their relative risk to water quality, using among other approaches the Risk Determination Methodology contained in the CGP and the Clean Water Act 303(d) list of impaired water bodies" (U.S. EPA R-9 A.O).

2.3 IQA Review Process

The third-party consultant conducted the following activities during the reporting period between July 1, 2014 and June 30, 2015:

- Assisted in selection of construction projects for IQA Reviews;
- Assisted with the 24-hour notification to required Caltrans staff;
- Conducted site reviews;
- Observed the conditions of stormwater pollution prevention measures implemented at the construction site and recorded instances where BMPs where not meeting contract document requirements, applicable CGP requirements, or applicable permits, licenses, agreements, and certifications, and approvals (PLACS) relative to stormwater BMP requirements.
- Provided a verbal debriefing of findings to the RE or the RE's representative and followed up with written and signed Review Report delivered to the RE and other Caltrans staff within 24 hours of the site review; and
- Collected all Review Reports for future data processing and storage.

2.4 Elements of the Review Report

The IQA reviewer evaluated stormwater compliance at a construction site by comparing observed site conditions, including project stormwater contract administration, with the following:

- SWRCB regulatory drivers, e.g., the CGP and the Caltrans Statewide Permit;
- PLACS and the Lahontan Regional Water Quality Control Board Permit, as applicable;
- Caltrans 2010 Standard Specifications and 2010 Standard Plans.

The Review Report documents the following the construction project information and observations:

- IQA reviewer, review date, and review participants;
- Caltrans contract number, County-Route-Post Mile, project name, and project description;
- Name and contact number for the RE and Water Pollution Control Manager (WPCM);
- Weather conditions, risk level, receiving water body, and amount of active and inactive DSAs; and
- PLACS.

The Review Report documents the information concerning administrative findings and field BMP findings. See Section 3.0, IQA Review Results, for further detail.

3.0 IQA Review Results

This section presents the IQA review findings as observed at Caltrans construction projects from July 1, 2014 to June 30, 2015. During this reporting period Caltrans revised the CCEP to meet regulatory changes over the past several years. The transition to the new process consumed a majority of the reporting year, and as a result IQA reviews were only conducted during the latter months. The total numbers of findings including total administrative and field BMP findings are presented first, followed with findings by administrative and field BMP categories, and lastly more detailed information concerning findings by field BMP types and IQA reviewer observations.

3.1 Total Numbers of Findings

Table 3-1 presents a summary of the total numbers of IQA review findings. The total numbers are further divided into totals of administrative and field BMP findings. Some districts were visited more than others because of the number of available projects and the project ranking process. No construction projects were reviewed in District 9 because none met the IQA review criteria described in Section 2.2. Items of note in the following table are as follows:

- 45 IQA Reviews were conducted in the reporting period
- Except for District 9, at least two construction projects were visited in all districts
- Very few administrative findings were noted during the IQA review. Administrative findings averaged less than one per IQA review.
- Field BMP findings averaged approximately 10 per IQA review.

Table 3-1 Summary of Findings				
District	Number of Sites Reviewed	Number of Findings		
		Total	Administrative	Field BMPs
1	4	**24**	3	21
2	4	**71**	4	67
3	4	**67**	0	67
4	5	**32**	4	28
5	2	**15**	2	13
6	4	**17**	4	13
7	5	**39**	2	37
8	5	**105**	3	102
9	0	**0**	0	0
10	5	**75**	3	72
11	4	**32**	4	28
12	3	**20**	1	19
Total	**45**	**497**	**30**	**467**

3.2 Administrative Findings

Table 3.2 presents the summary of administrative findings separated into several categories. The definitions of each category are as follows:

- **Plans and Permits**: Queries the IQA reviewer with two questions - whether the SWPPP is located on site and was it developed by a QSD.
- **Training**: Queries the IQA reviewer with two questions - whether the WPCM is certified as a QSD (or QSP for WPCP construction projects) and is the contractor conducting regular training with adequate documentation.
- **SMARTS**: Queries the IQA reviewer with one question - whether appropriate annual reporting is uploaded into SMARTS.
- **Active Treatment System (ATS)**: Queries the IQA reviewer with one question - for construction projects that employ an ATS, are all the required procedures of the ATS followed.
- **Construction Site Monitoring**: Queries the IQA reviewer with three questions - whether all of the site monitoring has been completed, and if a NAL has been exceeded, has a report been developed and reported to the SWRCB.
- **Tahoe Permit**: Queries the IQA reviewer with three questions - for projects within the Tahoe Permit, has a Restoration Monitoring Plan been developed, are there waste prohibition exemptions on file (100 year floodplain), and have all analytical information been uploaded into SMARTS within 5 days.

Items of note in the following table are as follows:

- No findings were encountered for administrative categories SMARTS, ATS, and Tahoe Permit.
- Findings in the Training category have been encountered the most of all administrative categories.
- Construction Site Monitoring is mostly implemented at reviewed sites. The IQA reviewer at eighty-two percent (82%) of the construction projects encountered no construction site monitoring findings.

Table 3-2 Summary of Administrative Findings

District	Number of Sites Reviewed	Total Findings	Administrative Category					
			Plans and Permits	Training	SMARTS	Active Treatment System	Construction Site Monitoring	Tahoe Permit
1	4	**3**	2	1	0	0	0	0
2	4	**4**	2	1	0	0	1	0
3	4	**0**	0	0	0	0	0	0
4	5	**4**	0	2	0	0	2	0
5	2	**2**	0	2	0	0	0	0
6	4	**4**	0	1	0	0	3	0
7	5	**2**	0	2	0	0	0	0
8	5	**3**	0	2	0	0	1	0
9	0	**0**	0	0	0	0	0	0
10	5	**3**	0	2	0	0	1	0
11	4	**4**	3	1	0	0	0	0
12	3	**1**	0	1	0	0	0	0
Total	**45**	**30**	**7**	**15**	**0**	**0**	**8**	**0**

3.3 Field BMP Findings

Table 3.3 presents a summary of the field BMP findings separated into the six standard field BMP categories as follows:

- **Soil Stabilization**: Includes preservation of vegetation, temporary cover of DSAs, temporary run-on and run-through control, and streambank stabilization.
- **Sediment Control**: Includes temporary perimeter control, temporary face of slope controls, temporary check dams and temporary drain inlet protection.
- **Tracking Control**: Includes stabilized construction entrance, stabilized construction roadways, and tire washes.
- **Wind Erosion Control**: Includes the control of dust throughout the construction site.
- **Non-Stormwater Control**: Includes dewatering, paving and sawcutting operations, temporary stream crossings and clear water diversions, equipment cleaning, fueling, and maintenance, pile driving operations, and working near and over water.

- **Materials and Waste Management Control**: Includes material storage and use, stockpile management, spill prevention and control, and waste management including solid, hazardous, contaminated soil, concrete, sanitary, and liquid wastes.

Items of note in the following table are as follows:

- Approximately forty-five percent (45.2%) of the total findings were in the field BMP category of Materials and Waste Management Control.
- Approximately thirty-three percent (33.2%) of the total findings were in the field BMP category of Sediment Control.
- Approximately seven percent each (6.9%, 7.2%, and 6.9%) of the total findings were in the field BMP categories of Soil Stabilization, Tracking Control, and Non-Stormwater Control.

Table 3-3 Summary of Field BMP Findings

District	Number of Sites Reviewed	Total Findings	Field BMP Category					
			Soil Stabilization	Sediment Control	Tracking Control	Wind Erosion Control	Non-Stormwater Control	Materials & Waste Management
1	4	21	3	6	0	0	0	12
2	4	67	3	20	2	2	5	35
3	4	67	6	30	1	0	6	24
4	5	28	0	13	5	0	0	10
5	2	13	1	5	0	0	0	7
6	4	13	0	3	0	0	3	7
7	5	37	2	14	7	0	1	13
8	5	102	3	30	4	0	13	52
9	0	0	0	0	0	0	0	0
10	5	72	10	21	10	0	0	31
11	4	28	3	6	5	1	3	10
12	3	19	1	7	0	0	1	10
Total	45	467	32	155	34	3	32	211

3.4 Field BMP Findings by Field BMP Type and IQA Reviewer Observation

Table 3.4 presents a summary of the field BMP findings by field BMP type and specific IQA reviewer observations.

Each field BMP type has standards that regulate the correct application (e.g., is the BMP implemented or implemented as intended?), the correct installation or placement, utilizing the correct materials, and the proper maintenance. The following table indicates the number of findings for each field BMP type that did not meet one of these listed standards.

Table 3-4 Findings by Field BMP Type			
BMP Category	BMP Type	BMP Name	Number of Findings
Soil Stabilization	SS-2	Preservation of Existing Vegetation	4
	SS-3	Hydraulic Mulch	17
	SS-5	Soil Binder	1
	SS-6	Straw Mulch	1
	SS-7	Geotextiles, Mats, Plastic Covers and Erosion Control Blankets	8
	SS-9	Earth Dikes/Drainage Swales and Lined ditches	1
Sediment Control	SC-1	Silt Fence	34
	SC-4	Check Dams	9
	SC-5	Fiber Rolls	47
	SC-6	Gravel Bag Berm	8
	SC-7	Street Sweeping and Vacuuming	24
	SC-10	Storm Drain Inlet Protection	33
Tracking Control	TC-1	Stabilized Construction Entrance/Exit	33
	TC-2	Stabilized Construction Roadway	1
Wind Erosion Control	WE-1	Wind Erosion Control	3
Non-Stormwater Control	NS-1	Water Conservation Practices	1
	NS-3	Paving and Grinding Operations	7
	NS-4	Temporary Stream Crossing	1
	NS-6	Illicit Connection/Illegal Discharge	1
	NS-9	Vehicle and Equipment Fueling	1
	NS-10	Vehicle and Equipment Maintenance	14
	NS-11	Pile Driving Operations	2
	NS-13	Materials and Equipment Use Over Water	5
Materials and Waste Management	WM-1	Material Delivery & Storage	37
	WM-3	Stockpile Management	58
	WM-4	Spill Prevention and Control	31
	WM-5	Solid Waste Management	50
	WM-6	Hazardous Waste Management	2
	WM-7	Contaminated Soil Management	1
	WM-8	Concrete Waste Management	22
	WM-9	Sanitary/Septic Waste Management	10

Figure 3-1 presents Table 3-4 information presented as a bar graph with the field BMP with highest number of findings on the far left and in descending order of findings towards the right for the other field BMPs.

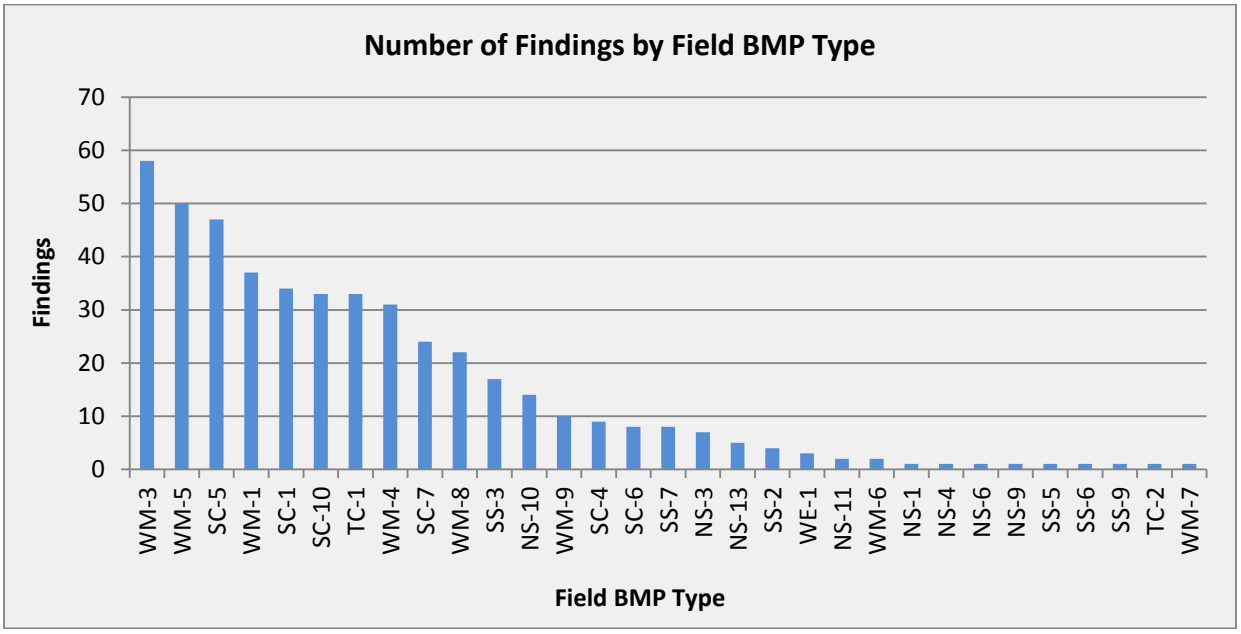


Figure 3-1 Number of Findings by Field BMP Type in Descending Order

An item to note concerning Figure 3-1 is that the top ten BMPs with the most field BMP findings total 369 findings which represent seventy-nine percent (79%) of all the findings. These ten field BMP types are as follows:

1.	WM-3, Stockpile Management	58
2.	WM-5, Solid Waste Management	50
3.	SC-5, Fiber Rolls	47
4.	WM-1, Material Storage and Delivery	37
5.	SC-1, Silt Fence	34
6.	SC-10, Storm Drain Inlet Protection	33
7.	TC-1, Stabilized Construction Entrance/Exit	33
8.	WM-4, Spill Prevention and Control	31
9.	SC-7, Street Sweeping and Vacuuming	24
10.	WM-8, Concrete Waste Management	22
	Total	369

As stated in Section 2.4, the reviewer includes photographic documentation of each finding which includes a description of the observation. Table 3-5 presents the number of findings based on like observations.

Table 3-5 Number of Findings by IQA Reviewer Observation

IQA Reviewer Observation	Number of Findings
1. Sediment Controls Need Maintenance	67
2. Stockpile Needs Cover and/or Linear Barrier	43
3. Trash and Debris Accumulated throughout Site	43
4. Liquid Hazardous Materials on Ground Surface	25
5. Liquid Materials not in Secondary Containment	23
6. Concrete Operation Waste Mismanaged	23
7. Inactive DSA Missing Perimeter Controls	22
8. Paved Areas not Swept Promptly	20
9. Inactive DSA Missing Soil Cover	17
10. Construction Access Missing Stabilized Entrance	17
11. Fiber Rolls not Trenched and Staked	13
12. Missing Drain Inlet Protection	12
13. Dumpster not Covered at Day's End	11
14. Stabilized Entrance Needs Maintenance	10
15. Soil Cover Needs Maintenance	9
16. Gas Can on Pervious Surfaces	8
17. Stored Materials Mismanaged (no Pallet or Cover, Spilled)	8
18. Paving or Pile Driving Equipment not Stored on Plastic	7
19. Active DSA Missing Perimeter Controls	6
20. Stabilized Entrance Installed Incorrectly	6
21. Stored Equipment not Fitted with BMPs	6
22. Treated Wood Needs to be on a Pallet and be Covered	6
23. Stockpile Cover and/or Linear Barrier Need Maintenance	6
24. Cold Mix Stockpile Needs to be Covered, Placed on an Impervious Liner, and/or have a Linear Barrier	5
25. Working Surface Over Water not Watertight	5
26. Sanitary Facilities Need Containment	5
27. Sanitary Facility Within 50 feet of Flow Line or Floodplain	4
28. Drain Inlet Protection Not Approved	3
29. Silt Fence not Trenched and Keyed In	3
30. Dust Plume Generated by Construction Traffic	3
31. Leaking Equipment Should Be Repaired or Removed	3

Table 3-5 Number of Findings by IQA Reviewer Observation (Continued)	
IQA Reviewer Observation	Number of Findings
32. Mobile Maintenance Operation Mismanaged	3
33. No Spill Kit or Absorbents on Spill not Picked up Promptly	3
34. Other Observations	3
35. Materials in Vegetation not to be Disturbed	2
36. Drain Inlet Protection Installed Incorrectly	2
37. Active DSA Missing Soil Cover (during Rain Event)	1
38. Run-on Mismanaged	1
39. Trees Require Protection	1
40. ESA Fencing Damaged	1
41. Inactive DSA Missing Controls on Face of Slope	1
42. Wrong Application for Check Dam	1
43. Gravel Bags Fill with Wrong Material	1
44. Sediment Generated During BMP Maintenance not Stabilized	1
45. Stabilized Roadway Missing	1
46. Accumulated Sediment on Stream Crossing	1
47. Leaking Fuel Hose	1
48. Illegal Discharge On-Site	1
49. Water-Filled Crash Cushion Leaking	1
50. Hazardous Waste Mismanaged	1
51. Stockpile Within 50 feet of Floodplain	1

Further definitions and examples of some of the top findings listed in Table 3-5 are as follows:

1. Sediment Controls Need Maintenance - Findings from this item generally included silt fence that was dilapidated or otherwise sagging, torn, and/or unraveled, fiber rolls that were torn and/or unraveled, or fiber rolls that had accumulated sediment that exceeded one-third the height of the barrier.
2. Stockpile Needs Cover and/or Linear Barrier - Findings from this item generally include inactive concrete rubble waste, aggregate materials, and/or soil stockpiles that were not covered and/or surrounded by a linear barrier
3. Trash and Debris Accumulated throughout Site - Findings from this item generally included accumulated construction waste that was gathered somewhere on the construction site, but was not placed in a dumpster. Evidence indicated that this trash and debris had been at this location significantly longer than a week.
4. Liquid Hazardous Materials on Ground Surface - Findings from this item generally included evidence of oil, grease, etc. that had leaked (from equipment) or spilled (during use of material or maintenance of equipment) onto the pervious or impervious surface. The stained area ranged from the size of the human hand to the shadow of a bus.

5. Liquid Materials not in Secondary Containment - Findings from this item generally included liquid materials, wastes, and/or fuels for equipment that were not properly stored in secondary containment.
6. Concrete Operation Waste Mismanaged - Findings from this item generally included concrete slurry not collected from the pavement surface, concrete operation waste not collected, concrete washout not near the concrete operation, concrete washout does not hold liquid, concrete washout exceeded capacity, concrete washout does not have the minimum 55-gallon capacity, or concrete washout need maintenance.
8. Paved Areas not Swept Promptly - Sediment tracked onto paved surfaces within and/or outside of the construction area and was not swept up or otherwise removed within the 1 hour or 24 hour minimum time period as specified.

4.0 Trends

The revisions to the CCEP initiated in 2015 makes comparing the findings of the July 1, 2014 - June 30, 2015 reporting year to the results of the 2013/2014 reporting year difficult because the CCEP process has changed and the late start limited the number of reviews that were conducted this year. However general analysis is presented here.

Table 4-1 presents the BMPs from the 2014 and 2015 YEPRs that were associated with the most number of findings in the reporting year. The BMPs in Table 4-1 are in descending order, i.e., the BMPs listed at the top had the most findings associated with them.

Table 4-1 Comparison of the BMPs with the Most Findings (in descending order) between the 2014 and 2015 YEPR

Field BMPs With the Most Associated Findings (in descending order)	
2015 YEPR	2014 YEPR
1. WM-3, Stockpile Management	1. WM-5, Solid Waste Management
2. WM-5, Solid Waste Management	2. SC-10, Storm Drain Inlet Protection
3. SC-5, Fiber Rolls	3. SC-1, Silt Fence
4. WM-1, Material Storage and Delivery	4. SC-5, Fiber Rolls
5. SC-1, Silt Fence	5. WM-1, Material Delivery and Storage
6. SC-10, Storm Drain Inlet Protection	6. WM-3, Stockpile Management
7. TC-1, Stabilized Construction Entrance/Exit	7. WM-4, Spill Prevention and Control
8. WM-4, Spill Prevention and Control	8. SC-4, Check Dam
9. SC-7, Street Sweeping and Vacuuming	9. WM-8, Concrete Waste Management
10. WM-8, Concrete Waste Management	10. WM-6, Hazardous Waste Management

These lists match up quite well, with 8 Field BMPs common between the 2 lists of 10 Field BMPs. The top 6 Field BMPs in the 2015 YEPR are the same as the top 6 Field BMPs in the 2014 YEPR. The only changes to the list in the 2015 YEPR Top 10 list is that SC-4, Check Dams and WM-6, Hazardous Waste Management have been replaced with TC-1, Stabilized Construction Entrance/Exit and SC-7, Street Sweeping and Vacuuming. It can be concluded from this brief analysis that the types of BMPs resulting in the most findings have not changed significantly between the 2014 and 2015 YEPR.

5.0 Conclusion

This 2015 YEPR summarizes construction project IQA reviews conducted between July 1, 2014 and June 30, 2015 by the independent assurance portion of the self-audit program implemented by Caltrans. These IQA reviews were conducted in accordance with the CCEP. The data is based on only forty-five reviews conducted during the last three months of the fiscal year; therefore, limited conclusions can be drawn from these reviews and are as follows:

- The 45 reviews resulted in 30 administrative and 467 field BMP findings, for a total of 497 findings.
- Very few administrative findings were noted during the IQA reviews, averaging less than one per IQA review. The category with the most administrative findings was training (33% of the total).
- Field BMP findings at IQA reviews averaged approximately 10 per review. The BMP categories with the most field BMP findings were Materials and Waste Management Control (45.2% of the total BMP findings) and Sediment Control (33.2% of the total BMP findings).
- The 4 field BMP types that had the most findings were, in descending order, 1) Stockpile Management, 2) Solid Waste Management, 3) Fiber Rolls, and 4) Material Delivery and Storage.
- The 4 most common observations were, in descending order, 1) Sediment Controls Need Maintenance, 2) Stockpile Needs Cover and/or Linear Barrier, 3) Trash and Debris Accumulated throughout Site, and 4) Liquid Hazardous Materials on Ground Surface.
- In general, the types and categories of findings were consistent with those found in the previous 3 years of the Self-Audit Program.

DEPARTMENT OF TRANSPORTATION
OFFICE OF THE DIRECTOR
P.O. BOX 942873, MS-49
SACRAMENTO, CA 94273-0001
PHONE (916) 654-6130
FAX (916) 653-5776
TTY 711
www.dot.ca.gov

Serious drought.
Help save water!

October 29, 2014

Ms. Diane Boyer-Vine
Legislative Counsel
State Capitol, Room 3021
Sacramento, CA 95814

Mr. Gregory Schmidt
Secretary of the Senate
State Capitol, Room 3044
Sacramento, CA 95814

Mr. E. Dotson Wilson
Chief Clerk of the Assembly
State Capitol, Room 3196
Sacramento, CA 95814

Dear Ms. Boyer-Vine, Messers. Schmidt and Wilson:

I am pleased to transmit the California Department of Transportation's (Caltrans) report entitled "2014 Coastal Anadromous Fish Passage Assessment and Remediation Progress Report" prepared pursuant to California Streets and Highway Code Section 156, Chapter 589, Statutes of 2005 (Senate Bill 857, Kuehl).

Distribution to the Legislature has been made by Caltrans pursuant to California Government Code 9795. This report can be found at http://www.dot.ca.gov/reports-legislature.htm.

Sincerely,

MALCOLM DOUGHERTY
Director

Enclosure

Annual Report to the Legislature
For Calendar Year 2013

COASTAL ANADROMOUS FISH PASSAGE ASSESSMENT AND REMEDIATION PROGRESS REPORT

***Chadd Creek (D1) Fish Passage structure**

Prepared:
October 2014

Prepared by the California Department of Transportation
Division of Environmental Analysis

Table of Contents

Executive summary……. Page 3

Related Policy and Regulation ……. Page 5

Table 1 - Figure 1 - 2013 Completed Fish Passage Remediation …….. Page 6

Table 2 - Figure 2 - 2013 Completed Fish Passage Assessments …… Page 7

Table 3 - Active Fish Passage Remediation Projects ……. Page 8

Figure 3 – **Active Fish Passage Remediation Projects** ……. Page 10

Table 4 - Priority Fish Passage Barriers for Remediation …….. Page 11

Figure 4 - Priority Fish Passage Barriers for Remediation …….. Page 13

Programmatic Environmental Review Process …….. Page 14

Appendix A – Completed Fish Passage Remediated, 2006 – 2013 …… Page 15

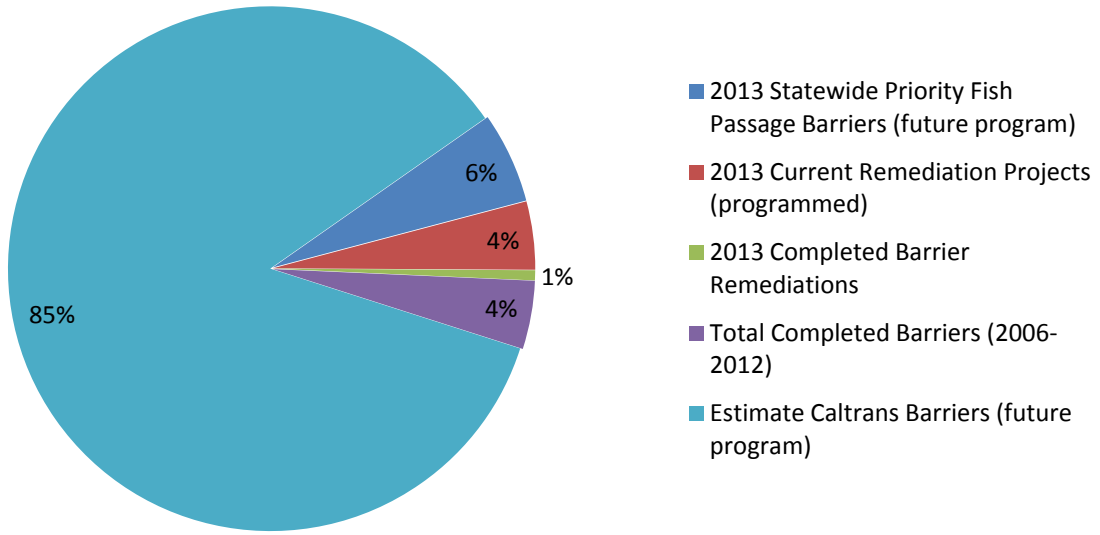
Executive Summary

The purpose of this report is to provide fish passage assessment and remediation information regarding state highways barrier locations, for which the California Department of Transportation (Caltrans) is responsible. This report updates Caltrans' progress and describes assessment and remediation activities between January 1 and December 31, 2013.

Fish Passage Program Accomplishments	
2013 - Completed Barrier Remediations	**4**
2013 - Completed Passage Assessments	**4**
Current Remediation Projects (programmed)	**27**
Statewide Priority Fish Passage Barriers (future program)	**36**
Total Remediated Fish Passage Barriers (Jan 1, 2006 to Dec 31, 2013)	**31**
Estimated Caltrans barriers, per the Passage Assessment Database (PAD), maintained by California Department of Fish & Wildlife (CDFW)	**569**

- Caltrans has worked with CDFW to create the first combined priority list of fish passage barriers on the state highway system.
- Five new fish passage remediation projects have been programmed since the last annual report (pages 8 & 9).
- There are twenty-nine prioritized locations that have been added since the last annual report (pages 11 & 12), in coordination with CDFW.

Fish Passage Program



Caltrans Fish Passage Barriers by District (all future program locations)		
District	**Estimated Fish Passage Barriers**	**2013 Priority Locations**
1 – Eureka	322	11
2 - Redding	56	9
3 - Marysville	6	0
4 - Oakland	72	10
5 – San Luis Obispo	87	2
6 – Fresno	0	0
7 – Los Angeles	23	2
10 – Stockton	0	0
11 – San Diego	2	2
12 - Orange	1	0
TOTAL	**569**	**36**

*Per the Passage Assessment Database (PAD)

- In coordination with CDFW, Caltrans has completed a quality assurance/quality control review (QA/QC) of all state highway locations within the PAD. The purpose of the QA/QC was to review and remove duplicate locations and locations that do not correlate with state highway facilities to determine where additional fish passage assessments are needed. The above table, **Caltrans Fish Passage Barriers by District**, lists existing fish passage barriers, in all district with current or history anadromous fish habitat, as provided by the PAD QA/QC effort.

- Related to the above bullet, Caltrans has funded a task order to assess identified stream crossings, statewide, to investigate additional fish passage barriers that may exist. The scope of this effort is currently in development. The task order was executed Oct 1, 2014.

Caltrans District Map

Related Policy & Regulation

This report is in accordance with Article 3.5 of Chapter 1 of Division 1 of the Streets and Highways Code (SB 857, Kuehl), which took effect January1, 2006. The law directs Caltrans to prepare an annual report describing the status of progress on locating, assessing and remediating barriers to anadromous fish passage on the State Highway System (SHS). SB 857 also directs Caltrans to report progress on developing a programmatic environmental review process to streamline permitting for fish passage barrier locations. Caltrans has issued policy and guidance for fish passage assessments and reporting protocols to the PAD.

In California, salmon and steelhead are listed under the Federal Endangered Species Act (FESA) and the California Endangered Species Act (CESA), as shown in the table below.

State and Federal Anadromous Species Listing

Species	Range	Federal/State Listing
Coho	Oregon to Northern CA coast Oregon (N Punta Gorda)	Threatened
Coho	Central CA coast (S. Punt Gorda to Monterey Bay)	Endangered
Chinook	California Coastal – Klamath River to Russian River	Threatened
Chinook	Central Valley Spring – Sacramento & Feather River	Threatened
Chinook	Sacramento River Winter – Sac River & tributaries	Endangered
Steelhead	Northern CA Coastal – Redwood Creek to Gualala River	Threatened
Steelhead	CA Central Valley – Sacramento, San Joaquin Rivers & tributaries	Threatened
Steelhead	Central CA Coast – Russian River to Aptos Creek	Threatened
Steelhead	Southern Central CA Coastal – Pajaro River to, but not including, Santa Maria River	Threatened
Steelhead	S. CA Coast – Santa Maria River to U.S./Mexico Border	Endangered

2013 Completed Fish Passage Remediation

Four fish passage remediation projects were completed in 2013. Table 1, 2013 Completed Fish Passage Remediation, contains information on the four locations. Below Table 1 is Figure 1, showing the locations that are listed in Table 1.

Table 1 – 2013 Completed Fish Passage Remediation

Map #	Caltrans District	County	Route	Post Mile	Pad ID #	Stream Name	Project Name
1	1	Del Norte	197	2.12	720982	Peacock Creek	Peacock Creek Emergency Project
2	1	Humboldt	299	4.2	716742	Hall Creek	Mad River Bridges Replacement - Mitigation
3	1	Mendocino	1	92.8	706958	Dunn Creek	10 Mile Bridge Replacement Mitigation
4	1	Mendocino	101	83.99	706987	Rattlesnake Creek	Rattlesnake Creek Fish Passage Remediation

Figure 1 - 2013 Completed Fish Passage Remediation

The fish passage remediation projects, above, which were completed in 2013 were initiated due to mitigation needs for bridge replacement projects (Dunn & Hall Creek), an emergency culvert repair (Peacock Creek) and maintenance upgrades that were needed (Rattlesnake Creek).

2013 Completed Fish Passage Assessments

Four fish passage assessments were completed in 2013. Table 2, 2013 Completed Fish Passage Assessments, contains information on assessment locations. Below Table 2 is Figure 2, showing the locations that are listed in Table 2.

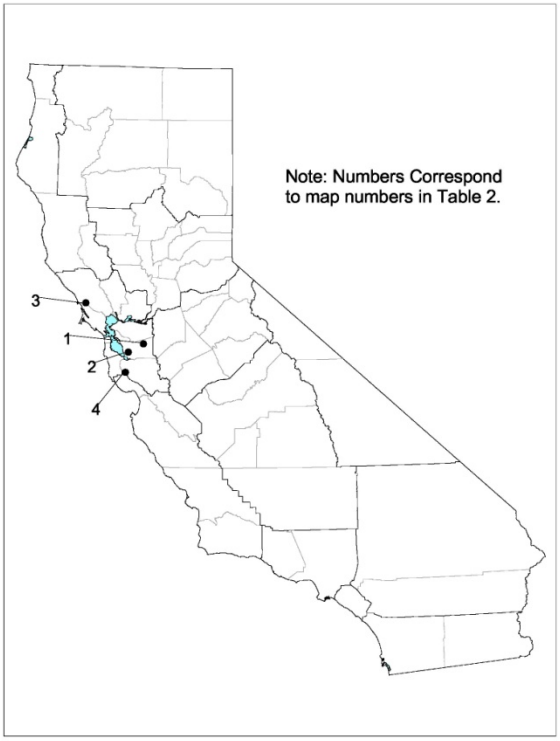
Table 2 – 2013 Completed Fish Passage Assessments

Map #	Caltrans District	Report Date	County	Route	Post Mile	PAD ID #	Stream Name	Tributary to
1	4	2/27/13	Alameda	580	11.04	758578	Arroyo Seco	Arroyo de la Laguna
2	4	2/27/13	Alameda	880	10.66	758579	Crandall Creek	Alameda Creek
3	4	3/01/13	Marin	1	50.5	732678	Americano Creek	Estero Americano
4	4	12/5/13	Santa Clara	9	3.6	733926	Booker Creek	Saratoga Creek

*Location 4 is a private diversion structure that is under the state highway.

Figure 2 - 2013 Completed Fish Passage Assessments

District 4 (Oakland) staff completed above assessments, as required, for work within planned SHS project locations.



Active Fish Passage Remediation Projects

Caltrans has 27 projects that are currently underway, to remediate fish passage barrier locations. Table 3, Active Fish Passage Remediation Projects, contains information on the current remediation project locations. Locations listed in the table below are either funded through construction, or partially funded for planning, design or permitting. Figure 3, (pg 10), is a map of locations that are listed in Table 3. The locations that are **bold and underlined** are new to the 2013 Fish Passage Annual Report.

Table 3 – Active Fish Passage Remediation Projects

Map #	Caltrans District	County	Route	Post Mile	Estimated CCA Date[1]	PAD ID #	Stream Name	Project Name
1	1	Mendocino	101	44.0	8/1/2019	713107	Unnamed tributary to Haehl Creek	Willits Bypass Mitigation
2	1	Mendocino	101	44.5	8/1/2019	712894	Unnamed tributary to Haehl Creek	Willits Bypass Mitigation
3	1	Mendocino	101	48.1	8/1/2019	705136	Upp Creek	Willits Bypass
4	1	Mendocino	101	52.25	10/1/2015	707085	South Fork Ryan Creek	Willits Bypass Mitigation
5	1	Mendocino	101	52.4	8/1/2015	707086	North Fork Ryan Creek	North Fork Ryan Creek
6	1	Mendocino	101	66.5	10/1/2015	707096	Ten Mile Creek	36 Culverts
7	**1**	**Mendocino**	**101**	**89.04**	**10/15/2016**	**706954**	**Cedar Creek**	**Cedar Creek**
8	1	Mendocino	128	20.15	7/3/2015	707196	Unnamed	22 Culverts[2]
9	1	Mendocino	128	21.8	9/15/2015	707199	Clow Creek	22 Culverts
10	1	Mendocino	128	27.5	9/15/2015	707205	Graveyard Creek	22 Culverts
11	1	Mendocino	128	36.6	9/15/2015	707208	Lost Creek	22 Culverts
12	1	Mendocino	128	39.8	9/15/2015	707210	Beebe Creek	22 Culverts
13	2	Shasta	299	32.2	11/3/2015	737295	Yank Creek/Lemm Creek Bridge	Bella Diddy Roadway Rehabilitation
14	2	Siskiyou	96	56.0	1/16/2015	707168	Fort Goff Creek	Fort Goff Creek Fish Passage

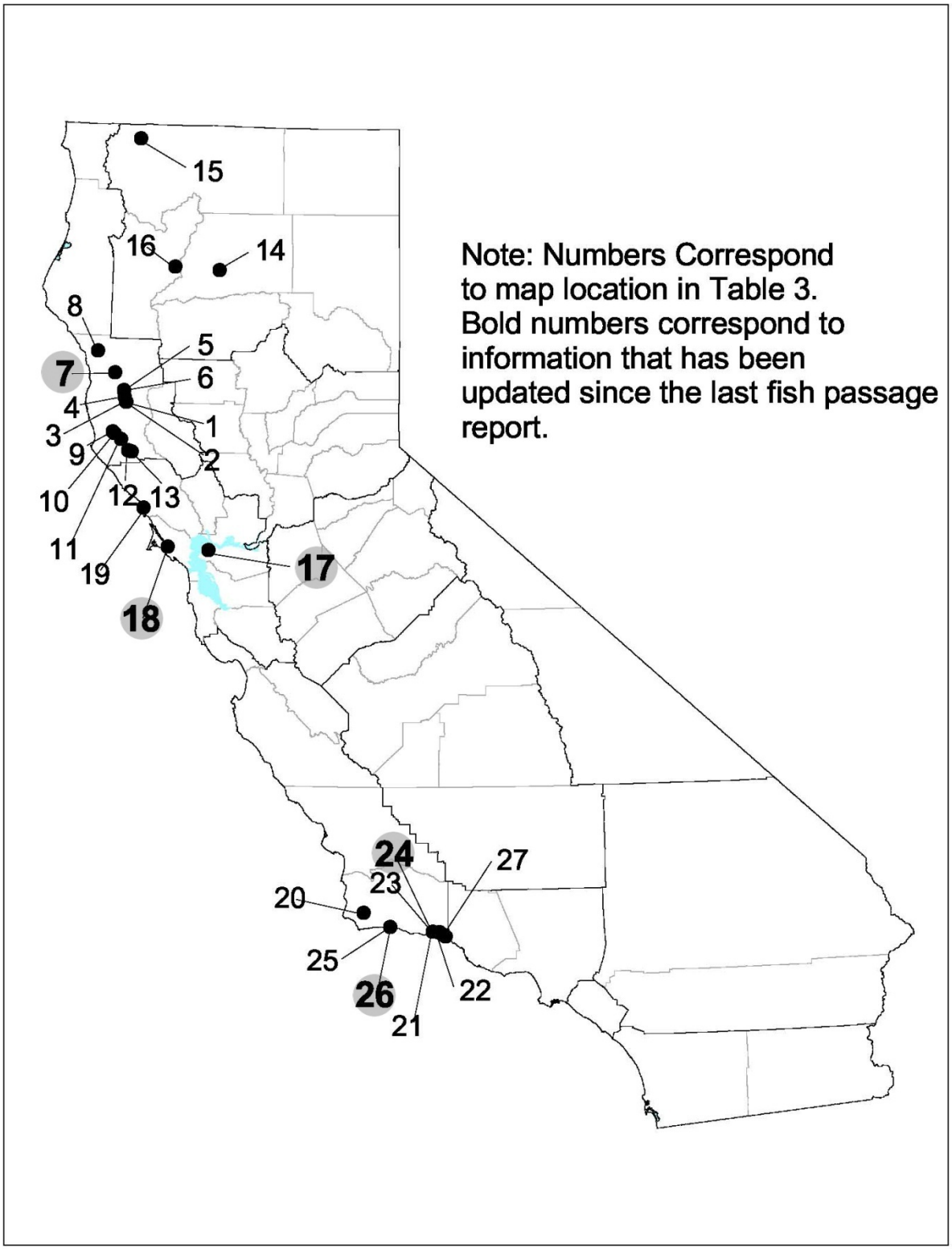
[1] Estimated Construction Contract Acceptance (CCA) dates.
[2] 22 culverts; only 5 of the 22 culverts have fish passage issues, all 5 are listed in this table.

Table 3 – Active Remediation Projects

Map #	Caltrans District	County	Route	Post Mile	Estimated CCA Date[1]	PAD ID #	Stream Name	Project Name
15	2	Trinity	299	68.0	9/15/2014	720511	Little Grass Valley Creek	Trinity Dam Boulevard Fish Ladder
16	2	Trinity	299	68.2	9/15/2014	735688	Little Grass Valley Creek	Trinity Dam Boulevard Fish Ladder
17	**4**	**Contra Costa**	**80**	**8.4**	**10/15/15**	**723716**	**Pinole Creek**	**Pinole Creek Fish Passage**
18	**4**	**Marin**	**1**	**24.77**	**10/30/18**	**732502**	**Tributary to Olema Creek**	**Olema Creek Culvert Replacement**
19	4	Sonoma	1	15.1	2/1/2016	733223	Scotty Creek	Gleason Beach Highway Realignment
20	5	Santa Barbara	1	15.6	4/1/2015	700085	Salsipuedes Creek	Salsipuedes Bridge Replacement
21	5	Santa Barbara	101	5.6	1/5/2022	734310	Arroyo Parida Creek	South Coast HOV
22	5	Santa Barbara	101	9.4	1/5/2022	705161	Romero Creek	South Coast HOV
23	5	Santa Barbara	101	9.6	1/5/2022	734342	San Ysidro Creek	South Coast HOV
24	**5**	**Santa Barbara**	**101**	**0.0**	**1/5/2022**	**707368**	**Rincon Creek**	**South Coast HOV**
25	5	Santa Barbara	101	38.8	9/15/2015	707403	Tajiguas Creek	Tajiguas Fish Passage
26	**5**	**Santa Barbara**	**101**	**2.2**	**5/1/2020**	**707182**	**Carpinteria Creek**	**Highway 101 Linden/ Casitas Pass**
27	5	Santa Barbara	192	15.5	9/4/2017	706239	Arroyo Parida Crk	Arroyo Parida Creek

***Projects that are bold and underlined are new to the list, for the 2013 Fish Passage Annual Report.**

Figure 3 - Active Fish Passage Remediation Projects



Priority Fish Passage Barriers for Remediation

Caltrans has worked with CDFW to create the first combined priority list of known fish passage barriers located on the State Highway System. Table 4, Priority Fish Passage Barriers for Remediation, is listed below. All listed crossings have equal priority at this time. Caltrans continues to work with resource agency partners toward the development of a statewide fish passage barrier ranking and optimization system. The locations that are **bold and underlined** are locations that are new to the 2013 Fish Passage Annual Report. There are 29 new locations identified on the priority table.

Table 4 – Priority Fish Passage Barriers for Remediation

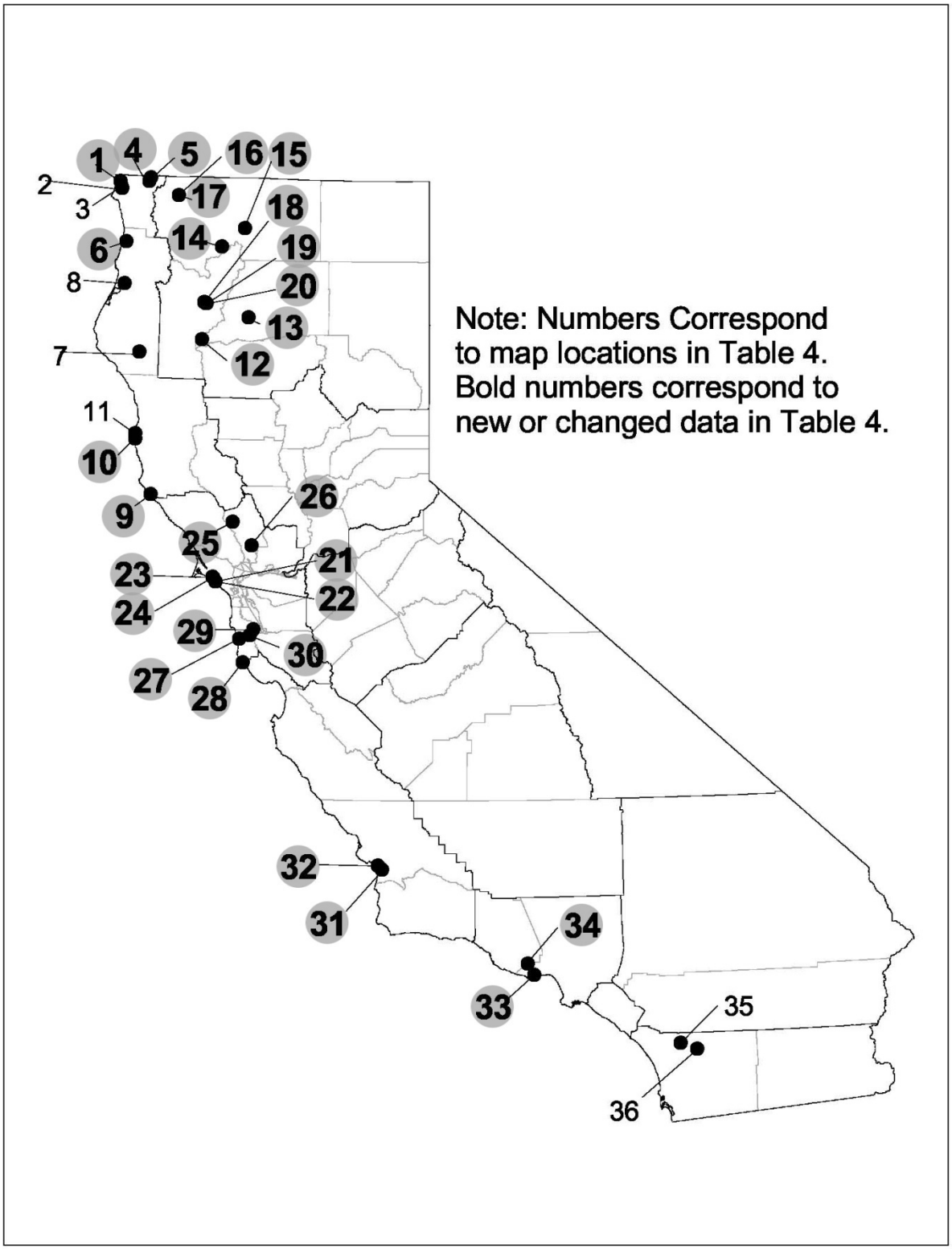
Map #	Caltrans District	County	Route	Post Mile	PAD ID #	Stream Name	Tributary to
1	**1**	**Del Norte**	**101**	**39.78**	**707134**	**Dominie Creek**	**Smith River**
2	1	Del Norte	197	5.0	707143	Sultan Creek	Smith River
3	1	Del Norte	197	6.2	707142	Little Mill Creek	Smith River
4	**1**	**Del Norte**	**199**	**31.31**	**707137**	**Griffin Creek**	**Middle Fork Smith River**
5	**1**	**Del Norte**	**199**	**34.04**	**712954**	**Broken Kettle Creek**	**Elk Creek**
6	**1**	**Humboldt**	**101**	**124.49**	**713025**	**Little Lost Man**	**Prairie Creek**
7	1	Humboldt	254	4.2	707157	Fish Creek – Ave of the Giants	South Fork Eel River
8	1	Humboldt	299	2.97	713051	Essex Gulch	Mad River
9	**1**	**Mendocino**	**1**	**4.64**	**713068**	**Fish Rock Gulch**	**Pacific Ocean**
10	**1**	**Mendocino**	**1**	**54.62**	**707070**	**Doyle Creek**	**Pacific Ocean**
11	1	Mendocino	1	58.78	707072	Digger Creek	Pacific Ocean
12	**2**	**Shasta**	**36**	**3.57**	**737281**	**Harrison Gulch**	**Middle Fork Cottonwood**
13	**2**	**Shasta**	**273**	**18**	**707132**	**Sulphur Creek**	**Sacramento River**
14	**2**	**Siskiyou**	**3**	**6.5**	**707148**	**Big Mill Creek**	**Scott River**
15	**2**	**Siskiyou**	**5**	**27.18**	**720504**	**Parks Creek**	**Shasta River**
16	**2**	**Siskiyou**	**96**	**43.2**	**720541**	**Cade Creek**	**Klamath River**
17	**2**	**Siskiyou**	**96**	**56.9**	**707169**	**Portuguese Creek**	**Klamath River**
18	**2**	**Trinity**	**299**	**49.6**	**720523**	**West Weaver Crk**	**Trinity River**
19	**2**	**Trinity**	**299**	**51.2**	**737674**	**Sydney Gulch**	**Trinity River**
20	**2**	**Trinity**	**299**	**51.4**	**735941**	**Garden Gulch**	**Trinity River**
21	**4**	**Marin**	**1**	**22.67**	**706059**	**John West Fork**	**Olema Creek**
22	**4**	**Marin**	**1**	**22.78**	**706058**	**Giacomini Gulch**	**Olema Creek**

Table 4 – Priority Fish Passage Barriers for Remediation

Map #	Caltrans District	County	Route	Post Mile	PAD ID #	Stream Name	Tributary to
23	**4**	**Marin**	**1**	**18.69**	**706078**	**McCurdy Creek**	**Pine Gulch Creek (Bolinas Lagoon)**
24	**4**	**Marin**	**1**	**18.69**	**706079**	**North Fork McCurdy Creek**	**McCurdy Creek/ Pine Gulch Creek**
25	**4**	**Napa**	**29**	**33.17**	**705459**	**Ritchie Creek**	**Napa River**
26	**4**	**Napa**	**121**	**9.3**	**758605**	**Sarco Creek**	**Miliken Creek**
27	**4**	**San Mateo**	**1**	**4.32**	**705302**	**Whitehouse Creek**	**Pacific Ocean**
28	**4**	**San Mateo**	**1**	**22.75**	**716835**	**Lobitos Creek**	**Pacific Ocean**
29	**4**	**San Mateo**	**84**	**19.25**	**705768**	**Bear Creek**	**San Francisquito**
30	**4**	**San Mateo**	**84**	**19.98**	**705768**	**West Union Creek**	**Bear Creek/San Francisquito Creek**
31	**5**	**San Luis Obispo**	**1**	**22.8**	**700040**	**Pennington Creek**	**Chorro Creek**
32	**5**	**San Luis Obispo**	**101**	**16.4**	**707126**	**Pismo Creek**	**Pacific Ocean**
33	**7**	**Los Angeles**	**1**	**50.3**	**705781**	**Solstice Creek**	**Pacific Ocean**
34	**7**	**Ventura**	**101**	**0.0**	**707368**	**Rincon Creek**	**Pacific Ocean**
35	11	San Diego	76	29.5	712680	Pauma Creek	San Luis Rey River
36	11	San Diego	76	45.5	735076	Wigham Creek	San Luis Rey River

***Projects that are bold and underlined are new to the list, for the 2013 Fish Passage Annual Report.**

Figure 4 - Priority Fish Passage Barriers for Remediation



Programmatic Environmental Review Process

Caltrans and the National Oceanic and Atmospheric Administration (NOAA) finalized a Programmatic Biological Opinion (PBO) on October 18, 2013. The geographic scope of the programmatic is for coastal drainages from the Oregon border to Santa Cruz County and is consistent with the range of Coho salmon, which are endangered in California. The PBO streamlines the majority of fish passage improvement activities that can be characterized as either routine maintenance or small projects. Routine maintenance includes culvert repair, culvert cleaning, vegetation management, and some categories of small projects to include culvert installation, weir and baffle installation and small bridge construction.

Caltrans continues to work on a programmatic agreement with the U.S. Fish and Wildlife Service (USFWS) and CDFW to streamline similar consultations. Caltrans has recently reinitiated programmatic discussions with the USFWS and both parties are working together to define the species, activities and associated impacts that are proposed for inclusion in the renewed programmatic effort. During preliminary discussions with CDFW, management has conveyed a continued interest in streamlining permitting efforts for routine activities, to include fish passage. CDFW has identified staff who will be working with Caltrans on this effort.

Appendix A – Completed Fish Passage Remediations

Senate Bill 857 was enacted into law effective January 1, 2006. Appendix A is a list of all fish passage barriers that Caltrans has remediated since SB 857 was enacted, to the end of the reporting period for the previous Annual Report, December 31, 2013.

Appendix A – Completed Fish Passage Remediations							
Map #	**Caltrans District**	**County**	**Route**	**Post Mile**	**PAD ID #**	**Stream Name**	**Project Name**
1	1	Del Norte	101	4.04	737008	Unnamed Tributary	Tributary to Elk Creek
2	1	Del Norte	101	43.7	715563	Lopez Creek	Smith River Widening
3	**1**	**Del Norte**	**197**	**2.12**	**720982**	**Peacock Creek**	**Peacock Creek Emergency Project**
4	1	Humboldt	101	40.7	722447	Chadd Creek	Chadd Creek Fish Passage
5	1	Humboldt	101	115.3	737005	Unnamed Tributary	Stone Lagoon
6	1	Humboldt	169	22.37	706138	Cappell Creek	Four Bridges Project
7	**1**	**Humboldt**	**299**	**4.2**	**716742**	**Hall Creek**	**Mad River Bridges Replacement - Mitigation**
8	1	Mendocino	1	62.5	737008	Unnamed Tributary	Culvert Rehab Trib to Pudding Creek
9	**1**	**Mendocino**	**1**	**92.8**	**706958**	**Dunn Creek**	**10 Mile Bridge Replacement Mitigation**
10	1	Mendocino	101	81.4	706986	Rattlesnake Creek	Rattlesnake Creek
11	**1**	**Mendocino**	**101**	**83.99**	**706987**	**Rattlesnake Creek**	**Rattlesnake Creek Fish Passage**
12	1	Mendocino	101	99.0	707115	Red Mountain Creek	Confusion Hill Mitigation
13	1	Mendocino	128	49.66	707220	Edwards Creek	Edwards Creek Fish Passage

Appendix A – Completed Fish Passage Remediations

Map #	Caltrans District	County	Route	Post Mile	PAD ID #	Stream Name	Project Name
14	1	Mendocino	128	39.37	707209	Beebe Creek	Beebe Creek Storm Damage
15	1	Mendocino	128	39.95	707211	John Hatt Creek	Beebe Storm Damage
16	1	Mendocino	128	39.95	707212	John Hatt Creek	Beebe Storm Damage
17	1	Mendocino	128	39.95	713145	John Hatt Creek	Beebe Storm Damage
18	2	Shasta	299	20.7	737289	Salt Creek	Salt Creek Fish Passage Project
19	2	Siskiyou	96	56.0	707168	Fort Goff Creek	Fort Goff Creek Fish Passage
20	2	Siskiyou	96	65.4	707147	O'Neil Creek	O'Neil Creek Fish Passage
21	2	Tehama	5	16.9	737006	Elder Creek	Elder Creek Scour Mitigation Project
22	2	Tehama	5	28.1	737007	Dibble Creek	Elder & Dibble Creek Scour Mit
23	2	Tehama	99	14.0	737012	Craig Creek	Craig Creek and Sunset Canal Bridges Project
24	2	Tehama	99	15.6	737013	Sunset Canal	Sunset Canal Bridge
25	4	Napa	121	1	733333	Huichica Creek	Duhig Rd Realign Curves and Widen Shoulder
26	5	Santa Barbara	101	33.9	707398	El Capitan Creek	El Capitan Creek
27	5	Santa Barbara	101	41.0	707405	Arroyo Hondo Creek	Arroyo Hondo
28	5	Santa Barbara	101	47.2	706669	Gaviota Creek	Gaviota Creek
29	5	Santa Cruz	1	10.0	706703	Valencia Creek	Tributary to Aptos Creek
30	5	Santa Cruz	1	17.4	735367	Branciforte Creek	Branciforte Creek and Carbonera Creek
31	7	Ventura	150	28.7	723744	Santa Paula Creek	Santa Paula Creek

***Projects that are bold and underlined are new to the list, for the 2013 Fish Passage Annual Report.**

DEPARTMENT OF TRANSPORTATION
LEGAL DIVISION -MS 57
1120 N STREET, SACRAMENTO, CA 95814
P.O. BOX 1438, SACRAMENTO, CA 95812-1438
PHONE (916) 654-2630
FAX (916) 654-6128
TTY 711

Serious drought
Help save water!

September 22, 2015

Thomas Howard
Executive Director
State Water Resources Control Board
P.O. Box 100
Sacramento, CA 95812-0100

Re: Annual Report

Dear Mr. Howard:

The Department certifies that it has adequate legal authority through statute, permit, contract or other means (i.e. filing a complaint with local regional water quality control board or local municipal separate storm sewer system operator (MS4), or filing a lawsuit, since the Department does not have enforcement authority) to control discharges to and from the Department's properties, facilities and activities.

Very truly yours,

Jerry M. Montoya

Jerry M. Montoya
Acting Chief Counsel

Year-End Performance Report FY2014–2015

A Summary of Maintenance Activity Storm Water Compliance Reviews

CTSW-RT-15-321.04.4

September 2015

California Department of Transportation
Division of Environmental Analysis, Stormwater Program
1120 N Street, MS 27
Sacramento, California 95814
http://www.dot.ca.gov/hq/env/stormwater/index.htm

For individuals with sensory disabilities, this document is available in alternate formats upon request. Please call or write to Stormwater Liaison, California Department of Transportation Division of Environmental Analysis, PO Box 942874, MS-27, Sacramento, CA 94274-0001, (916) 653-8896 Voice, or dial 711 to use a relay service.

Table of Contents

1. Introduction 1
2. Maintenance Activity Compliance Program 1
   2.1 Maintenance Activity BMPs 1
   2.2 Activity Review 3
      2.2.1 Review Guidelines and Checklist 3
      2.2.2 Rating System 3
   2.3 Reporting and Communications 4
      2.3.1 Status Reports 4
      2.3.2 Maintenance Activity Review Database Summary 4
      2.3.3 On-Site Training 4
3. Summary of Maintenance Activity Compliance Review Results 4
   3.1 Activity Review Results by District 5
   3.2 Activity Review Results by Maintenance Family 7
4. Maintenance Activity Compliance Review Assessments 8
   4.1 A Family – Flexible Pavement 8
   4.2 B Family – Rigid Pavement 8
   4.3 C Family – Slope/Drain/Vegetation 9
   4.4 D Family – Litter/Debris/Graffiti 9
   4.5 E Family – Landscaping 9
   4.6 F Family – Environmental 9
   4.7 G Family – Public Facilities 9
   4.8 H Family – Bridges 10
   4.9 J Family – Other Structures 10
   4.10 K Family – Electrical 10
   4.11 M Family – Traffic Guidance 10
   4.12 R Family – Snow and Ice Removal 10
   4.13 S Family – Storm Maintenance 10
   4.14 T Family – Management and Support 10
5. Summary of Compliance Assistance 11

List of Attachments

Attachment A: Maintenance Activity Compliance Review Rating Guidelines and Procedures

Attachment B: Caltrans Maintenance Site Stormwater Compliance Review Checklist

Attachment C: Maintenance Activity Review Database Summary (FY2014–2015)

List of Tables

Table 2-1: Family of Activities 2

Table 2-2: Maintenance Activity Compliance Rating Summary 3

Table 3-1: Maintenance Family Activities Reviewed FY2014–2015 5

Table 3-2: Compliance Review Activity Ratings Summary By District FY2014–2015 6

Table 3-3: Compliance Review Activity Ratings Summary By Family FY2014–2015 7

Acronyms, Abbreviations, and Definitions

AMACRP: Annual Maintenance Activity Compliance Review Plan

BMPs: Best Management Practices

Department: State of California, Department of Transportation

DMSWC: District Maintenance Stormwater Coordinator

Family: Organization of Maintenance work consistent with the Department's methods used to record, report and monitor maintenance work as it is planned and performed.

FPPP: Facility Pollution Prevention Plan

FY: Fiscal Year

Maintenance: California Department of Transportation, Division of Maintenance

Maintenance Activities: Routine maintenance activities that may require clearing, grading or excavation to maintain original line and grade, hydraulic capacity or original purpose of the facility (SWMP [2012]).

Maintenance Facility: Facilities under the Department's ownership or control that contain such areas as fueling areas, waste storage or disposal facilities, wash racks, equipment or vehicle storage and materials storage areas (SWMP [2012]).

NPDES: National Pollutant Discharge Elimination System

Permit: National Pollutant Discharge Elimination System Statewide Stormwater Permit and Waste Discharge Requirements (WDRs) for the State of California, Department of Transportation

Maintenance Staff Guide: Caltrans Stormwater Quality Handbook: Maintenance Staff Guide (Interim, rev. September 2012)

SWMP: Caltrans Stormwater Management Plan (2012)

USEPA: U.S. Environmental Protection Agency

1. Introduction

This Year-End Performance Report is for Fiscal Year (FY) 2014 – 2015. It summarizes the results of stormwater compliance reviews conducted on the California Department of Transportation (Department) maintenance activities. Facilities and activities reviews were conducted to verify compliance with the requirements of the Department's Statewide Storm Water Management Plan (SWMP). The SWMP was developed in accordance with the requirements prescribed in the National Pollutant Discharge Elimination System (NPDES) Statewide Storm Water Permit and Waste Discharge Requirements (WDRs) for the State of California, Department of Transportation (Permit).

The key elements of this Year-End Performance Report include:

- Description of the stormwater maintenance activity compliance program (Section 2).
- Summaries of maintenance activity compliance reviews and stormwater management Best Management Practice (BMP) effectiveness (Section 3).
- Maintenance activity compliance review assessments (Section 4).
- Summary of compliance assistance (Section 5).

2. Maintenance Activity Compliance Program

The Maintenance Activity Compliance Program is a Departmental effort to review maintenance activities for compliance with the Permit. Reviews are conducted by an independent third party consultant (third party). To implement the compliance program and meet the SWMP requirements, guidelines are developed and presented in an Annual Maintenance Activity Compliance Review Plan (AMACRP). Under this plan, a minimum of 10 activities are reviewed in each District annually. Statewide, there are 12 Districts with various maintenance activities.

The reviews are conducted in accordance with the AMACRP and in consultation and coordination with the Department's Division of Environmental Analysis and the Department's Division of Maintenance.

The key component of the Storm Water Maintenance Activity Compliance Program is the Caltrans Stormwater Quality Handbook: Maintenance Staff Guide (Interim, rev. September 2012) (Maintenance Staff Guide). The Maintenance Staff Guide is a Maintenance employee handbook that incorporates the approved Maintenance BMPs providing direction, guidance, policies and procedures for maintenance activities. The Storm Water Maintenance Activity Compliance Program objectives are to:

- Evaluate compliance of activities with the requirements of the Permit.
- Report compliance status to Department management.
- Evaluate BMP implementation results, suggest areas for improvement and recommend new BMP implementation methodologies.

This Year-End Performance Report summarizes the results of maintenance activities reviewed from July 1, 2014 to June 30, 2015.

2.1 Maintenance Activity BMPs

Maintenance work is organized into several Families (Families A through T) consistent with the Department's method to record, report and monitor maintenance work as it is planned and performed. Maintenance activities are listed under the Families identified in the Maintenance Staff Guide. These activities represent typical maintenance work on State highways. The activities have the potential to

affect stormwater quality. The 62 maintenance activities are grouped into 14 Families that represent work of a similar nature. The Families and activities are defined in Table 2-1.

Table 2-1: Family of Activities

Family of Activity	Activities
A Family – Flexible Pavement	Asphalt Cement Crack and Joint Grinding/Sealing; Asphalt Paving; Structural Pavement Failure (Digouts) Pavement Grinding/Paving; Emergency Pothole Repair; and Sealing Operations
B Family – Rigid Pavement	Portland Cement Crack and Joint Sealing; Mudjacking and Drilling; and Concrete Slab/Spall Repair
C Family – Slope/Drain/Vegetation	Shoulder Grading; Non-landscape Chemical Vegetation Control; Non-landscape Mechanical Vegetation Control/Mowing; Non-landscape Tree/Shrub Pruning, Brush Chipping, Tree/Shrub Removal; Fence Repair; Drainage Ditch/Channel Maintenance; Drain/Culvert Maintenance; and Curb/Sidewalk Repair
D Family – Litter/Debris/Graffiti	Sweeping Operations; Litter and Debris Removal; Emergency Response and Cleanup Practices; and Graffiti Removal
E Family – Landscaping	Chemical Vegetation Control; Manual Vegetation Control; Landscape Mechanical Vegetation Control/Mowing; Landscape Tree/Shrub Pruning, Brush Chipping, Tree/Shrub Removal; Irrigation Line Repair; and Irrigation
F Family – Environmental	Storm Drain Stenciling; Roadside Slope Inspection; Roadside Stabilization; Storm Water Treatment Devices; and Traction Sand Trap Devices
G Family - Public Facilities	Custodial Responsibilities at Restrooms, Fountains, and Picnic Areas,; Maintenance of Appurtenances such as Roadway Surfacing, Signs, Pavement Markings, Buildings, Landscaping, and Electrical Installations
H Family – Bridges	Welding and Grinding; Sandblasting, Wet Blast (Sand Injection) and Hydroblasting; Painting; Bridge Repairs; and Draw Bridge Maintenance
J Family – Other Structures	Pump Station Cleaning; Tube and Tunnel Maintenance and Repair; Ferryboat Operations; Tow Truck Operations; and Toll Booth Lane Scrubbing Operations
K Family – Electrical	Sawcutting for Loop Installation
M Family – Traffic Guidance	Thermoplastic Stripping and Marking; Paint Stripping and Marking; Raised/Recessed Pavement Marker Application and Removal; Sign Repair and Maintenance; Median Barrier and Guard Rail Repair; and Emergency Vehicle Energy Attenuator Repair
R Family – Snow and Ice Removal	Snow Removal; and Ice Control
S Family – Storm Maintenance	Minor Slides and Slipouts Cleanup/Repair
T Family – Management and Support	Building and Grounds Maintenance; Storage of Hazardous Materials; Material Storage Control; Outdoor Storage of Raw Materials; Vehicle and Equipment Fueling/Cleaning/ Maintenance and Repair; and Aboveground and Underground Tank Leak/Spill Control

The Maintenance Staff Guide provides 71 Maintenance BMPs approved for statewide use. These Maintenance BMPs are individual BMPs relevant to maintenance activities. In addition to BMPs relevant to a specific maintenance activity, there are BMPs that are commonly applied to all maintenance activities and are defined as General BMPs. The General BMPs include Scheduling and Planning, Spill Prevention and Control, Sanitary/Septic Waste Management, Material Use, Safer Alternative Products, Vehicle/Equipment Cleaning/Fueling /Maintenance, Illicit Connection Detection/Reporting/Removal, Illegal Spill Discharge Control, and Maintenance Facility Housekeeping Practices.

In the Maintenance Staff Guide, Activity Cut-Sheets are provided to summarize the BMPs that are appropriate to implement for each maintenance activity in the Families.

2.2 Activity Review

Activity reviews were completed in FY2014–2015 for all the Maintenance Families listed in Table 2-1 except the J Family - Other Structures. No Other Structure family of maintenance activities were encountered during the FY2014–2015. Although reviews were planned to be conducted in all of the Families, maintenance activities selected for review are limited by maintenance work planned and seasonal conditions. It is worth noting that an unseasonably warm, dry winter was experienced in FY2014–2015. As a result, limited evaluations of R Family - Snow and Ice Removal activities were conducted. The previous review periods, FY2011–2012, FY2012–2013, and FY2013–2014 had similar dry winters and resulted in very few or no reviews of the R Family.

2.2.1 Review Guidelines and Checklist

To maintain compliance with the AMACRP, Maintenance Activity Compliance Review Rating Guidelines and Procedures and a standardized Maintenance Activity Storm Water Compliance Review Checklist are developed and implemented for all activity reviews (Attachments A and B, respectively). The procedures and checklist are developed to evaluate the overall effectiveness of stormwater pollution prevention practices, implementation of those practices and the potential for pollutant discharge for maintenance activities.

During each review, the third party auditor rates the compliance status of the activity and documents the results using the Maintenance Activity Storm Water Compliance Inspection Form. A rating is assigned representing an overall assessment of the activity's compliance with the stormwater pollution prevention requirements. A copy of the completed checklist is submitted and reviewed with the supervisor or designated representative. An electronic online copy of the completed checklist is available to the District Maintenance Stormwater Coordinator (DMSWC).

2.2.2 Rating System

The rating system consists of a numeric component (1 through 4) and a letter component (A, B and C) as defined in the Maintenance Activity Compliance Review Rating Guidelines and Procedures (Table 2-2) presented in Attachment A.

Table 2-2: Maintenance Activity Compliance Rating Summary

Numeric Rating Summary	
1	Compliant. The activity is in compliance with SWMP requirements. A revisit will not be necessary.
2	Minor deficiency. The activity is in compliance with SWMP requirements. A revisit will not be necessary.
3	Major deficiency noted that requires prompt correction. The activity crew will be required to attend a BMP tailgate meeting within 2 weeks focusing on the relevant BMPs.
4	Critical deficiency noted that requires immediate correction. The activity crew will be required to attend a BMP tailgate meeting within 1 week focusing on the relevant BMPs.
Letter Rating Summary	
A	Overall implementation of BMPs is highly effective. Stormwater pollutants are substantially controlled.
B	Overall implementation of BMPs is moderately effective. Stormwater pollutants are partially controlled.
C	Overall implementation of BMPs is critically ineffective. Stormwater pollutant is not controlled.

Maintenance activities that receive a 1 or 2 Rating (i.e., compliant or minor deficiency) are considered to be compliant with the stormwater requirements. A letter rating of A or B indicates that the activities water pollution control effort is highly or moderately effective.

In contrast, the 3 or 4 Rating (i.e., major or critical deficiency) indicates the need for immediate corrective action and additional training. The C Rating indicates that the activity's water pollution control effort is ineffective. If an activity received a 3 or 4 Rating, the corrective action(s) is implemented immediately prior to the auditor leaving the activity location and a revisit is not conducted. If additional training is required, training is conducted and documented on a BMP Tailgate Meeting Form upon return to the maintenance facility.

2.3 Reporting and Communications

Throughout the reporting period, Department Headquarters and third party auditors maintain on-going communication on the progress of the program activities and the self-audit results. Monthly status meetings are conducted with Department Headquarters and the third party auditors to identify programmatic issues and BMP deficiencies identified in the field.

2.3.1 Status Reports

The third party auditors prepare monthly status reports that are submitted to Headquarters staff. Each status report provides a list of District maintenance activities reviewed and a summary of review results.

2.3.2 Maintenance Activity Review Database Summary

A database is maintained to make review results and other useful information readily available to Headquarters staff. The database includes the maintenance activity reviewed, reference information (i.e., the maintenance activity location, supervisor/lead worker, Maintenance Facility assigned, contact information), overall activity BMP ratings and completed stormwater compliance forms. The summary of the database for FY2014-2015 is provided in Attachment C.

2.3.3 On-Site Training

Informal on-the-job training can occur during the compliance review to provide immediate site-specific guidance to facility supervisors and maintenance staff. The review schedule also allows sufficient time for the third party auditor to discuss observations with the facility supervisor, DMSWC or designated representatives.

3. Summary of Maintenance Activity Compliance Review Results

This section summarizes the review results and BMP implementation results of the stormwater compliance reviews that were conducted statewide from July 2014 through June 2015. A detailed list of results is provided in the Maintenance Activity Review Database Summary (FY2014–2015) (Attachment C).

Based on the maintenance work planned and the seasonal conditions (e.g., warm dry winter) in FY2014–2015, 0 to 77 activity reviews were evaluated in the Families (Table 3-1).

Table 3-1: Maintenance Family Activities Reviewed FY2014–2015		
Maintenance Family	No. of Activities Reviewed	Location of Activities Reviewed
C Family – Slope/Drain/Vegetation	77	All Districts
D Family – Litter/Debris/Graffiti	49	Districts 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, and 11
E Family – Landscaping	48	Districts 2, 3, 4, 5, 7, 8,10, 11, and 12
M Family – Traffic Guidance	22	Districts 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, and 11
A Family – Flexible Pavement	18	Districts 1, 2, 4, 6, 9, 10, 11, and 12
F Family – Environmental	13	Districts 1, 2, 3, 5, 7, 9, 11, and 12
K Family – Electrical	12	Districts 1, 2, 3, 4, 5, 7, 8, 9, 10, and 12
H Family – Bridges	5	Districts 1, 4, 5, 6, and 10
S Family – Storm Maintenance	4	Districts 5, 6, 9, and 11
G Family - Public Facilities	4	Districts 3, 4, 6, and 8
B Family – Rigid Pavement	2	Districts 3 and 8
T Family – Management and Support	2	Districts 6 and 7
R Family – Snow and Ice Removal	1	District 9
J Family -Other Structures	0	None
TOTAL	**257**	

The activity reviews focused on proper implementation of the General BMPs and the activity-specific BMPs associated with the 14 Families. The Maintenance Activity Review Database Summary (FY2014–2015) provides review details, which includes the District, activity evaluated, location (County/Route/PM/Direction), review date and compliance rating (Attachment C).

3.1 Activity Review Results by District

The third party auditors reviewed an average of 21 individual maintenance activities per District. In FY2014–2015, a total of 257 reviews were conducted across the 12 Districts. The selection process for the activities reviewed was based on geographical location and specific types of activities. All of the Families were targeted for review and the goal of 10 compliance reviews per District was achieved.

The numeric and letter ratings results organized by District are presented in Table 3-2. A summary of the ratings results for the Districts include the following:

- Activity reviews were conducted in 39 of 58 counties statewide.
- Throughout the Districts a total of 256 activities (99.6%) receive a 1 or 2 Rating (compliant or minor deficiency).
- The Districts had a total of 256 activities (99.6%) receive an A or B Rating (BMPs highly to moderately effective).
- Reviews across the 12 Districts were generally evenly distributed. District 7 had the most activity reviews (32 reviews) and District 10 had the least (13 reviews).
- One activity (0.4%) in District 4 received a 3C Rating (major deficiency and BMPs ineffective).
- None of the Districts had activities receive a 4 Rating (critical deficiency).

Table 3-2: Compliance Review Activity Ratings Summary By District FY2014–2015

Numeric Rating Summary									
District	No. of Activities Reviewed	Compliant		Minor Deficiency		Major Deficiency		Critical Deficiency	
		1 Rating		2 Rating		3 Rating		4 Rating	
1	17	16	94%	1	6%	0	0%	0	0%
2	16	15	94%	1	6%	0	0%	0	0%
3	21	21	100%	0	0%	0	0%	0	0%
4	26	21	81%	4	15%	1	4%	0	0%
5	20	18	90%	2	10%	0	0%	0	0%
6	27	26	96%	1	4%	0	0%	0	0%
7	32	32	100%	0	0%	0	0%	0	0%
8	31	30	97%	1	3%	0	0%	0	0%
9	20	19	95%	1	5%	0	0%	0	0%
10	13	12	92%	1	8%	0	0%	0	0%
11	19	18	95%	1	5%	0	0%	0	0%
12	15	15	100%	0	0%	0	0%	0	0%
TOTAL	257	243	95%	13	5%	1	<1%	0	0%

Letter Rating Summary							
District	No. of Activities Reviewed	Highly Effective		Moderately Effective		Ineffective	
		A Rating		B Rating		C Rating	
1	17	16	94%	1	6%	0	0%
2	16	14	88%	2	12%	0	0%
3	21	20	95%	1	5%	0	0%
4	26	20	77%	5	19%	1	4%
5	20	19	95%	1	5%	0	0%
6	27	24	89%	3	11%	0	0%
7	32	31	97%	1	3%	0	0%
8	31	31	100%	0	0%	0	0%
9	20	20	100%	0	0%	0	0%
10	13	11	85%	2	15%	0	0%
11	19	17	89%	2	11%	0	0%
12	15	15	100%	0	0%	0	0%
TOTAL	257	238	93%	18	7%	1	<1%

3.2 Activity Review Results by Maintenance Family

The numeric and letter ratings for BMP effectiveness organized by Family are presented in Table 3-3. A summary of the rating results for the Families includes the following:

- Except for one Family activity, all of the 256 Family activities (99.6%) received a 1 or 2 Rating.
- Except for one Family activity, all of the 256 Family activities (99.6%) received an A or B Rating.
- One maintenance activity in Family C, Slope/Drain/Vegetation, received a 3C Rating.
- None of the Family activities received a 4 Rating.

Table 3-3: Compliance Review Activity Ratings Summary By Family FY2014–2015

Numeric Rating Summary									
Maintenance Family	No. of Activities Reviewed	Compliant				Non-Compliant			
		Compliant		Minor Deficiency		Major Deficiency		Critical Deficiency	
		1 Rating		2 Rating		3 Rating		4 Rating	
A Family – Flexible Pavement	18	16	89%	2	11%	0	0%	0	0%
B Family – Rigid Pavement	2	2	100%	0	0%	0	0%	0	0%
C Family – Slope/Drain/Vegetation	77	70	91%	6	8%	1	1%	0	0%
D Family – Litter/Debris/Graffiti	49	48	98%	1	2%	0	0%	0	0%
E Family – Landscaping	48	47	98%	1	2%	0	0%	0	0%
F Family – Environmental	13	13	100%	0	0%	0	0%	0	0%
G Family - Public Facilities	4	4	100%	0	0%	0	0%	0	0%
H Family – Bridges	5	5	100%	0	0%	0	0%	0	0%
J Family - Other Structures	0	0	0%	0	0%	0	0%	0	0%
K Family – Electrical	12	11	92%	1	8%	0	0%	0	0%
M Family – Traffic Guidance	22	20	91%	2	9%	0	0%	0	0%
R Family – Snow and Ice Removal	1	1	100%	0	0%	0	0%	0	0%
S Family – Storm Maintenance	4	4	100%	0	0%	0	0%	0	0%
T Family – Management and Support [1]	2	2	100%	0	0%	0	0%	0	0%
TOTAL	257	243	95%	13	5%	1	<1%	0	0%

Table 3-3: Compliance Review Activity Ratings Summary By Family FY2014-2015 *(Continued)*

Letter Rating Summary							
Maintenance Family	No of Activities Reviewed	Highly Effective		Moderately Effective		Ineffective	
		A Rating		B Rating		C Rating	
A Family – Flexible Pavement	18	14	78%	4	22%	0	0%
B Family – Rigid Pavement	2	2	100%	0	0%	0	0%
C Family – Slope/Drain/Vegetation	77	70	91%	6	8%	1	1%
D Family – Litter/Debris/Graffiti	49	47	96%	2	4%	0	0%
E Family – Landscaping	48	45	94%	3	6%	0	0%
F Family – Environmental	13	13	100%	0	0%	0	0%
G Family - Public Facilities	4	4	100%	0	0%	0	0%
H Family – Bridges	5	4	80%	1	20%	0	0%
J Family - Other Structures	0	0	0%	0	0%	0	0%
K Family – Electrical	12	12	100%	0	0%	0	0%
M Family – Traffic Guidance	22	21	95%	1	5%	0	0%
R Family – Snow and Ice Removal	1	1	100%	0	0%	0	0%
S Family – Storm Maintenance	4	4	100%	0	0%	0	0%
T Family – Management and Support	2	1	50%	1	50%	0	0%
TOTAL	257	238	93%	18	7%	1	<1%

4. Maintenance Activity Compliance Review Assessments

This section summarizes the overall BMP implementation and effectiveness observed during the reporting period. Overall, BMP implementation statewide complied with the SWMP.

4.1 A Family – Flexible Pavement

Flexible Pavement maintenance activities consist of asphalt cement crack and joint grinding/sealing, asphalt paving, structural pavement failure (digouts), pavement grinding/paving, emergency pothole repair, and sealing operations.

Flexible Pavement maintenance activity evaluations were conducted statewide except in Districts 3, 5, 7, and 8. The BMPs at all 18 flexible pavement work sites (100%) were compliant (received a 1 or 2 Rating) and were highly to moderately effective (received an A or B Rating).

4.2 B Family – Rigid Pavement

Rigid Pavement maintenance activities consist of Portland cement crack and joint sealing, mudjacking and drilling, and concrete slab/spall repair.

Rigid Pavement maintenance activity evaluations were conducted at 2 locations in Districts 3 and 8. The BMPs at both rigid pavement work sites (100%) were completely compliant (received a 1 Rating) and were highly effective (received an A Rating).

4.3 C Family – Slope/Drain/Vegetation

Slope/Drain/Vegetation maintenance activities consist of shoulder grading, nonlandscape chemical vegetation control, nonlandscape mechanical vegetation control/mowing, nonlandscape tree/shrub pruning, brush chipping, tree/shrub removal, fence repair, drainage ditch and channel maintenance, drain and culvert maintenance, and curb/sidewalk repair.

Slope/Drain/Vegetation maintenance activity evaluations were conducted in all the Districts. The BMPs at 76 of the 77 work sites (98.7%) were compliant (received a 1 or 2 Rating) and were highly to moderately effective (received an A or B Rating). BMPs were ineffective at one activity location in District 4 and received a 3C Rating.

4.4 D Family – Litter/Debris/Graffiti

Litter/Debris/Graffiti maintenance activities consist of sweeping operations, litter/debris removal, emergency response and cleanup practices, and graffiti removal.

Litter/Debris/Graffiti maintenance activity evaluations were conducted statewide except in District 12. The BMPs at all 49 work sites (100%) were compliant (received a 1 or 2 Rating) and were highly to moderately effective (received an A or B Rating).

4.5 E Family – Landscaping

Landscaping maintenance activities consist of chemical vegetation control, manual vegetation control, landscape mechanical vegetation control/mowing, landscape tree/shrub pruning, brush chipping, tree/shrub removal, irrigation line repair, and irrigation.

Landscaping maintenance activity evaluations were conducted statewide except in Districts 1, 6, and 9. The BMPs at all 48 landscape related work sites (100%) were compliant (received a 1 or 2 Rating) and were highly to moderately effective (received an A or B Rating).

4.6 F Family – Environmental

Environmental maintenance activities consist of storm drain stenciling, roadside slope inspection, roadside stabilization, stormwater treatment devices and, traction sand trap devices.

Environmental maintenance activity evaluations were conducted statewide except in Districts 4, 6, 8, and 10. The BMPs at all 13 work sites (100%) were completely compliant (received a 1 Rating) and were highly effective (received an A Rating).

4.7 G Family – Public Facilities

Public Facility maintenance activities consist of custodial responsibilities at restrooms, fountains, and picnic areas, as well as, the maintenance of appurtenances such as roadway surfacing, signs, pavement markings, buildings, landscaping, and electrical installations.

Public Facility maintenance activity evaluations were conducted in Districts 3, 4, 6, and 8. The BMPs at all 4 work sites (100%) were completely compliant (received a 1 Rating) and were highly effective (received an A Rating).

4.8 H Family – Bridges

Bridge maintenance activities consist of welding and grinding, sandblasting, wet-blast (sand injection) and hydroblasting, painting, bridge repairs, and draw bridge maintenance.

Bridge maintenance activity evaluations were conducted in Districts 1, 4, 5, 6, and 10. The BMPs at all 5 bridge work sites (100%) were completely compliant (received a 1 Rating) and were highly to moderately effective (received an A or B Rating).

4.9 J Family – Other Structures

Other Structure maintenance activities consist of pump station cleaning, tube/tunnel maintenance and repair, ferryboat operations, tow truck operations and toll booth lane scrubbing operations.

No Other Structures maintenance activity evaluations were conducted in any District.

4.10 K Family – Electrical

Electrical maintenance consists of saw cutting for detector loops.

Electrical maintenance activity evaluations were conducted statewide except in Districts 6 and 11. The BMPs at all 12 work sites (100%) were compliant (received a 1 or 2 Rating) and were highly effective (received an A Rating).

4.11 M Family – Traffic Guidance

Traffic Guidance maintenance activities consist of thermoplastic stripping/marking, paint stripping/marking, raised/recessed pavement marker application/removal, sign repair/maintenance, median barrier and guard rail repair, and emergency energy attenuator repair.

Traffic Guidance maintenance activity evaluations were conducted statewide except in District 12. The BMPs at all 22 work sites (100%) were compliant (received a 1 or 2 Rating) and were highly to moderately effective (received an A or B Rating).

4.12 R Family – Snow and Ice Removal

Snow and Ice Removal maintenance activities consist of snow removal and ice control. Few activity reviews of Snow and Ice Removal activities were conducted during this reporting period as the warm winter and lack of snow resulted in minimal activity in this Family for FY2014-2015.

Snow and Ice Removal maintenance activity evaluations were conducted in District 9. The BMPs at the single work site (100%) was completely compliant (received a 1 Rating) and was highly effective (received an A Rating).

4.13 S Family – Storm Maintenance

Storm Maintenance activities consist of minor slides and slipouts cleanup and repair.

Storm maintenance activity evaluations were conducted in Districts 5, 6, 9 and 11. The BMPs at all 4 storm maintenance work sites (100%) were completely compliant (received a 1 Rating) and were highly effective (received an A Rating).

4.14 T Family – Management and Support

Management and Support includes the maintenance activities at permanent maintenance facilities including Building and Grounds Maintenance and protection of Outdoor Storage of Raw Materials from the effects of rain and wind. The BMPs of Building and Grounds Maintenance and Outdoor Storage of

Raw Materials are normally associated with maintenance facilities. However, crews were actively placing BMPs; therefore, conducting a maintenance activity.

Building and Grounds Maintenance and protection of Outdoor Storage of Raw Materials activity evaluations were conducted in Districts 6 and 7. The BMPs at all 2 work sites (100%) were compliant (received a 1 or 2 Rating) and were highly to moderately effective (received an A or B Rating).

5. Summary of Compliance Assistance

This section summarizes the compliance assistance requested by the DMSWCs or other Department Storm Water Coordinators. Expert water pollution control assistance was provided by a third party from July 1, 2014 through June 30, 2015 through Statewide Contracts to conduct the maintenance evaluations, support maintenance training and update maintenance stormwater plans. No assistance was provided for maintenance activities during this reporting period.

Attachment A: Maintenance Activity Compliance Review Rating Guidelines and Procedures

Maintenance Activity Compliance Review Rating Guidelines and Procedures

The numeric rating criteria are as follows:

1 Rating The Activity Site is in compliance with SWMP requirements. A revisit will not be necessary.

2 Rating Minor deficiencies noted. The Activity Site is in compliance with SWMP requirements. A revisit will not be necessary.

3 Rating A Major deficiency was noted that requires prompt correction. The activity crew will be required to attend a BMP tailgate meeting focusing on BMPs for the activity that was inspected. The Maintenance Supervisor must hold the meeting and submit an attendance record to the DMSWC within 2 weeks of the inspection. The District Storm Water personnel will be notified.

4 Rating A Critical deficiency was noted that requires immediate correction. The activity crew will be required to attend a BMP tailgate meeting focusing on the BMPs for the activity that was inspected. The Maintenance Supervisor must hold the meeting and submit an attendance record to the DMSWC within one week of the inspection. The DMSWC, District Managers, Environmental, and Headquarters Maintenance Storm Water personnel will be notified.

Note: For ratings of 3 or 4, comments are required on the Review Summary Sheet describing the deficiencies.

- The letter rating criteria are as follows:
-

A Rating The overall water pollution prevention effort is highly effective. Storm water pollutants are substantially controlled.

B Rating The overall water pollution prevention effort is moderately effective. Storm water pollutants are partially controlled.

C Rating The overall water pollution prevention effort is ineffective. Storm water pollutants are not controlled.

Compliance review reports and rating results, including completed Inspection Summaries, will be provided to the Maintenance Supervisor or designee and the DMSWC who attends the review before leaving the Activity Site. District Maintenance Managers and District Maintenance Superintendents are invited to participate in the reviews. When applicable, the DMSWC or NPDES Coordinator (duty may vary by district) will notify the RWQCB pursuant to the SWMP.

Attachment B: Caltrans Maintenance Site Stormwater Compliance Review Checklist

Caltrans Maintenance Site Stormwater Compliance Review Checklist

District: Weather Conditions:	Inspection Date:	**Overall Activity Rating ***	
Location:			
Family of Activity:			
Description of Activity:			
Supervisor/Lead Worker:	Phone No:		
Maintenance Facility Assigned To:			
Inspector(s):	Phone No:		
Attendees:			
Date of Last BMP Tailgate Meeting for this Activity:			
Recommend Additional Training for this Activity: ☐ Yes	Date of Training:		
	Signature:		

BMP	CRITERION	BMP RATING	COMMENT NUMBER(S)

Comments:

Description of Rating
1. The site is in compliance with the Storm Water Management Plan (SWMP)
2. Minor deficiencies noted. The site is in compliance with the SWMP.
3. Major deficiency. Prompt correction required. A BMP tailgate meeting will be conducted by date noted.
4. Critical deficiency. Immediate correction required. A BMP tailgate meeting will be conducted by date noted.
A. Overall implementation of BMPs is highly effective.
B. Overall implementation of BMPs is moderately effective.
C. Major and critical deficiencies in overall implementation of BMPs.

Attachment C: Maintenance Activity Review Database Summary (FY2014–2015)

Activity Ratings

District	Cost Center	Maintenance Family	Maintenance Activity	Date	Location	Overall Activity Number	Overall Activity Letter
1	642	F	Erosion, Sediment Control	1-Dec-14	HUM-299-PM12.4WB	1	A
1	643	M	Guardrail Repair	1-Dec-14	HUM-299-PM31.80WB	1	A
1	653	M	Sign Repair	2-Dec-14	HUM-101-PM74.7SB	1	A
1	645	C	Drainage Repair	3-Dec-14	DN-199-PM34.25NB	1	A
1	642	C	Sidewalk Repair	4-Dec-14	HUM-101-PM76.50SB	1	A
1	663	C	Vegetation Removal from Culverts/Ditches	4-Dec-14	HUM-101-PM71.02SB	1	A
1	663	F	Stockpile Management	4-Dec-14	HUM-101-PM68.25NB	1	A
1	663	F	ICID Investigation	4-Dec-14	HUM-101-PM65.0SB	1	A
1	652	K	Electrical/Utility Locator	4-Dec-14	HUM-101-PM76.00SB	1	A
1	653	M	Sign Repair	4-Dec-14	HUM-101-PM76.01SB	1	A
1	642	C	Mowing	11-May-15	HUM-101-PM85.25NB	1	A
1	642	C	Tree Pruning	11-May-15	HUM-101-PM87.9NB	1	A
1	642	A	Grind and Re-Pave	12-May-15	HUM-101-PM87.9NB	2	B
1	657	C	Tree Removal	13-May-15	HUM-101-PM63.26SB	1	A
1	663	C	Mowing	13-May-15	HUM-101-PM48.0NB	1	A
1	642	D	Graffiti	13-May-15	HUM-101-PM77.0NB	1	A
1	689	H	Bridge Painting	13-May-15	HUM-101-PM49.1NB	1	A
2	675	C	Slope/Drains/Vegetation	29-Sep-14	TEH-36-87.9WB	1	A
2	634	D	Litter/Debris/Grafiti	29-Sep-14	TEH-36-PM50EB	1	A
2	638	A	Flexible Pavement	30-Sep-14	SHA-89-38.55NB	1	A
2	637	F	Environmental	30-Sep-14	SIS-05-PM4.7NB	1	A
2	612	A	Flexible Pavement	1-Oct-14	SIS-5-PM61.5NB	1	A
2	612	A	Flexible Pavement	1-Oct-14	SIS-5-64.8NB	1	A
2	636	C	Slope/Drains/Vegetation	2-Oct-14	SHA-5-43.3SB	1	A
2	696	E	Landscaping	2-Oct-14	SHA-5-15.8NB	1	B
2	694	K	Electrical	2-Oct-14	SHA-5-17.280NB	1	A
2	692	M	Traffic Guidance	2-Oct-14	TEH-36-44.31EB	1	A
2	634	D	Litter and Debris	15-Jun-15	TEH-5-SB at the Hooker Creek Offramp	1	A
2	692	M	Install Sign	15-Jun-15	TEH-5-PM20.0NB	1	A
2	637	A	Crack Seal	17-Jun-15	SIS-5-PM8.7NB	1	A

Activity Ratings

District	Cost Center	Maintenance Family	Maintenance Activity	Date	Location	Overall Activity Number	Overall Activity Letter
2	612	A	Grind and Pave	17-Jun-15	SIS-5-PM42.0SB	2	B
2	636	D	Sweeping Operations	17-Jun-15	SHA-5-PM55/44SB	1	A
2	672	A	Grind and Pave	18-Jun-15	PLU-89-PM21.5/23.0EB&WB	1	A
3	722	G	Maintain Public Facilities	10-Nov-14	PLA-80-PM41.80EB	1	A
3	632	C	Shoulder Grading/Clean-Up	12-Nov-14	ED-50-41.6EB	1	A
3	714	D	Sweeping Operations	13-Nov-14	Marysville Maintenance Facility, 1001 Beale Rd, Marysville, CA 95901	1	A
3	612	B	Concrete Panel Repair	27-Apr-15	YOL-PM2.0EB	1	A
3	624	E	Manual Veg. Control	27-Apr-15	6th St. @ X St., Sacramento, CA	1	A
3	744	F	Dike Repair Above Slope	27-Apr-15	03-YOL-5-PM19.0SB	1	A
3	721	E	Pruning, Mulching	29-Apr-15	03-PLA-80PM15.1EB	1	A
3	614	M	Replace Signs	29-Apr-15	03-SAC-80-PM10.5WB	1	A
3	624	C	Pruning Trees	30-Apr-15	03-SAC-5-PM10.84SB	1	A
3	744	C	Tree Removal	30-Apr-15	03-SAC-99-PM22.2NB	1	B
3	617	C	Manual Brush Clearing	30-Apr-15	03-SAC-5-PM13.5WB	1	A
3	624	E	Chemical Vegitation Control	30-Apr-15	06-SAC-99-PM21.0NB	1	A
3	624	E	Hedge Trimming	30-Apr-15	X St. @ 22nd St., Sacramento, CA	1	A
3	721	C	Mowing	8-Jun-15	03-PLA-80-PM21.0EB	1	A
3	723	C	Shoulder Grading	8-Jun-15	03-NEV-80-PM2.48WB	1	A
3	643	K	Signal Maintenance	8-Jun-15	03-NEV-49-PM7.09SB	1	A
3	617	C	Pruning	11-Jun-15	03-SAC-80-PM10.70WB	1	A
3	617	C	Chemical Vegitation	11-Jun-15	03-SAC-80-PM10.68WB	1	A
3	612	C	Shoulder Grading	11-Jun-15	03-YOL-80-PM5.0WB	1	A
3	612	D	Litter/Debris	11-Jun-15	03-SAC-80-PM9.5EB	1	A
3	628	M	Sign Repair	11-Jun-15	03-SAC-5-PM2.4NB	1	A
4	614	A	Crack Sealing	27-Oct-14	NAP-29-PM23.5SB	1	A
4	638	D	Litter Removal	27-Oct-14	2019 W. Texas St. Fairfield, CA	1	A
4	764	M	Sign Repair and Maintenance	27-Oct-14	NAP-29-PM24.11NB	1	A
4	719	C	Mechanical Vegetation	28-Oct-14	ALA-238-PM14.5NB	2	B
4	622	D	Litter and Debris Pick-Up	30-Oct-14	SON-101-PM38 TO PM56 NB & SB	1	A

Activity Ratings

District	Cost Center	Maintenance Family	Maintenance Activity	Date	Location	Overall Activity Number	Overall Activity Letter
4	619	C	Emergency Tree Removal	18-Dec-14	SON-128-PM1.36WB	1	A
4	638	D	Litter/Debris	23-Mar-15	SOL-80-PM6.1EB	1	A
4	633	E	Mowing	24-Mar-15	SON-12-PM14.4EB	1	A
4	779	K	Investigating Damage	24-Mar-15	MRN-101-PM21.1SB	1	A
4	624	D	Litter and Debris	25-Mar-15	MRN-101-PM23.88SB	1	A
4	625	D	Sweeping and Vacuuming	25-Mar-15	MRN-101-PM16.6NB	1	A
4	634	D	Litter and Debris	25-Mar-15	MRN-101-PM16.6NB	1	A
4	619	C	Tree Pruning, Chipping	26-Mar-15	SON-37-PM2.56EB	1	A
4	695	C	Fence Repair	26-Mar-15	CC-24-PM2.8WB	3	C
4	702	D	Illegal Encampment Clean-Up	26-Mar-15	SOL-680-PM19NB	2	B
4	693	E	Chemical Vegitation Control	26-Mar-15	CC-80-PM7.6NB	1	A
4	638	E	Chemical Vegitation Control	26-Mar-15	SOL-80-PM44.7WB	1	B
4	625	C	Manual Vegetation Control	4-May-15	04-MRN-101-PM1.7NB	1	A
4	625	C	Mowing	4-May-15	04-MRN-101-PM1.5NB	2	B
4	732	C	Tree Pruning	5-May-15	04-SAN-101-PM28.15SB	2	B
4	742	H	Bridge Rail Repair	5-May-15	04-SAN-101-PM22.1SB	1	A
4	694	D	Large Debris Patrol	6-May-15	04-CC-680-PM23.3NB	1	A
4	654	C	CLF Repair	7-May-15	04-SCL-680-PM1.868NB	1	A
4	712	D	Litter and Debris	7-May-15	04-ALA-880-PM8.9SB	1	A
4	725	E	Mowing	7-May-15	04-ALA-880-PM8.8SB	1	A
4	727	G	Public Facilities	7-May-15	04-ALA-680-PM6.42NB	1	A
5	645	D	Litter and Debris Removal	27-Oct-14	SLO-101-PM13.5NB	1	A
5	645	E	Tree and Shrub Removal	27-Oct-14	SLO-101-PM29.99NB	2	A
5	641	F	Environmental	27-Oct-14	SLO-101-PM25.4NB	1	A
5	645	F	Environmental	28-Oct-14	MON-101-PM53NB	1	A
5	3656	H	Bridges	28-Oct-14	SLO-101-PM65.6NB	1	A
5	648	C	Nonlandscaped Tree Pruning	29-Oct-14	SLO-227-PM4.5SB	1	A
5	658	C	Nonlandscaped Chemical Vegitation Control	29-Oct-14	SB-101-PM35.3SB	1	A
5	642	C	Fence Repair	30-Oct-14	Santa Maria Maintenance Yard	1	A
5	641	D	Graffiti Removal	30-Oct-14	SLO-101-PM16.2SB	1	A

Activity Ratings

District	Cost Center	Maintenance Family	Maintenance Activity	Date	Location	Overall Activity Number	Overall Activity Letter
5	662	K	Electrical	30-Oct-14	SLO-1-PM22.21SB	1	A
5	1263	C	Ditch Clearing	18-May-15	SC-236-1.01-EB	1	A
5	1266	C	Manual Vegetation Control	18-May-15	SC-1-PM16.1-NB	1	A
5	1261	S	Minor Slides and Slipouts	18-May-15	SC-17-PM6.03NB	1	A
5	12554	C	Mechanical Mowing	19-May-15	MON-68-PM11WB	2	A
5	1254	D	Sweeping	19-May-15	MON-68-PM11WB	1	A
5	1254	M	Raised Marker Application	19-May-15	MON-1-46-70	1	A
5	1272	C	Manual Vegetation Control	20-May-15	SLO-101-PM58NB	1	B
5	1290	M	Sign Repair	20-May-15	SLO-101-PM51.8NB	1	A
5	1277	C	Manual Vegetation Control	21-May-15	SLO-101-PM14SB	1	A
5	1291	F	Roadside Stabilization	21-May-15	SLO-101-PM25.4NB	1	A
6	632	D	Sweeping Operations	4-Nov-14	Visalia Maintenance Yard, 15337 Ave. 296 Visalia, CA 93292	1	A
6	673	M	Sign Repair	4-Nov-14	TUL-245-PM11.9NB	1	A
6	634	T	Outdoor Storage of Raw Material (Installing Perimeter Controls)	4-Nov-14	Visalia Maintenance Yard, 15337 Ave. 296 Visalia, CA 93292	1	B
6	642	A	Repair Curb, Drains, Fill Potholes (with cold mix)	5-Nov-14	FRE-5-PM19.0SB	1	A
6	640	C	Mechanical Weed Control	5-Nov-14	FRE-5-PM19-18SB	1	A
6	642	C	Shoulder Shaping, Lateral Support	5-Nov-14	KIN-41-PM2.0SB	1	A
6	642	C	Nonlandscaped Chemical Vegitation Control/Moving	5-Nov-14	KIN-41-PM2.5NB	1	A
6	645	D	Sweeping Operations	5-Nov-14	FRE-5-PM 21 to 18SB	1	A
6	644	D	Litter Removal Support	5-Nov-14	FRE-5-PM 20 to 18SB	1	A
6	655	S	Minor Slide Cleanup/Slough/Talus Cleanup	6-Nov-14	FRE-168-PMT29WB	1	A
6	615	C	Drain Maintenance	9-Feb-15	KER-204-PM3.0NB	1	A
6	612	E	Chemical Vegitation Control	9-Feb-15	KER-204-PM27.245WB	1	A
6	612	E	Manual Vegetation Control/Brush Pruning	9-Feb-15	KER-99-PM26.4NB	1	A
6	615	E	Chemical Vegitation Control	9-Feb-15	KER-178-PM0.36 TO 7.0EB	1	A
6	611	M	Guardrail Repair	9-Feb-15	KER-99-PM26.7NB (off ramp to Airport Drive)	1	A
6	611	D	Sweeping Operations	9-Feb-15	KER-99-PM26.05 TO 27.30	1	A
6	642	G	Public Facilities	11-Feb-15	FRE-5-PM0.3SB Median	1	A

Activity Ratings

District	Cost Center	Maintenance Family	Maintenance Activity	Date	Location	Overall Activity Number	Overall Activity Letter
6	626	C	Repair Culvert Headwall	12-Feb-15	KER-178-PM26.5EB	1	A
6	624	D	Litter and Debris	12-Feb-15	KER-99-PM41.5SB	1	A
6	622	E	Chemical Vegitation Control	12-Feb-15	KER-155-PM11-45WB(NB)	1	A
6	646	C	Cleaning Gutters, Drains	13-Apr-15	FRE-41-PM9.5NB	1	A
6	645	C	Mowing	13-Apr-15	FRE-145-PM22.6	2	B
6	622	C	Cleaning Ditch	15-Apr-15	TUL-190-PM35WB	1	A
6	622	E	Sprinkler Repair	15-Apr-15	TUL-65-PM19.5NB	1	A
6	675	H	Bridge Deck Repair	15-Apr-15	TUL-99-PM19.50SB	1	B
6	652	A	Pothole Repair	16-Apr-15	FRE-41-PM5.61NB	1	A
6	655	C	Manual Vegetation Control	16-Apr-15	FRE-168-PM28.5WB	1	A
7	630	T	Building and Grounds Maintenance	18-Nov-14	Valencia Maintenance Facility	1	A
7	631	C	Fence Repair/Support	18-Nov-14	KER--5-0.1SB	1	A
7	631	C	Fence Repair/Support	18-Nov-14	LA-5-85.4NB	1	A
7	631	D	Litter and Debris Removal	18-Nov-14	KER-05-0.18SB	1	A
7	692	E	Remove Downed Tree	19-Nov-14	3725 Pacific Place, Long Beach, CA	1	A
7	625	E	Landscaped Tree and Shrub Pruning	19-Nov-14	LA-118-PM7.0WB	1	B
7	705	M	Repair Guardrail	19-Nov-14	LA-405-5.27NB	1	A
7	652	D	Graffiti Removal	20-Nov-14	LA-60-PM5.3EB	1	A
7	649	E	Tree and Shrub Removal	20-Nov-14	LA-60-PM5.2EB	1	A
7	649	E	Brush Removal/Tree Pruning	20-Nov-14	LA-60-PM5.2EB	1	A
7	723	C	Fence Repair	13-Jan-15	VEN-101-PM0.20EB	1	A
7	731	E	Irrigation Repair	13-Jan-15	VEN-101-PM0.70WB	1	A
7	671	D	Litter and Debris Pick Up	14-Jan-15	LA-210-PM28.0EB	1	A
7	671	E	RE-Planting Ice Plant	14-Jan-15	LA-210-PM26.2WB	1	A
7	735	D	Sweeping Operations	15-Jan-15	VEN-101-PM3.5NB	1	A
7	630	D	Litter/Debris	15-Jan-15	LA-5-PM58.9SB	1	A
7	736	E	Shrub Pruning	15-Jan-15	VEN-101-PM22.8SB	1	A
7	620	D	Sweeping Operations	9-Mar-15	LA-134-PM5.9/13.0WB	1	A
7	672	D	Litter and Debris Removal	9-Mar-15	LA-210-PM30.6EB	1	A
7	619	E	Landscaped Tree Pruning	9-Mar-15	LA-210-PM24.5WB	1	A

Activity Ratings

District	Cost Center	Maintenance Family	Maintenance Activity	Date	Location	Overall Activity Number	Overall Activity Letter
7	672	E	Manual Vegetation Control	9-Mar-15	LA-210-PM36.4EB	1	A
7	630	C	Shoulder Grading	10-Mar-15	LA-5-PM48/50SB	1	A
7	633	C	Fence Repair	10-Mar-15	LA-210-PM4.0EB	1	A
7	633	D	Sweeping and Vacuuming	10-Mar-15	LA-14-PM28.4EB	1	A
7	625	E	Manual Vegetation Control	11-Mar-15	LA-118-PM7.0WB	1	A
7	627	K	Wiring Seatrain Bins for Lighting	11-Mar-15	San Fernando Maintenance Facility	1	A
7	737	C	Nonlandscaped Tree and Shrub Removal	12-Mar-15	VEN-126-PM8.52WB	1	A
7	760	E	Manual Vegetation Control	12-Mar-15	LA-5-PM41.6SB	1	A
7	649	D	Litter and Debris	1-Jun-15	07-LA-710-PM26.791SB	1	A
7	651	D	Sweeping/Litter and Debris	1-Jun-15	07-LA-10-PM23.962EB	1	A
7	703	D	Illegal Encampment	3-Jun-15	07-LA-105-PM6.8EB	1	A
7	605	F	Drainage Inspection/Maintainance	3-Jun-15	07-LA-105-PM15.6EB	1	A
8	731	D	Litter and Debris Removal	20-Oct-14	SBD-10-14.60	1	A
8	751	B	Concrete Slab and Spall Repair	21-Oct-14	RIV-15-21.5	1	A
8	716	C	Drainage Ditch and Channel Maintenance	21-Oct-14	RIV-215-9.0	1	A
8	726	D	Sweeping Operations	21-Oct-14	RIV-15-23.75	1	A
8	685	K	Sawcutting for Loop Installation	21-Oct-14	RIV-215-37.0	1	A
8	622	C	Drain and Culvert Maintenance	22-Oct-14	SBD-18-40.36	1	A
8	624,623	C	Drain and Culvert Maintenance	22-Oct-14	SBD-18-40.36	1	A
8	731	C	Cleaning Drains	23-Feb-15	SBD-10-PM2.4EB	1	A
8	724	E	Manual Vegetation Control	23-Feb-15	RIV-60-PM11.5WB	1	A
8	752	G	Public Facilities	23-Feb-15	RIV-15-PM45.72SB	1	A
8	683	K	Electrical	23-Feb-15	SBD-10-PM8.18WB	2	A
8	633	D	Litter and Debris Removal	24-Feb-15	SBD-15-PM75.0SB	1	A
8	721	C	Fence Repair	26-Feb-15	RIV-215-PM36.88NB	1	A
8	732	D	Litter/Debris	26-Feb-15	SBD-10-PM13.0WB	1	A
8	752	E	Manual Brush Removal	26-Feb-15	RIV-15-PM45.8NB	1	A
8	752	E	Chem. Vegetation Control	26-Feb-15	RIV-15-PM45.7SB	1	A
8	734	D	Litter/Debris	7-Apr-15	08-SBD-60-PM5.1WB	1	A
8	722	D	Litter/Debris	7-Apr-15	08-SBD-215-PM42.184NB	1	A

Activity Ratings

District	Cost Center	Maintenance Family	Maintenance Activity	Date	Location	Overall Activity Number	Overall Activity Letter
8	724	E	Manual Vegetation Control	7-Apr-15	08-SBD-60-PM832EB	1	A
8	736	D	Sweeping Operations	8-Apr-15	08-SBD-210-PM0.0/20.0EB	1	A
8	732	E	Sprinkler Repair	8-Apr-15	08-SBD*210-PM24.22WB	1	A
8	661	M	Thermoplastic Markings	8-Apr-15	08-SBD-210-PM22.0EB	1	A
8	611	C	Mech Vegetation Control	9-Apr-15	08-SBD-15-PM43.6NB	1	A
8	611	C	Shoulder Grading	9-Apr-15	08-SBD-15-PM43.7SB	1	A
8	623	D	Litter/Debris	9-Apr-15	SBD-08-15-PM62.2NB	1	A
8	611	E	Chem. Vegetation Control	9-Apr-15	08-SBD-15-PM40.2/43.5NB and SB	1	A
8	753	D	Litter and Debris Removal	10-Apr-15	SBD-10-7.30	1	A
8	753	D	Sweeping Operations	10-Apr-15	SBD-10-2.55	1	A
8	733	E	Irrigation Line Repairs	10-Apr-15	SBD-210-14.10	1	A
8	733	E	Landscaped Tree and Shrub Pruning, Brush Chipping, Tree & Shrub Removal	10-Apr-15	SBD-210-10.40	1	A
8	733	E	Landscaped Tree and Shrub Pruning, Brush Chipping, Tree & Shrub Removal	10-Apr-15	SBD-210-8.89	1	A
9	622	C	Slopes/Drains/Vegetation	22-Sep-14	INY-395-125SB	1	A
9	621	C	Slopes/Drains/Vegetation	22-Sep-14	INY-395-65SB	1	A
9	635	C	Slopes/Drains/Vegetation	23-Sep-14	MON-395-111.5NB	1	A
9	641	D	Litter/Debris/Graffiti	24-Sep-14	INY-395-49.5SB	1	A
9	621	F	Environmental	24-Sep-14	INY-395-53SB	1	A
9	629	M	Traffic Guidance	24-Sep-14	INY-395-99NB	2	A
9	632	M	Traffic Guidance	25-Sep-14	MON-395-34.2NB	1	A
9	631	R	Snow and Ice Control	25-Sep-14	MON-395-18.5NB	1	A
9	622	C	Fence Repair	16-Mar-15	INY-6-PM7.6NB(EB)	1	A
9	622	C	Shoulder Lateral Support	16-Mar-15	MON-6-PM20.5EB(NB)	1	A
9	621	C	Shoulder Work	16-Mar-15	INY-395-PM94.5NB	1	A
9	622	F	Stockpile Management	16-Mar-15	INY-395-PM113.25SB	1	A
9	629	K	Electrical	16-Mar-15	INY-168-PM16.8EB	1	A
9	622	S	Minor Slides/Slip Outs	16-Mar-15	MON-6-PM2.8EB	1	A
9	601	A	Pavement Grind and Pave	17-Mar-15	181 Jay St. Bishop, CA 93514	1	A
9	632	A	AC Crack Sealing	17-Mar-15	MNO-395-PMR51NB	1	A

Activity Ratings

District	Cost Center	Maintenance Family	Maintenance Activity	Date	Location	Overall Activity Number	Overall Activity Letter
9	631	C	Mowing	17-Mar-15	MNO-203-PM7.0EB	1	A
9	634	A	Digout Repair Pothole	18-Mar-15	MNO-395-PM75.5NB	1	A
9	632	C	Culvert Maintenance-Inspection	18-Mar-15	MNO-385-PM36.0NB	1	A
9	621	C	Shoulder Lateral Support	19-Mar-15	INY-395-PM72.5NB	1	A
10	682	A	Flexible Pavement	23-Sep-14	SJ-12-PM8.5WB	1	B
10	676	A	Flexible Pavement	23-Sep-14	SJ-580-PM2.5EB	1	A
10	608	C	Slopes/Drains/Vegetation	23-Sep-14	SJ-PM45.12NB	1	A
10		D	Litter/Debris/Graffiti	23-Sep-14	Various Rte 5 and Rte 4 (Stockton)	1	A
10		D	Litter/Debris/Graffiti	23-Sep-14	Various Rte 5 and Rte 4 (Stockton)	1	A
10		E	Landscaping Tree and Shrub Pruning, Removal, Chipping	23-Sep-14	San Joaquin County, Rte 5-PM26.4	1	A
10	2602	M	Traffic Guidance	23-Sep-14	SJ-12-PM14.9-18.6WB	1	A
10	619	A	Flexible Paving	25-Sep-14	Capeles Lake Maintenance Station/ 20 Schnider Cow Camp Rd. Kirkwood, CA	1	B
10	654	M	Sign Repair	21-Apr-15	10-AMA-88-PM45.5EB	1	A
10	653	C	Maintain Culverts	21-Apr-15	10-AMA-88-PM25.5WB	1	A
10	672	C	Mowing	22-Apr-15	10-STA-99-PM20NB	2	A
10	641	H	Bridge Planting	22-Apr-15	10-SJ-120-PM0.0WB	1	A
10	642	K	Replace Lightpole	22-Apr-15	10-SJ-5-PM24NB	1	A
11	731	D	Shoulder Sweeping	20-Oct-14	SD-15PM14.392-16.75NB	1	B
11	739	E	Irrigation Repair	21-Oct-14	SD-8-PM4.333	1	A
11	651	F	Hauling Material to Waste Site (stockpile management)	21-Oct-14	SD-I-8PM39.8EB	1	A
11	728	E	Irrigation Repair/Adj Controller	23-Oct-14	SD-I5-PM38.3NB	1	A
11		E	Irrigation Repair	23-Oct-14	SD-I15-PM9.949SB	1	A
11	727	M	Repair Guardrail	23-Oct-14	SD-76-PM0.02EB	1	A
11	749	M	Sign Repair and Maintenance	23-Oct-14	SD-I-5-PM2.2SB	1	A
11	711	D	Litter and Debris	26-Jan-15	SD-52-PM0.01.0EB	1	A
11	710	E	Brush Pruning, Removal	26-Jan-15	SD-52-PM8.703WB	1	A
11	622	M	Thermo Plastic Markings	26-Jan-15	SD-53-PM13,2WB	1	A
11	714	M	Repair Guardrail	26-Jan-15	SD-15-PM18.594NB	2	B
11	743	E	Trimming Brush	27-Jan-15	SD-8-PM2.831EB	1	A

Activity Ratings

District	Cost Center	Maintenance Family	Maintenance Activity	Date	Location	Overall Activity Number	Overall Activity Letter
11	631	C	Non-Landscape Mechanical Vegetation Control	28-Jan-15	IMP-8-PM35.47EB	1	A
11	631	E	Landscaped Tree and Brush Pruning	28-Jan-15	IMP-8-PM37.4-37.9WB	1	A
11	651	S	Slides/Slip Outs	28-Jan-15	SD-8-PM39.8EB (Median)	1	A
11	633	A	Crack Sealing AC Pavement	29-Jan-15	IMP-115-PM9.5SB	1	A
11	632	C	Non-Landscaped/Mowing	29-Jan-15	IMP-111-PM28-30 N/S Bound	1	A
11	626	C	Non-Landscaped Tree and Shrub Pruning	29-Jan-15	IMP-78-29.5EB	1	A
11	635	C	Non-Landscaped Tree Pruning	29-Jan-15	IMP-8-PM29.8EB	1	A
12	624	C	Clearing Brush	3-Nov-14	ORA-74-PM5.5WB	1	A
12	644	C	Trimming Trees	3-Nov-14	ORA-74-PM5.6WB	1	A
12	635	C	Trimming Trees	3-Nov-14	ORA-133-PM12.08NB	1	A
12	685	C	Weed Abatement	3-Nov-14	ORA-241-PM35.4NB	1	A
12	674	C	Clearing Drainage Area	3-Nov-14	ORA-91-PM17.9EB Cole Canyon	1	A
12	682	E	Weed Abatement	3-Nov-14	ORA-5-PM0.7SB	1	A
12	645	F	Storm Drain Cleaning	3-Nov-14	ORA-5-PM11.6NB	1	A
12	676	E	Manual Vegetation Control/Irrigation Repair	4-Nov-14	ORA-22-PM3.4EB	1	A
12	633	A	Flexible Pavement	5-Nov-14	ORA-133-PM12.2SB	1	A
12	634	E	Landscaping/Tree Trimming and Debris Removal	5-Nov-14	ORA-261-PM3.0EB	1	A
12	683	E	Landscaping/Irrigation Replacement	5-Nov-14	ORA-55-PM6.8SB	1	A
12	683	E	Landscaping/Irrigation Replacement	5-Nov-14	ORA-405-PM5.3NB	1	A
12	655	K	Electrical Work/Pulling Wire	5-Nov-14	ORA-5-PM33.8NB	1	A
12	653	K	Electrical/Relamping	5-Nov-14	ORA-1-PM6.76NB	1	A
12	683	E	Landscaping/Manual Vegetation Control	6-Nov-14	ORA-55-PM3.6NB	1	A

Year-End Performance Report FY2014–2015

A Summary of Maintenance Facility Storm Water Compliance Reviews

CTSW-RT-15-321.04.3

September 2015

California Department of Transportation
Division of Environmental Analysis, Stormwater Program
1120 N Street, MS 27
Sacramento, California 95814
http://www.dot.ca.gov/hg/env/stormwater/index.htm

For individuals with sensory disabilities, this document is available in alternate formats upon request. Please call or write to Stormwater Liaison, California Department of Transportation Division of Environmental Analysis, PO Box 942874, MS-27, Sacramento, CA 94274-0001, (916) 653-8896 Voice, or dial 711 to use a relay service.

Table of Contents

1. Introduction 1
2. Maintenance Facility Compliance Program 1
2.1 Maintenance Facility BMPs 2
2.2 Facility Review 3
2.2.1 Review Guidelines and Checklist 3
2.2.2 Rating System 3
2.2.3 Facility Pollution Prevention Plan 4
2.3 Reporting and Communications 4
2.3.1 Status Reports 4
2.3.2 Maintenance Facility Review Database Summary 4
2.3.3 On-Site Training 4
3. Summary of Maintenance Facility Compliance Review Results 4
3.1 Facility Review Results by District 5
3.2 Facility Review Results by T Family Activity 7
4. Maintenance Facility Compliance Review Assessments 8
4.1 Building and Grounds Maintenance Activity 8
4.2 Storage of Hazardous Materials (Working Stock) Activity 9
4.3 Material Storage Control (Hazardous Waste) Activity 9
4.4 Outdoor Storage of Raw Materials Activity 9
4.5 Vehicle and Equipment Fueling Activity 9
4.6 Vehicle and Equipment Cleaning Activity 9
4.7 Vehicle and Equipment Maintenance and Repair Activity 10
4.8 Aboveground and Underground Tank Leak and Spill Control Activity 10
5. Summary of Compliance Assistance 10

List of Attachments

Attachment A: Maintenance Facility Compliance Review Rating Guidelines and Procedures

Attachment B: Caltrans Maintenance Site Storm Water Compliance Review Checklist

Attachment C: Maintenance Facility Review Database Summary (FY2014–2015)

List of Tables

Table 2-1: Family of Activities 2
Table 2-2: Maintenance Facility Compliance Review Rating Summary 3
Table 3-1: Facilities Reviewed FY2014–2015 5
Table 3-2: Facility Rating Summary by District FY2014–2015 6
Table 3-3: Facility Rating Summary – T Family Activity FY2014–2015 7
Table 3-3: Facility Rating Summary – T Family Activity FY2014–2015 8
(continued) 8

Acronyms, Abbreviations, and Definitions

AMFCRP: Annual Maintenance Facility Compliance Review Plan

BMPs: Best Management Practices

Department: State of California, Department of Transportation

DMSWC: District Maintenance Storm Water Coordinator

Family: Organization of Maintenance work (activities) consistent with the Department's methods used to record, report and monitor maintenance work as it is planned and performed.

FPPP: Facility Pollution Prevention Plan

FY: Fiscal Year

Maintenance: California Department of Transportation, Division of Maintenance

Maintenance Activities: Routine maintenance activities that may require clearing, grading or excavation to maintain original line and grade, hydraulic capacity or original purpose of the facility (SWMP [2012]).

Maintenance Facility: Facilities under the Department's ownership or control that contain such areas as fueling areas, waste storage or disposal facilities, wash racks, equipment or vehicle storage and materials storage areas (SWMP [2012]).

Maintenance Staff Guide: Storm Water Quality Handbook: Maintenance Staff Guide (Interim, rev. September 2012)

NPDES: National Pollutant Discharge Elimination System

Permit: National Pollutant Discharge Elimination System Statewide Storm Water Permit and Waste Discharge Requirements (WDRs) for the State of California, Department of Transportation

SWMP: Storm Water Management Plan (2012)

USEPA: U.S. Environmental Protection Agency

1. Introduction

This Year-End Performance Report is Fiscal Year (FY) 2014 – 2015. It summarizes the results of stormwater compliance reviews conducted at the State of California, Department of Transportation (Department) maintenance facilities. The independent quality assurance reviews of facilities were conducted to verify compliance with the requirements in the Department's Statewide Storm Water Management Plan (SWMP). The SWMP was developed in accordance with the requirements prescribed in the National Pollutant Discharge Elimination System (NPDES) Statewide Storm Water Permit and Waste Discharge Requirements (WDRs) for the State of California, Department of Transportation (Permit).

The key elements of this Year-End Performance Report include:

- Description of the stormwater maintenance facility compliance program (Section 2).
- Summaries of maintenance facility compliance review results and stormwater management Best Management Practice (BMP) effectiveness (Section 3).
- Maintenance facility compliance review assessments (Section 4).
- Summary of compliance assistance (Section 5).

2. Maintenance Facility Compliance Program

The Maintenance Facility Compliance Program is a Departmental effort to review all maintenance facilities statewide for compliance with the Permit within a 5-year review cycle. Reviews are conducted by an independent third party consultant (third party). To meet the goal of a 5-year review cycle, compliance reviews are conducted on a minimum of 20% of the maintenance facilities in each District annually. To implement the program and meet the requirements in the SWMP, guidelines were developed and are presented in an Annual Maintenance Facility Compliance Review Plan (AMFCRP).

The reviews are conducted in accordance with the AMFCRP, and in consultation and coordination with the Department's Division of Environmental Analysis and Division of Maintenance (Maintenance) staff.

The key component of the Maintenance Facility Compliance Program is the Caltrans Stormwater Quality Handbook: Maintenance Staff Guide (Interim, rev. September 2012) (Maintenance Staff Guide). The Maintenance Staff Guide is a Maintenance employee handbook that incorporates the approved Maintenance BMPs providing direction, guidance, policies and procedures for maintenance facilities. The Storm Water Maintenance Facility Compliance Program objectives are to:

- Evaluate compliance of maintenance facilities with the requirements of the Permit.
- Report compliance status to Department management.
- Evaluate BMP implementation results, suggest areas for improvement and recommend new BMP implementation methodologies.

This Year-End Performance Report summarizes the results of maintenance facilities reviewed from July 1, 2014 to June 30, 2015.

2.1 Maintenance Facility BMPs

Maintenance work is organized into several Families (Families A through T) consistent with the Department's methods used to record, report and monitor maintenance work as it is planned and performed. Maintenance activities are listed under Families identified in the Maintenance Staff Guide. These activities represent typical maintenance work on State highways. The activities have the potential to affect stormwater quality. There are 62 maintenance activities grouped into 14 Families that represent work of a similar nature (Table 2-1).

Maintenance of the facilities is organized under the T Family – Management and Support. There are eight maintenance activities associated with the T Family (Table 2-1). The Maintenance facility compliance reviews were conducted on these eight activities.

Table 2-1: Family of Activities

Family of Activity	Activities
A Family – Flexible Pavement	Asphalt Cement Crack and Joint Grinding/Sealing; Asphalt Paving; Structural Pavement Failure (Digouts) Pavement Grinding/Paving; Emergency Pothole Repair; and Sealing Operations
B Family – Rigid Pavement	Portland Cement Crack and Joint Sealing; Mudjacking and Drilling; and Concrete Slab/Spall Repair
C Family – Slope/Drain/Vegetation	Shoulder Grading; Non-landscape Chemical Vegetation Control; Non-landscape Mechanical Vegetation Control/Mowing; Non-landscape Tree/Shrub Pruning, Brush Chipping, Tree/Shrub Removal; Fence Repair; Drainage Ditch/Channel Maintenance; Drain/Culvert Maintenance; and Curb/Sidewalk Repair
D Family – Litter/Debris/Graffiti	Sweeping Operations; Litter and Debris Removal; Emergency Response and Cleanup Practices; and Graffiti Removal
E Family – Landscaping	Chemical Vegetation Control; Manual Vegetation Control; Landscape Mechanical Vegetation Control/Mowing; Landscape Tree/Shrub Pruning, Brush Chipping, Tree/Shrub Removal; Irrigation Line Repair; and Irrigation
F Family – Environmental	Storm Drain Stenciling; Roadside Slope Inspection; Roadside Stabilization; Storm Water Treatment Devices; and Traction Sand Trap Devices
G Familiy - Public Facilities	Custodial Responsibilities at Restrooms, Fountains, and Picnic Areas,; Maintenance of Appurtenances such as Roadway Surfacing, Signs, Pavement Markings, Buildings, Landscaping, and Electrical Installations
H Family – Bridges	Welding and Grinding; Sandblasting, Wet Blast (Sand Injection) and Hydroblasting; Painting; Bridge Repairs; and Draw Bridge Maintenance
J Family – Other Structures	Pump Station Cleaning; Tube and Tunnel Maintenance and Repair; Ferryboat Operations; Tow Truck Operations; and Toll Booth Lane Scrubbing Operations
K Family – Electrical	Sawcutting for Loop Installation
M Family – Traffic Guidance	Thermoplastic Stripping and Marking; Paint Stripping and Marking; Raised/Recessed Pavement Marker Application and Removal; Sign Repair and Maintenance; Median Barrier and Guard Rail Repair; and Emergency Vehicle Energy Attenuator Repair
R Family – Snow and Ice Removal	Snow Removal; and Ice Control
S Family – Storm Maintenance	Minor Slides and Slipouts Cleanup/Repair
T Family – Management and Support	Building and Grounds Maintenance; Storage of Hazardous Materials; Material Storage Control; Outdoor Storage of Raw Materials; Vehicle and Equipment Fueling; Vehicle and Equipment Cleaning; Vehicle and Equipment Maintenance and Repair; and Aboveground and Underground Tank Leak/Spill Control

The Maintenance Staff Guide describes 64 individual BMPs approved for statewide use. In addition to individual BMPs relevant to maintenance facilities, there are BMPs that are commonly applied to all maintenance activities and are defined as General BMPs. The General BMPs include Scheduling and

Planning, Spill Prevention and Control, Sanitary/Septic Waste Management, Material Use, Safer Alternative Products, Vehicle/Equipment Cleaning/Fueling/Maintenance, Illicit Connection Detection/Reporting/Removal, Illegal Spill Discharge Control, and Maintenance Facility Housekeeping Practices (Maintenance Staff Guide, Interim rev. September 2012).

In the Maintenance Staff Guide, Activity Cut-Sheets are provided to summarize the appropriate BMPs to be implemented when performing maintenance activities at the T Family.

2.2 Facility Review

Facility reviews were completed in FY2014–2015 for the activities within the T Family – Management and Support (Table 2-1). At the facility, non-routine maintenance work not listed in the T Family may have also been conducted (e.g., Asphalt Cement Crack and Joint Grinding/Sealing, Thermoplastic Striping and Marking). These activity reviews are presented in the Year End Performance Report - Maintenance Activity Storm Water Compliance Reviews (CTSW-RT-15-321.04.4).

2.2.1 Review Guidelines and Checklist

To maintain compliance with the AMFCRP, Maintenance Facility Compliance Review Rating Guidelines and Procedures and a standard Maintenance Site Storm Water Compliance Review Checklist were developed and implemented for all facility reviews (Attachments A and B, respectively). The procedures and checklist were developed to evaluate the overall effectiveness of stormwater pollution prevention practices, implementation of those practices and the potential for pollutant discharge at a facility.

During each review, the third party auditor rates the compliance status of the facility and documents the results using the Maintenance Site Storm Water Compliance Review Checklist. A rating is assigned for each applicable facility activity along with an overall rating of the facility's compliance with the stormwater pollution prevention requirements. Following each review, a copy of the completed checklist is submitted and reviewed with the maintenance facility supervisor and District Maintenance Storm Water Coordinator (DMSWC) or their designated representatives.

2.2.2 Rating System

The rating system consists of a numeric component (1 through 4) and a letter component (A, B and C) as defined in the Maintenance Facility Compliance Review Rating Guidelines and Procedures (Table 2-2).

Table 2-2: Maintenance Facility Compliance Review Rating Summary

Numeric Rating Summary	
1	Compliant. The facility is in compliance with SWMP requirements.
2	Minor deficiency. The facility is in compliance with SWMP requirements.
3	Major deficiency noted that requires prompt correction.
4	Critical deficiency noted that requires immediate correction.
Letter Rating Summary	
A	Overall implementation of BMPs is highly effective.
B	Overall implementation of BMPs is moderately effective.
C	Major or critical deficiency in the overall implementation of BMPs.

Facilities that receive a 1 or 2 Rating (i.e., compliant or minor deficiency) are considered to be compliant with stormwater requirements. An A or B Rating indicates that the facility's water pollution control effort is effective (i.e., highly to moderately effective).

In contrast, the 3 or 4 Rating (i.e., major to critical deficiency) indicates the need for immediate corrective action. The C Rating indicates that the facility's water pollution control effort is ineffective. If a facility receives the 3 or 4 Rating, immediate corrective action(s) is recommended and the facility is re-inspected to verify the corrective action(s) was implemented. Facilities with a 3 Rating are scheduled to be revisited within two weeks of the initial visit; revisits are to be scheduled within one week for the 4 Rating.

2.2.3 Facility Pollution Prevention Plan

Each facility review includes a review of the site-specific Facility Pollution Prevention Plan (FPPP) and monthly stormwater inspection documentation in order to evaluate the facility's compliance with the Department's NPDES Permit. The FPPP and documentation review results are noted in the Maintenance Site Storm Water Compliance Review Checklist.

2.3 Reporting and Communications

Through the reporting period, Department Headquarters and third party auditors maintain on-going communication on the progress of the program activities and the self-audit results. Monthly status meetings are conducted with Department Headquarters and the third party auditors to identify programmatic issues and BMP deficiencies identified in the field.

2.3.1 Status Reports

The third party auditors prepare monthly status reports that are submitted to Headquarters staff. Each status report provides a list of District maintenance activities facilities reviewed and a summary of review results.

2.3.2 Maintenance Facility Review Database Summary

A database is maintained to make review results and other useful information readily available to Headquarters staff. The database includes facility reference information, such as maintenance facility address, third party auditor contact information, overall facility rating, BMP ratings associated with the T Family activities, and completed review checklists. A summary of the database for FY2014–2015 is provided in Attachment C.

2.3.3 On-Site Training

Informal on-the-job training can occur during the compliance reviews to provide immediate site-specific guidance to facility supervisors and staff. The review schedule allows sufficient time for the third party auditor to discuss observations with the facility supervisor, DMSWC or designated facility representatives.

3. Summary of Maintenance Facility Compliance Review Results

This section summarizes the review results and BMP implementation results of the 219 stormwater compliance reviews that were conducted statewide from July 2014 through June 2015. A detailed list of results is provided in the Maintenance Facility Review Database Summary (FY2014–2015) (Attachment C).

In addition to compliance reviews of maintenance facilities, other facility types were reviewed for stormwater compliance. In FY2014–2015, the Department continued the practice of including some of these other facility types into the compliance review process to understand and formulate a basis for including them in the future compliance review plan and a future SWMP (Table 3-1). This fiscal year third party reviews included Sand & Salt Storage Sites and Material Storage Sites which are planned to be included as a defined maintenance facility in future revisions of the SWMP.

Table 3-1: Facilities Reviewed FY2014–2015

Facilities	No. of Facilities Reviewed
Maintenance Facilities	79
Equipment Shops	7 [1]
Commercial Vehicle Enforcement Facilities	9 [1]
Border Protection Stations	4 [1]
Safety Roadside Rest Areas	17 [1]
Agriculture Stations	0 [1]
Sand & Salt Storage Sites	20 [1]
Material Storage Sites	83 [1]
TOTAL	**219**

1. These other facilities are not Maintenance facilities as defined in the SWMP (2003). See Section 5 for further information.

3.1 Facility Review Results by District

There were 890 maintenance facilities (as defined in the draft SWMP [2012]) operated by the Department in FY2014-2015. The third party consultant completed a total of 219 initial reviews (separate maintenance facilities) during the reporting period. This represents approximately 25% of the total operated facilities. Ten facilities required re-visits. These facilities were found to be in compliance upon subsequent re-visits.

The Maintenance Facility Review Database Summary (FY2014–2015) is shown in Attachment C. In the summary, the details of the reviews, including the District, facility evaluated, compliance rating for each relevant activity, an overall facility rating and the inspection date are described. The overall numeric and letter rating results organized by District are presented in Table 3-2.

A summary of the ratings by District include the following:

- 209 maintenance facilities (95.4%) received a 1 or 2 Rating during the initial review.
- 10 maintenance facilities (4.6%) received a 3 Rating during the initial review. All 10 facilities were found to be compliant upon subsequent third party visits.
- None of the facilities received a 4 Rating.

Letter rating data show the following:

- 118 facilities (53.9%) received an A Rating during the initial review.
- 91 facilities (41.5%) received a B Rating during the initial review.
- 10 facilities (4.6%) received a C Rating during the initial review.

Table 3-2: Facility Rating Summary by District FY2014–2015

Numeric Rating Summary									
District	No. of Facilities Reviewed	Compliant		Minor Deficiency		Major Deficiency		Critical Deficiency	
		1 Rating		2 Rating		3 Rating		4 Rating	
1	24	15	63%	7	29%	2	8%	0	0%
2	26	18	69%	8	31%	0	0%	0	0%
3	18	10	56%	7	39%	1	5%	0	0%
4	29	21	72%	6	21%	2	7%	0	0%
5	27	6	22%	20	74%	1	4%	0	0%
6	22	9	41%	13	59%	0	0%	0	0%
7	19	6	32%	12	63%	1	5%	0	0%
8	18	5	28%	10	55%	3	17%	0	0%
9	8	4	50%	4	50%	0	0%	0	0%
10	16	10	63%	6	37%	0	0%	0	0%
11	8	3	38%	5	62%	0	0%	0	0%
12	4	2	50%	2	50%	0	0%	0	0%
	219	109	50%	100	46%	10	4%	0	0%

Letter Rating Summary							
District	No. of Facilities Reviewed	Highly Effective		Moderately Effective		Ineffective	
		A Rating		B Rating		C Rating	
1	24	13	54%	9	38%	2	8%
2	26	20	77%	6	23%	0	0%
3	18	10	56%	7	39%	1	5%
4	29	16	55%	11	38%	2	7%
5	27	19	70%	7	26%	1	4%
6	22	6	27%	16	73%	0	0%
7	19	5	26%	13	69%	1	5%
8	18	9	50%	6	33%	3	17%
9	8	4	50%	4	50%	0	0%
10	16	12	75%	4	25%	0	0%
11	8	0	0%	8	100%	0	0%
12	4	4	100%	0	0%	0	0%
TOTAL	219	118	54%	91	42%	10	4%

3.2 Facility Review Results by T Family Activity

The T Family – Management and Support addresses the maintenance of facilities. There are eight activities commonly associated with the T Family. Based on the Maintenance Facility Review Database (FY2014–2015), the numeric and letter ratings for BMP effectiveness, organized by the T Family activity, are presented in Table 3-3.

A summary of the rating by activity include the following:

- 786 (98.4%) of the activities evaluated received a 1 or 2 Rating.
- 13 (1.6%) of the activities evaluated received a 3 Rating at 10 separate facilities. All of the 10 facilities received the 3 rating for BMPs that were associated with the Building and Grounds Maintenance activity. One facility received additional 3 Ratings concerning BMPs that were associated with Material Storage Control (Hazardous Waste), Outdoor Storage of Raw Materials, and Vehicle and Equipment Maintenance and Repair activities. The BMPs for these activities were found to be compliant at all 10 facilities upon subsequent third party visits.
- None of the activities evaluated received a 4 Rating.

The letter rating results by T Family activities show the following:

- 586 (73.3%) of the activities received an A Rating.
- 202 (25.3%) of the activities received a B Rating.
- 11 (1.4%) of the activities received a C Rating at 10 separate facilities.

Table 3-3: Facility Rating Summary – T Family Activity FY2014–2015

Numeric Rating Summary									
T Family Activity	No. of Activities Reviewed	Compliant				Non-Compliant			
		Compliant		Minor Deficiencies		Major Deficiencies		Critical Deficiencies	
		1 Rating		2 Rating		3 Rating		4 Rating	
Building and Grounds Maintenance	215	142	66%	63	29%	10	5%	0	0%
Storage of Hazardous Materials (Working Stock)	109	51	47%	58	53%	0	0%	0	0%
Material Storage Control (Hazardous Waste)	97	78	80%	18	19%	1	1%	0	0%
Outdoor Storage of Raw Materials	133	105	79%	27	20%	1	1%	0	0%
Vehicle and Equipment Fueling	57	54	95%	3	5%	0	0%	0	0%
Vehicle and Equipment Cleaning	59	56	95%	3	5%	0	0%	0	0%
Vehicle and Equipment Maintenance and Repair	72	62	86%	9	13%	1	1%	0	0%
Aboveground and Underground Tank Leak and Spill Control	57	55	96%	2	4%	0	0%	0	0%
TOTAL	799	603	75%	183	23%	13	2%	0	0%

Table 3-3: Facility Rating Summary – T Family Activity FY2014–2015 (continued)

T Family Activity	No. of Activities Reviewed	Highly Effective		Moderately Effective		Ineffective	
		A Rating		B Rating		C Rating	
Building and Grounds Maintenance	215	133	62%	73	34%	9	4%
Storage of Hazardous Materials (Working Stock)	109	49	45%	60	55%	0	0%
Material Storage Control (Hazardous Waste)	97	80	82%	16	17%	1	1%
Outdoor Storage of Raw Materials	133	101	76%	32	24%	0	0%
Vehicle and Equipment Fueling	57	56	98%	1	2%	0	0%
Vehicle and Equipment Cleaning	59	56	95%	3	5%	0	0%
Vehicle and Equipment Maintenance and Repair	72	57	79%	14	20%	1	1%
Aboveground and Underground Tank Leak and Spill Control	57	54	95%	3	5%	0	0%
TOTAL	799	586	73%	202	25%	11	2%

4. Maintenance Facility Compliance Review Assessments

This section summarizes the overall BMP implementation and effectiveness applied to the 8 activities for maintenance facilities observed during the reporting period. The overall status of stormwater management compliance and BMP implementation was in compliance.

4.1 Building and Grounds Maintenance Activity

The Building and Grounds Maintenance activity include permanent maintenance facilities that need building and ground maintenance, which requires care of landscaped areas around each facility, cleaning of parking areas and pavements and maintenance of the storm water drainage system. The BMPs for the Building and Grounds Maintenance activity are some of the most effective stormwater management practices at facilities when implemented properly.

Overall, the BMPs for this maintenance activity were found to be effectively implemented. A total of 205 (95.3%) of the facilities were in compliance and received a 1 or 2 Rating and an A or B Rating for this maintenance activity. Nine facilities received the 3C Rating and one facility received the 3B Rating for the BMPs applied to the Building and Grounds Maintenance activity. Six of these facilities were Materials Storage Sites or Sand & Salt Storage Sites. These facilities are new to the third party review program this reporting period. All facilities that received a rating of 3C were re-visited as soon as practicable. Except for one Sand & Salt Storage Site, all of these facilities were compliant with the Building and Grounds

Maintenance activity BMPs during the re-visit. The Ione Sand & Salt Storage Site was found to be in compliance at a second re-visit.

4.2 Storage of Hazardous Materials (Working Stock) Activity

The Storage of Hazardous Materials (Working Stock) activity includes the storage of a variety of products which may be harmful to the environment if they come in contact with surface waters. The proper storage of hazardous materials is critical to prevent potential spills and leaks of the working stock at the facility.

These BMPs were found to be effectively implemented. All (100%) of the facilities were in compliance and received a 1 or 2 Rating and an A or B Rating.

4.3 Material Storage Control (Hazardous Waste) Activity

The Material Storage Control (Hazardous Waste) activity includes the storage of a variety of products that may adversely impact water quality if the come in contact with surface waters. The proper storage of hazardous wastes is critical to prevent potential spills and leaks of hazardous wastes at the facility.

These BMPs were found to be effectively implemented. A total of 96 (99.0%) of the facilities were in compliance and received a 1 or 2 Rating and an A or B Rating. One facility (one same facility of the facilities included in Section 4.2) received the 3C Rating for the BMPs applied to the Material Storage Control (Hazardous Waste) activity.

4.4 Outdoor Storage of Raw Materials Activity

The Outdoor Storage of Raw Materials activity includes the storage of a variety of raw materials that may adversely impact water quality if they come in contact with surface waters. Most facilities store raw materials outdoors. The BMPs for the Outdoor Storage of Raw Material activity provide guidelines for minimizing the potential for these materials from being conveyed off-site by stormwater.

These BMPs were found to be effectively implemented. A total of 132 (99.2%) of the facilities were in compliance and received a 1 or 2 Rating and an A or B Rating. One facility (the same facility as in Sections 4.2 and 4.3) received the 3B Rating for the BMPs applied to the Outdoor Storage of Raw Materials activity.

4.5 Vehicle and Equipment Fueling Activity

The Vehicle and Equipment Fueling activity takes place at a maintenance facility with the potential for fuel leaks or spills at the site. The BMPs for the Vehicle and Equipment Fueling activity provide guidelines for minimizing the potential release of vehicle fluids at the fueling area.

These BMPs were found to be effectively implemented. All (100%) of the facilities were in compliance and received a 1 or 2 Rating and an A or B Rating.

4.6 Vehicle and Equipment Cleaning Activity

The Vehicle and Equipment Cleaning activity conducted at a maintenance facility is done in a controlled area to ensure wash water is not released to the stormwater drainage system or nearby watercourses. These BMPs address proper practices for managing non-stormwater pollutants (e.g., oils), excessive rinse water, and sediment associated with the Vehicle and Equipment Cleaning activity.

These BMPs were found to be effectively implemented. All (100%) of the facilities were in compliance and received a 1 or 2 Rating and an A or B Rating.

4.7 Vehicle and Equipment Maintenance and Repair Activity

The Vehicle and Equipment Maintenance and Repair activity includes vehicle fluid removal, engine and parts cleaning, body repair and painting. The BMPs applied to the Vehicle and Equipment Maintenance and Repair activity addresses spills and leaks associated with fuels, oils, hydraulic fluids, lead-acid batteries, antifreeze, and oil filters.

These BMPs were found to be effectively implemented. A total of 71 (98.7%) of the facilities were in compliance and received a 1 or 2 Rating and an A or B Rating. One facility (the same facility as in Sections 4.2, 4.3, and 4.4) received the 3C Rating for the BMPs applied to the Vehicle and Equipment Maintenance and Repair activity.

4.8 Aboveground and Underground Tank Leak and Spill Control Activity

The Aboveground and Underground Tank Leak and Spill Control activity addresses the use of storage tanks for storage of bulk quantities of petroleum products. The BMPs applied to the Aboveground and Underground Tank Leak and Spill Control activity address practices for handling fuels, oils, de-icing chemicals and emulsions stored in tanks. The Department has completed removal of all underground tanks from the maintenance facilities.

Overall, the BMPs for this maintenance activity were found to be effectively implemented. All (100%) of the facilities were in compliance and received a 1 or 2 Rating and an A or B Rating for this maintenance activity.

5. Summary of Compliance Assistance

In July 1999, the Permit required the Department to prepare FPPPs for all maintenance facilities. The SWMP (2003) further clarified the requirement by defining maintenance facilities as “facilities under the Department’s ownership or control that contain such areas as fueling areas, waste storage or disposal facilities, wash racks, equipment/vehicle storage and materials storage.”

In October 2010, the U.S. Environmental Protection Agency (USEPA) Findings of Violation and Order for Compliance required that the SWMP redefine the term “maintenance facility” to include vehicle maintenance facilities, salt and sand storage facilities, material and equipment storage facilities, roadside rest areas, agricultural stations, and highway patrol weigh stations, sweeper/roadway waste and decant storage/disposal locations (USEPA Docket No. CWA-09-2011-0001). The new definition of “maintenance facility” increased the number of facilities originally identified in the SWMP (2003).

Late in 2013, an inventory was initiated and completed to include the “new facilities.” The Department is continuing proactive steps to include the “new facilities” into the FY2014–2015 compliance reviews to formulate a process for including them in the future compliance review plan. In this fiscal year Material Storage Sites and Sand & Salt Storage Sites were added to the facilities reviewed by the third party. The future SWMP will provide the stormwater management procedures and practices to meet requirements of the Permit and the USEPA Order. Beginning from July 1, 2015, the third party quality assurance reviews of Maintenance facilities will be conducted in accordance with Annual Maintenance and Operation Compliance Review Plan (AMOCRP). The AMOCRP is consistent with the Permit, SWMP and USEPA Order.

No assistance was provided for maintenance facilities during this reporting period.

Attachment A: Maintenance Facility Compliance Review Rating Guidelines and Procedures

Maintenance Facility Compliance Review
Rating Guidelines and Procedures

The numeric rating criteria are as follows:

1 Rating The facility is in compliance with Storm Water Management Plan (SWMP) requirements. Revisit will be conducted during the next cycle.

- No observed activities that contribute to a non-storm water discharge.

2 Rating Minor deficiency noted. The facility is in compliance with SWMP requirements. Revisit will be conducted during the next cycle.

- Minor housekeeping problems (e.g., some areas need sweeping, some litter, small fluid spots need cleanup and removal).
- Minor waste management and storage problems (e.g., solid waste storage inadequate or exposed during rainfall).

3 Rating Major deficiency noted that require prompt correction. A re-visit will be conducted within two weeks. District Maintenance Storm Water Coordinator and Headquarters Maintenance Storm Water personnel are notified.

- Potential non-storm water discharge.
- Evidence of a prior non-storm water discharge that has not been completely cleaned up.
- Multiple deficiencies described in the "2" rating, which cannot be corrected immediately.

4 Rating Critical deficiency noted that require immediate correction. A re-visit will be conducted within one week. District Maintenance Storm Water Coordinator, District Managers, Environmental, and Headquarters Maintenance Storm Water personnel are notified.

- Observed non-storm water discharge.

Note: For ratings of 3 or 4, comments are required on the Review Summary Sheet describing the deficiencies.

- The letter rating criteria are as follows:

A Rating Overall implementation of BMPs is highly effective.

- BMPs are implemented and maintained in good condition.
- Some minor deficiencies with the implemented BMPs

B Rating Overall implementation of BMPs is moderately effective.

- Some BMPs are not fully or properly maintained.
- Improper implementation of some BMPs.
- Some BMPs have not been installed.

C Rating Major or critical deficiency in the overall implementation of BMPs.

- Many BMPs improperly installed.
- BMPs have failed due to non-maintenance.
- Many BMPs not implemented or installed.

Attachment B: Caltrans Maintenance Site Storm Water Compliance Review Checklist

Caltrans Maintenance Site Stormwater Review Checklist

District/Cost Center:	**Review Date:**	**Overall Rating:**
Activity:	**Weather Conditions:**	
Location (Cnty-Rte-PM, Dir):	**Site Description:**	
Interviewee:		
Supervisor:	**Supervisor Contact Number:**	
IA Reviewer:	**IA Reviewer Contact Number:**	
Attendees:	**Additional training required for this Activity:** ☐	
	Re-Training documentation due to DMSWC by:	

1	The Activity Site is in compliance with the Storm Water Management Plan (SWMP).
2	Minor deficiencies noted. The Activity Site is in compliance with the SWMP.
3	Major deficiency noted. Prompt correction required. BMP re-training will be conducted.
4	Critical deficiency noted. Immediate correction required. BMP re-training will be conducted.
A	Overall implementation of BMPs is highly effective.
B	Overall implementation of BMPs is moderately effective.
C	Major and critical deficiencies noted in overall implementation of BMPs.

Rating Justification:

Other Observations:

Attachment C: Maintenance Facility Review Database Summary (FY2014–2015)

Facility Ratings

					Overall Facility		Buildings and Grounds Maintenance		Storage of Hazardous Materials		Storage of Hazardous Wastes		Outdoor Storage of Raw Materials		Vehicle & Equipment Fueling		Vehicle & Equipment Cleaning		Vehicle & Equipment Maintenance and Repair		Aboveground & Underground Tank Leak and Spill Control	
District	Cost Center	Facility Type	Facility Name	Date	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter
1	643	S&SS	Berry Summit Sand & Salt Storage	1-Dec-14	1	A	1	A														
1	662	MF	Bridgeville Maintenance Facility	2-Dec-14	2	B	2	B	2	B	1	A	1	A	1	A	2	B	1	A	1	A
1	645	SRRA	Collier Tunnel Safety Roadside Rest Area	3-Dec-14	2	A	1	A	2	A												
1	662	MSS	D1W02	2-Dec-14	1	A	1	A					1	A								
1	663	MSS	D1W07	4-Dec-14	1	A	1	A														
1	688	MSS	D1W16	14-May-15	1	A	1	A														
1	662	MSS	D1W20	2-Dec-14	2	B	2	B					1	A								
1	642	MSS	D1W28	11-May-15	3	C	3	C														
1	642	MSS	D1W28	28-May-15	1	A	1	A														
1	642	MSS	D1W29	11-May-15	1	A	1	A														
1	642	MSS	D1W30	11-May-15	1	A	1	A														
1	642	MSS	D1W31	11-May-15	3	C	3	C														
1	642	MSS	D1W31	28-May-15	1	A	1	A														
1	642	MSS	D1W33	11-May-15	1	A	1	A														
1	642	MSS	D1W34	11-May-15	1	A	1	A														
1	643	MSS	D1W35	1-Dec-14	1	A	1	A					1	A								
1	643	MSS	D1W36	1-Dec-14	1	B	1	A					1	B								
1	688	MSS	D1W38	14-May-15	1	B	1	B					1	B								
1	643	MSS	D1W59	1-Dec-14	2	B	2	B					1	B								
1	643	MSS	D1W60	1-Dec-14	1	A	1	A														
1	643	MSS	D1W61	1-Dec-14	1	A	1	A														
1	662	S&SS	Dinsmore Sand & Salt Storage	2-Dec-14	1	A	1	A					1	A								
1	643	SRRA	Francis B MattheMSS Safety Roadside Rest Area	1-Dec-14	2	B	1	B	2	B												
1	664	MF	Garberville Maintenance Facility	13-May-15	2	B	2	B	2	B	1	A	1	A			1	A	1	B		
1	645	MF	Idlewild Maintenance Facility	3-Dec-14	2	B	2	A	2	B	1	A	1	A	1	A	1	A	1	A	1	A
1	688	MF	Lakeport Maintenance Facility	14-May-15	1	B	1	B	1	B	1	A	1	A	1	A	1	A	1	A	1	A
2	638	S&SS	4 Corners Burney Junction Sand & Salt Storage	16-Jun-15	2	B	1	A	1	A	1	A	2	B								

Facility Ratings

					Overall Facility		Buildings and Grounds Maintenance		Storage of Hazardous Materials		Storage of Hazardous Wastes		Outdoor Storage of Raw Materials		Vehicle & Equipment Fueling		Vehicle & Equipment Cleaning		Vehicle & Equipment Maintenance and Repair		Aboveground & Underground Tank Leak and Spill Control	
District	Cost Center	Facility Type	Facility Name	Date	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter
2	668	MF	Adin Maintenance Facility	16-Jun-15	2	A	1	A	1	B	1	A	2	A			1	A	1	A	1	A
2	634	CVEF	Cottonwood Commercial Vehicle Enforcement Facility SB	15-Jun-15	2	B	2	A	1	B			2	B								
2	637	MSS	D2W112	2-Oct-14	1	A	1	A					1	A								
2	634	MSS	D2W117	29-Sep-14	1	A	1	A														
2	636	MSS	D2W26	17-Jun-15	1	A	1	A					1	A								
2	636	MSS	D2W68	17-Jun-15	1	A	1	A					1	A								
2	636	MSS	D2W70	17-Jun-15	1	A	1	A					1	A								
2	636	MSS	D2W72	17-Jun-15	1	A	1	A					1	A								
2	636	MSS	D2W74	17-Jun-15	1	A	1	A														
2	638	MSS	D2W86	16-Jun-15	1	A	1	A														
2	637	MSS	D2W97	30-Sep-14	2	B	2	B					1	A								
2	618	MF	Grass Lake Maintenance Station	2-Oct-14	1	B	1	B	1	A	1	A	1	B	1	A	1	B	1	A	1	A
2	614	SRRA	Grass Lake Safety Roadside Rest Area	17-Jun-15	1	A	1	A	1	A												
2	672	S&SS	Greenville Wye Sand House	18-Jun-15	1	A	1	A	1	A	1	A	1	A								
2	612	S&SS	Hilt Sand & Salt Storage	1-Oct-14	1	A	1	A					1	A								
2	612	BPS	Hornbrook Border Protection Station	1-Oct-14	1	A	1	A	1	A												
2	661	S&SS	JCT 36/44 Sandhouse	18-Jun-15	2	A	1	A	1	A	1	A	2	A								
2	672	CVEF	Keddie Commercial Vehicle Enforcement Facility	18-Jun-15	1	A	1	A														
2	672	S&SS	Lee's Summit Sand House	18-Jun-15	1	A	1	A														
2	695	SRRA	Lt John C Helmick Safety Roadside Rest Area SB	15-Jun-15	1	A	1	A	1	A	1	A										
2	637	S&SS	McCloud Sand & Salt Storage	30-Sep-14	1	A	1	A					1	A								
2	637	MF	Mount Shasta Maintenance Station	30-Sep-14	2	B	2	A	2	B	1	A	1	A	1	A	1	A	1	A	1	A
2	634	MF	Red Bluff Maintenance Station	29-Sep-14	2	A	1	A	2	A	1	A	1	A	1	A	1	A	1	A	1	A
2	637	S&SS	Weed Sand & Salt Storage	2-Oct-14	1	A	1	A					1	A								
2	612	MF	Yreka Maintenance Station	1-Oct-14	2	B	2	B	2	A	1	A	1	B	1	A	1	A	1	A	1	A
3	617	MF	2nd Street Satellite Yard	27-Apr-15	1	A	1	A														
3	624	MF	3rd Street Satellite Yard	27-Apr-15	1	A	1	A														

Facility Ratings

					Overall Facility		Buildings and Grounds Maintenance		Storage of Hazardous Materials		Storage of Hazardous Wastes		Outdoor Storage of Raw Materials		Vehicle & Equipment Fueling		Vehicle & Equipment Cleaning		Vehicle & Equipment Maintenance and Repair		Aboveground & Underground Tank Leak and Spill Control	
District	Cost Center	Facility Type	Facility Name	Date	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter
3	614	CVEF	Antelope Commercial Vehicle Enforcement Facility	11-Jun-15	1	A	1	A														
3	721	MF	Auburn Maintenance Station	29-Apr-15	2	B	2	B	2	B	1	A	1	B	1	A	1	A	1	A	1	A
3	633	S&SS	Camino Sand & Salt Storage	12-Nov-14	2	B	2	B	1	B			1	A								
3	723	S&SS	Cisco Grove Sand & Salt Storage	8-Jun-15	2	A	2	A					1	A								
3	721	MF	Colfax Satellite Yard	30-Apr-15	2	B	1	B	2	B	2	B										
3	633	MSS	D3W12	12-Nov-14	2	B	2	B					1	A								
3	731	MSS	D3W25	8-Jun-15	1	A	1	A					1	A								
3	731	MSS	D3W55	14-Nov-14	1	B	1	A					1	B								
3	611	SRRA	Dunnigan South Safety Roadside Rest Area	27-Apr-15	2	B	2	B	2	B												
3	731	MF	Empire Street Satellite Facility	14-Nov-14	1	A	1	A														
3	3227	ES	Equipment Shop 3	13-Nov-14	2	B	1	B	2	B	2	A					1	A	1	A		
3	722	SRRA	Gold Run Safety Roadside Rest Area	10-Nov-14	1	A	1	A														
3	721	S&SS	Gold Run Sand & Salt Storage	8-Jun-15	1	A	1	A	1	A			1	A	1	A					1	A
3	723	MF	Kingvale Maintenance Facility	9-Jun-15	3	C	3	C	2	B	1	A	1	A	2	B	1	A	2	B	1	A
3	723	MF	Kingvale Maintenance Facility	25-Jun-15	1	A	1	A	1	A	1	A	1	A	1	A	1	A	1	A	1	A
3	617	MF	Richards Boulvard Satellite Yard	11-Jun-15	1	A	1	A														
3	734	MF	Sierraville Maintenance Station	10-Jun-15	1	A	1	A	1	A	1	A	1	A	1	A	1	A	1	A	1	A
4	783	MF	Benicia Maintenance Facility	26-Mar-15	1	B	1	B	1	B	1	A	1	A								
4	675	MF	Carquinez Bridge Maintenance Facility	15-Dec-14	2	B	1	A	2	B	2	B										
4	622	MSS	D4W02	27-Oct-14	1	A	1	A														
4	625	MSS	D4W12	25-Mar-15	1	A	1	A														
4	614	MSS	D4W14	27-Oct-14	2	A	2	A														
4	636	MSS	D4W25	23-Mar-15	3	C	3	C														
4	636	MSS	D4W25	27-Mar-15	1	B	1	B														
4	726	MSS	D4W27	16-Dec-14	1	A	1	A														
4	726	MSS	D4W6	16-Dec-14	1	A	1	A					1	A								
4	2401	ES	Equipment Shop #4	28-Oct-14	2	B	1	B	2	B	1	A			1	A	1	A	2	B	1	A

Facility Ratings

District	Cost Center	Facility Type	Facility Name	Date	Overall Facility		Buildings and Grounds Maintenance		Storage of Hazardous Materials		Storage of Hazardous Wastes		Outdoor Storage of Raw Materials		Vehicle & Equipment Fueling		Vehicle & Equipment Cleaning		Vehicle & Equipment Maintenance and Repair		Aboveground & Underground Tank Leak and Spill Control	
					Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter
4	745	MF	Foster City Maintenance Facility	29-Oct-14	2	B	1	B	2	B	2	B	1	A	1	A	1	A	2	B	1	A
4	726	MF	Fremont Maintenance Facility	7-May-15	1	A	1	A	1	A	1	A	1	A	1	A			1	A	1	A
4	622	MF	Geyserville Maintenance Facility	18-Dec-14	1	B	1	A	1	B	1	A	1	B	1	A	1	A	1	A	1	A
4	655	CVEF	Gilroy SB Commercil Vehicle Enforcement Facility	16-Dec-14	1	A	1	A			1	A							1	A		
4	625	SRRA	H Dana Bowers Safety Roadside Rest Area	4-May-15	1	A	1	A	1	A												
4	632	MF	Kyburz Maintenance Yard	12-Nov-14	1	A	1	A	1	A	1	A	1	A	1	A	1	A	1	A	1	A
4	625	MF	Manzanita Maintenance Facility	17-Dec-14	3	C	3	C	2	A	1	A	1	B	1	A	1	A	1	A	1	A
4	625	MF	Manzanita Maintenance Facility	7-Jan-15	1	B	1	B	1	A	1	A	1	A	1	A	1	A	1	A	1	A
4	712	SRRA	Maxwell South Safety Roadside Rest Area	27-Apr-15	2	B	1	B	2	B												
4	614	MF	Northgate Maintenance Station	28-Apr-15	1	B	1	B	1	B	1	A	1	A	1	A	1	A	1	A	1	A
4	624	MF	Petaluma Maintenance Facility	25-Mar-15	1	B	1	B	1	B	1	A	1	A	1	A	1	A	1	A		
4	634	MF	Point Reyes Maintenance Facility	24-Mar-15	1	A	1	A	1	A			1	A					1	A	1	A
4	689	MF	Rio Dell Paint Crew Maintenance Facility	12-May-15	1	A	1	A	1	A	1	A										
4	743	MF	San Francisco Maintenance Facility	5-May-15	1	B	1	B	1	B	1	A	1	A			1	A				
4	634	MF	San Rafael Landscape Storage	30-Oct-14	1	A	1	A														
4	633	MF	Santa Rosa Maintenance Facility	30-Oct-14	1	A	1	A	1	A	1	A										
4	623	MF	Sebastopol Maintaintance Facility	24-Mar-15	1	B	1	B	1	B	1	A	1	A	1	A			1	A	1	A
4	768	MF	South Petaluma Maintenance Facility	4-May-15	1	A	1	A	1	A	1	A										
4	675	MF	Tri Bridge Maintenance Facility	6-May-15	1	B	1	A	1	B	1	A	1	A	1	A	1	A	1	A	1	A
4	639	MF	Vallejo Maintenance Facility	23-Mar-15	1	A	1	A	1	A	1	A	1	A					1	A		
4	694	CVEF	Walnut Creek Commercial Vehicle Enforcement Facility NB	6-May-15	2	A	2	A														
5	637	SRRA	Camp Roberts Safety Roadside Rest Area NB	28-Oct-14	2	A	2	A	2	A	1	A	1	A								
5	1254	MSS	D5W04	18-May-15	2	A	1	A					2	A								
5	655	MSS	D5W22	29-Oct-14	2	A	2	A					1	A								
5	641	MSS	D5W34	27-Oct-15	1	A	1	A														
5	641	MSS	D5W36	27-Oct-14	2	B	2	B			2	B	2	B								
5	641	MSS	D5W41	27-Oct-14	1	A	1	A														

Facility Ratings

					Overall Facility		Buildings and Grounds Maintenance		Storage of Hazardous Materials		Storage of Hazardous Wastes		Outdoor Storage of Raw Materials		Vehicle & Equipment Fueling		Vehicle & Equipment Cleaning		Vehicle & Equipment Maintenance and Repair		Aboveground & Underground Tank Leak and Spill Control	
District	Cost Center	Facility Type	Facility Name	Date	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter
5	655	MSS	D5W53	29-Oct-14	2	A	2	A														
5	1254	MSS	D5W55	19-May-15	2	A	1	A					2	A								
5	1261	MSS	D5W56	18-May-15	2	A	1	A					2	A								
5	1263	MSS	D5W64	18-May-15	1	A	1	A														
5	1263	MSS	D5W65	18-May-15	2	A	1	A					2	A								
5	1263	MSS	D5W66	18-May-15	1	A	1	A														
5	1261	MSS	D5W67	18-May-15	1	A	1	A														
5	1261	MSS	D5W68	18-May-15	2	B	1	A					2	B								
5	632	MSS	D5W7	28-Oct-14	1	A	1	A					1	A								
5	641	MSS	D5W72	27-Oct-14	2	A	2	A					2	A								
5	653	MSS	D5W75	29-Oct-14	3	C	3	C					1	A								
5	653	MSS	D5W75	12-Dec-14	2	A	2	A					1	A								
5	654	MSS	D5W77	29-Oct-15	2	B	2	B					2	B								
5	654	MSS	D5W79	29-Oct-14	2	A	2	A					2	A								
5	654	MSS	D5W84	29-Oct-14	2	B	2	B	2	A	2	B	1	A	1	A					1	A
5	1261	MSS	D5W93	18-May-15	2	A	1	A					2	A								
5	1261	MSS	D5W97	18-May-15	2	B	2	B														
5	632	MF	King City Maintenance Yard	28-Oct-14	2	A	2	A	1	A	1	A	1	A	1	A	1	A	1	A		
5	1254	MF	Monterey Maintenance Facility	19-May-15	2	B	2	B			2	B	2	B	1	A	2	B	2	B	1	A
5	1278	MF	San Luis Obispo Maintenance Facility	21-May-15	2	A	2	A	2	A	2	A	1	A	1	A			1	A	1	A
5	32-3229	ES	San Luis Obispo Shop 5	20-May-15	2	A	1	A	2	A	1	A	1	A	2	A	1	A	1	A		
5	642	MF	Santa Maria Maintenance Yard	30-Oct-14	2	B	2	B	2	A	2	B	2	A	1	A	1	A	2	A	1	A
6	622	MF	Camp Nelson Maintenance Station	15-Apr-15	2	B	2	B	2	B	1	B	1	A	1	A			1	A	1	A
6	642	SRRA	Coalinga Safety Roadside Rest Area NB	11-Feb-15	2	B	1	B	2	B												
6	642	SRRA	Coalinga/Avenal Safety Roadside Rest Area SB	5-Nov-14	2	B	2	B	2	B												
6	642	MSS	D6W01	11-Feb-15	1	B	1	B					1	B								
6	655	MSS	D6W11	16-Apr-15	2	B	2	B					2	B								

Facility Ratings

					Overall Facility		Buildings and Grounds Maintenance		Storage of Hazardous Materials		Storage of Hazardous Wastes		Outdoor Storage of Raw Materials		Vehicle & Equipment Fueling		Vehicle & Equipment Cleaning		Vehicle & Equipment Maintenance and Repair		Aboveground & Underground Tank Leak and Spill Control	
District	Cost Center	Facility Type	Facility Name	Date	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter
6	636	MSS	D6W17	13-Apr-15	1	B	1	B														
6	611	MSS	D6W37	10-Feb-15	2	B	2	B			2	B										
6	611	MSS	D6W38	10-Feb-15	1	B	1	B					1	B								
6	626	MSS	D6W42	12-Feb-15	1	A	1	A					1	A								
6	645	MSS	D6W55	3-Nov-15	1	A	1	A														
6	645	MSS	D6W56	3-Nov-14	1	A	1	A														
6	630	MSS	D6W62	15-Apr-15	1	A	1	A					1	A								
6	645	MSS	D6W64	3-Nov-14	1	B	1	B														
6	645	MSS	D6W65	3-Nov-14	2	A	2	A														
6	655	MSS	D6W66	16-Apr-15	1	A	1	A					1	A								
6	626	S&SS	Greenhorn Summit Sand & Salt Storage	12-Feb-15	2	B	1	A	2	B			1	A	1	A						
6	636	S&SS	Happy Gap Sand & Salt Storage	13-Apr-15	2	B	2	B	1	B	1	A	2	B								
6	655	MF	Huntington Lake Satellite Facility	16-Apr-15	2	B	2	B	2	B	1	B	1	A	1	A			1	A	1	A
6	636	MF	Pinehurst Maintenance Station	4-Nov-14	2	B	2	B	2	B	1	A	2	A	1	A	1	A	1	B	1	A
6	655	MF	Shaver Lake Maintenance Facility	6-Nov-14	2	B	1	A	2	B	2	A	1	A	1	A	1	A	1	B	1	A
6	2602	ES	Shop 2602 Division of Equipment Repair	10-Feb-15	2	B	1	B	2	B	1	B							1	B		
6	630	MF	Visalia Maintenance Facility	14-Apr-15	2	B	1	B	2	B	1	A	1	A	1	A	1	A	1	B	1	A
7	620	MF	Altadena Maintenance Facility	9-Mar-15	2	B	1	B	2	B	1	A	1	A	1	A	1	A	1	A	1	A
7	749	MF	Burbank Electrical Maintenance Facility	12-Jan-15	2	B	1	B	1	B	2	B	1	A								
7	703	MF	Century Maintenance Facility	3-Jun-15	2	B	2	B	2	B	1	A	1	A	1	A	1	A	1	A		
7	605	MSS	D7W02	17-Nov-14	3	C	3	C														
7	605	MSS	D7W02	9-Dec-14	1	A	1	A														
7	662	MF	Diamond Bar Maintenance Facility	20-Nov-14	2	B	2	B	1	B	1	A	1	A	1	A	1	A	1	A	1	A
7	605	MF	District 7 Warehouse	1-Jun-15	1	A	1	A	1	A												
7	3231	ES	Equipment Sub Shop 27301	17-Nov-15	1	B	1	A	1	B	1	A					1	A	1	A	1	A
7	690	MF	Felton Maintenance Facility	4-Jun-15	1	A	1	A	1	A	1	A										
7	645	MF	Florence Maintenance Facility	14-Jan-15	2	B	2	B	2	B	1	A	1	B			1	A	1	A		

Facility Ratings

District	Cost Center	Facility Type	Facility Name	Date	Overall Facility		Buildings and Grounds Maintenance		Storage of Hazardous Materials		Storage of Hazardous Wastes		Outdoor Storage of Raw Materials		Vehicle & Equipment Fueling		Vehicle & Equipment Cleaning		Vehicle & Equipment Maintenance and Repair		Aboveground & Underground Tank Leak and Spill Control	
					Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter
7	631	S&SS	Fraizer Park Sand & Salt torageS	15-Jan-15	2	B	2	B					1	B								
7	706	MF	META LAX	4-Jun-15	1	A	1	A														
7	633	MF	Newhall Maintenance Facility	12-Mar-15	2	A	2	A	1	A	2	A	1	A	1	A	1	A	1	A	1	A
7	692	MF	Pacific Place Maintenance Facility	19-Nov-14	2	A	2	A	2	A	1	A										
7	626	MF	San Fernando Maintenance Facility	11-Mar-15	1	B	1	A	1	B	1	A	1	A	1	A	1	A	1	A	1	A
7	719	MF	Tarzana Maintenance Facility	13-Jan-15	2	B	2	B	2	B	1	B	1	A	1	A	1	A	1	B	1	A
7	631	SRRA	Tejon Pass Safety Roadside Rest Area SB	18-Nov-14	2	B	1	B	2	B												
7	630	MF	Valencia & North Region Maintenance Facility	10-Mar-15	2	B	1	B	2	B	1	A	1	A	1	A	1	A	2	B	1	A
7	630	S&SS	Whittaker Summit Sand & Salt Storage	15-Jan-15	2	B	2	B					1	B								
7	657	MF	Whittier Maintenance Facility	2-Jun-15	1	B	1	A	1	B	1	A	1	A	1	A	1	A	1	A		
8	624	MF	Burnt Mill Maintenance Station	8-Apr-15	2	B	2	B	2	B	1	A	1	A	1	A	1	A	1	B	1	B
8		CVEF	Cajon NB Commercial Vehicle Enforcement Facility	23-Oct-14	2	A	2	A	1	A	2	A							1	A	1	A
8	611	S&SS	Cajon Pass Sand & Salt Storage	9-Apr-15	2	B	2	B					2	B								
8	612	S&SS	Cleghorn Sand & Salt Storage	6-Apr-15	3	C	3	C														
8	612	S&SS	Cleghorn Sand & Salt Storage	10-Apr-15	3	C	3	C			3	C										
8	612	S&SS	Cleghorn Sand & Salt Storage	1-May-15	1	A	1	A			1	A										
8	726	MF	Corona Maintenance Station	23-Oct-14	3	C	3	B	2	A	3	C	3	B	2	A	2	A	3	C		
8	726	MF	Corona Maintenance Station	14-Nov-14	2	A	1	A	1	A	2	A	1	A	1	A	1	A	2	A		
8	612	MSS	D8W Material Site	6-Apr-15	2	A	1	B														
8	611	MSS	D8W16	9-Apr-15	1	A	1	A														
8	612	MSS	D8W32	6-Apr-15	2	B	2	B					2	B								
8	612	MSS	D8W56	6-Apr-15	1	B	1	B														
8	622	MF	Fawnskin Maintenance Station	22-Oct-14	2	A	2	A	1	A	1	A	2	A	1	A	1	A	2	A	1	A
8	731	MF	Fontana Storage Yard, Magana Ortega Maintenance Station	20-Oct-14	2	A	2	A	2	A	2	A	2	A								
8	716	MF	Lake Elsinore Maintenance Station	21-Oct-14	2	A	2	A	1	A	1	A	1	A	1	A	1	A	2	A	2	A
8	634	MF	Needles Maintenance Facility	24-Feb-15	3	C	3	C	2	B	1	A	2	B	1	A	1	A	1	A	1	B
8	634	MF	Needles Maintenance Facility	6-Mar-15	1	A	1	A	1	A	1	A	1	A	1	A	1	A	1	A	1	A

Facility Ratings

District	Cost Center	Facility Type	Facility Name	Date	Overall Facility		Buildings and Grounds Maintenance		Storage of Hazardous Materials		Storage of Hazardous Wastes		Outdoor Storage of Raw Materials		Vehicle & Equipment Fueling		Vehicle & Equipment Cleaning		Vehicle & Equipment Maintenance and Repair		Aboveground & Underground Tank Leak and Spill Control	
					Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter
8	753	MF	Ontario Maintenance Facility	7-Apr-15	2	B	2	B	2	B	1	A	1	A	1	A	1	A	1	B	1	A
8	716	CVEF	Rainbow Valley Commercial Vehicle Enforcement Facility	26-Feb-15	1	A	1	A											1	A	1	A
8	632	SRRA	Valley Wells Safety Roadside Rest Area (NB)	25-Feb-15	1	A	1	A	1	A			1	A								
8	632	SRRA	Valley Wells Safety Roadside Rest Area (SB)	25-Feb-15	1	A	1	A	1	A			1	A								
8	631	BPS	Yermo Border Protection Station	25-Feb-15	2	B	2	B	2	B												
9	614	SRRA	Coso Junction Safety Roadside Rest Area	24-Sep-14	2	A	2	A	2	A	1	A	1	A	1	A	1	A	1	A	1	A
9	635	MSS	D9W07	18-Mar-15	1	B	1	B														
9	631	MSS	D9W10	24-Sep-14	1	A	1	A					1	A								
9	632	MF	Lee Vining Maintenance Station	23-Sep-14	2	A	2	A	2	A	1	A	1	A	1	A	1	A	2	A	1	A
9	631	MF	Minaret Maintenance Station	17-Mar-15	1	B	1	A	1	A	1	A	1	B	1	A			1	A	1	A
9	2901	ES	Shop 2901 Division of Equipment Repair Shop	17-Mar-15	2	B	1	B	2	B	1	A					1	A	1	A		
9	635	MF	Sonora Junction Maintenance Station	18-Mar-15	1	B	1	A	1	B	1	A	1	A	1	A	1	A	1	A	1	A
9	635	BPS	Topaz Border Protection Station	25-Sep-14	2	A	1	A	2	A	1	A	1	A	1	A	1	A	1	A	1	A
10	661	MF	Altaville Maintenance Facility	23-Apr-15	1	A	1	A	1	A	1	A	1	A			1	A	1	A	1	A
10	660	MF	Altaville Regional Office	23-Apr-15	1	A	1	A														
10	674	MSS	D10W11	26-Sep-14	1	A					1	A	1	A								
10	692	MSS	D10W13	26-Sep-14	1	A							1	A								
10	676	MSS	D10W23	26-Sep-14	1	A					1	A	1	A								
10	672	MSS	D10W25	22-Apr-15	2	B	2	B														
10	676	MSS	D10W36	26-Sep-14	2	A							2	A								
10	661	MSS	D10W8	20-Apr-15	1	B	1	B					1	A								
10		SRRA	Enoch Christofferson Safety Roadside Rest Area	24-Sep-14	1	A	1	A	1	A	1	A										
10	664	CVEF	Lyons Dam Commercial Vehicle Enforcement Facility	20-Apr-15	1	A	1	A														
10	654	S&SS	Milts Place Sand & Salt Storage	21-Apr-15	1	A	1	A					1	A								
10	643	MF	Modesto Electrical Facility	22-Apr-15	2	B	2	B	2	B	1	A										
10	2618	S&SS	Mud Springs Sand & Salt Storage	25-Sep-14	1	A	1	A					1	A								
10	674	MF	Patterson Maintenance Yard	24-Sep-14	2	A	2	A	2	A	1	A	2	B	1	A	1	A	1	A	1	A

Facility Ratings

					Overall Facility		Buildings and Grounds Maintenance		Storage of Hazardous Materials		Storage of Hazardous Wastes		Outdoor Storage of Raw Materials		Vehicle & Equipment Fueling		Vehicle & Equipment Cleaning		Vehicle & Equipment Maintenance and Repair		Aboveground & Underground Tank Leak and Spill Control	
District	Cost Center	Facility Type	Facility Name	Date	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter	Number	Letter
10	654	MF	Peddler Hill Maintenance Facility	25-Sep-14	2	A	1	A	2	B	1	A	1	A	1	A	1	A	1	A	1	A
10	656	MF	Woodfords Maintenance Facility	21-Apr-15	2	B	1	B	2	B	1	A	1	A	1	A	1	A	1	A	1	A
11	723	SRRA	Aliso Creek Safety Roadside Rest Area (SB)	22-Oct-14	2	B	2	B	1	A	1	B	1	B								
11	723	MF	Carlsbad Maintenance Facility	22-Oct-14	2	B	1	A	2	B	2	B	1	A	1	A	1	A	1	B	1	A
11	31210	ES	Equipment Sub Shop 31201	28-Jan-15	1	B	1	A	1	B	1	A	1	B					1	A		
11	654	MF	Santee Maintenance Station	27-Jan-15	2	B	2	B	2	B	1	A	1	A			1	A	1	A		
11	633	BPS	Winterhaven Border Protection Station	29-Jan-15	1	B	1	A	1	B	1	A										
11	713	MSS	D11W01	20-Oct-14	2	B	2	B	2	B			2	B								
11	651	MF	Descanso Maintenance Facility	21-Oct-14	2	B	1	B	2	A	2	B	1	B	1	A	1	A	1	A	2	B
11	723	CVEF	San Onofre Commercial Vehicle Enforcement Facility (SB)	22-Oct-14	1	B	1	B			1	A							1	A		
12	627	MF	Bolsa Chica Maintenance Facility	4-Nov-14	2	A	2	A	1	A	1	A	1	A			1	A	1	A		
12	672	MF	Brea Maintenance Facility	6-Nov-14	2	A	1	A	2	A	2	A	1	A			1	A	1	A		
12	645	MSS	D12W Main Street	5-Nov-14	1	A	1	A			1	A									1	A
12	674	MSS	D12W8	6-Nov-14	1	A	1	A														

Re-visit

Treatment BMP Technology Report

October 2015

CTSW-RT-15-999

2015 Edition

California Department of Transportation
Division of Environmental Analysis
1120 N Street, Sacramento, California 95814

blank for double-sided printing

TABLE OF CONTENTS

1.0 Introduction 1

2.0 Purpose of Treatment BMP Technology Report 1

3.0 Identifying and Evaluating New Technology 1

4.0 Catalog of Treatment BMPs 3

5.0 References 5

APPENDIX A: BMP Fact Sheet Description and Format A-1

APPENDIX B: Technology Fact Sheets B-1

APPENDIX C: Caltrans-Approved BMP Fact Sheets C-1

blank for double-sided printing

1.0 INTRODUCTION

The Treatment BMP Technology Report represents part of the California Department of Transportation (the Department) BMP identification, evaluation, and approval process as described in Section 3.3 of the Storm Water Management Plan (SWMP) (CTSW-RT-12-286.19.1).This report satisfies the requirement for a New Technology Report contained in the State Water Resources Control Board Order No. 2012-0011-DWQ. This report consolidates information for post-construction technologies in a standardized manner by using a fact sheet format. The BMP fact sheets summarize available design, construction, and performance information. The fact sheets result from a desktop evaluation of BMPs. Usually, a full-scale field evaluation (pilot testing) is required to collect sufficient information to determine if a BMP should be approved and under what conditions (siting constraints). The Department uses the fact sheets as a preliminary screening tool for selection of pilot BMPs when approved BMPs cannot meet project-specific treatment requirements due to siting constraints. BMPs selected for pilot testing are not automatically approved for statewide use. The SWMP includes procedures to (a)

Department-Approved Treatment BMPs:

- Biofiltration Systems
- Infiltration Devices
- Detention Devices
- Traction Sand Traps
- Dry Weather Flow Diversion
- Gross Solids Removal Devices (GSRDs)
- Media Filters
- Multi-Chambered Treatment Train
- Wet Basins

Identify the need for Pilot BMPs and (b) propose them. Refer to the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) for comprehensive information on this issue (Caltrans 2010).

2.0 PURPOSE OF TREATMENT BMP TECHNOLOGY REPORT

This document is used by the Department to identify and evaluate treatment BMP technologies for potential use in the highway environment only. The Department does not evaluate BMPs for other situations or entities. This document is intended for internal use by the Department. Unless stated otherwise, vendor products discussed in this document are not approved for use by the Department and are not endorsed by Caltrans or the State of California.

3.0 IDENTIFYING AND EVALUATING NEW TECHNOLOGY

The Department prepares fact sheets based on an initial evaluation of identified treatment technologies. The Department may identify technologies in the course of performing reconnaissance studies for specific treatment needs, including non-proprietary BMPs used by other state departments of transportation. To identify proprietary treatment technologies, the Department relies on manufacturers to submit product information. To introduce products to the Department, manufacturers must contact the New Product Coordinator at (916) 227-7073 for submittal instructions. Fact sheets are updated when new information is submitted to the New Product Coordinator before the end of the reporting period (June 30th).

The Department evaluates identified technologies using several criteria (discussed in Section 3.1) and develops fact sheets of the BMPs for this report.

3.1 Evaluation Criteria and Fact Sheet Content

BMP fact sheets are developed using a standard format to facilitate comparison among BMPs. Each fact sheet addresses a standard series of topics, including design, operations, maintenance, construction, treatment, advantages, and constraints. The Department, with input from universities, consultants, regulators, third parties, and manufacturers, continually reviews BMP information reported in literature. Appendix A describes the content of the fact sheets and the evaluation criteria for performance.

3.2 Fact Sheet Organization and Treatment BMP Technology Approval

Completed BMP fact sheets are presented in Appendices B and C. Section 4 provides an alphabetical list of all the BMP categories to aid in locating fact sheets for specific types of BMPs.

Appendix B contains fact sheets for BMPs that are not approved by the Department. Favorable evaluations of BMPs can lead to pilot studies to gather cost and performance data. In most cases, a group of similar BMPs are represented on a single fact sheet.

Appendix C contains fact sheets for approved BMPs. Consult the PPDG for more details on the implementation of approved BMPs (Caltrans 2010).

4.0 CATALOG OF TREATMENT BMPS

This alphabetical list includes all BMP technologies. Proprietary BMPs are listed on each fact sheet. The page numbers correspond to the location of the fact sheets in Appendices B and C.

Table 1. List of Treatment BMPs in Appendices

BMP Category	*Stormwater Technology*	*Page No.*
Bioretention		B-3
	Linear Bioretention Trench	B-5
	Tree Box Filter	B-7
Biofiltration		
	Strip	C-3
	Swale	C-5
Detention/Sedimentation		
Chemical Treatment		B-9
Electrocoagulation		B-11
Permanent Pool		B-13
	Wet Basin/Pond	C-27
	Vegetated Rock Filter	B-15
Plate and Tube Settlers		B-17
Temporary Pool		B-19
	Detention Basin	C-7
	Double Barrel	C-25
	Hold and Release	B-21
	Infiltration Chambers	B-23
	Skimmer	B-25
Disinfection		
Chemical Treatment		B-27
Ultraviolet		B-29
Drain Inlet Insert		
Baffle Box		B-31
Basket/Box	Baffled Filtration Box	B-33
	GSR Basket (Mechanically Removed)	B-35
Fabric		B-37
Media		B-39
Screen		B-41
Skimmer		B-43
Dry Weather Flow Diversion		C-9
Filtration		
Bed		B-45
	Austin Filter with Activated lumina	B-47
	Austin Sand Filter	C-11
	Delaware Sand Filter	C-13
	DC Sand Filter	B-49
	Infiltration Chambers	B-51
	Linear Filter Trench	B-53
	Media Filter Drain	B-55

BMP Category	Stormwater Technology	Page No.
Cartridge/Canister		B-57
Fabric		B-59
Pressure		B-61
Hydrodynamic Separator		B-63
Infiltration		
Basin		C-15
Trench		C-17
Below Grade		B-65
	Linear Infiltration Trench	B-67
Porous Surface		
Asphalt Overlay		B-69
Asphalt Pavement		B-71
Concrete Pavement		B-73
Permeable Pavers/Cellular Confinement		B-75
Screening		
GSRD–Inclined Screen		C-19
GSRD–Linear Radial		C-21
Gross Solids Removal		B-77
Multi-Chambered Treatment Train		C-23
Water Quality Inlet		
Oil/Water Separator		B-79

5.0 REFERENCES

Caltrans 2012. *Statewide Storm Water Management Plan* (SWMP). Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-12-286.19.1

Caltrans 2010. *Storm Water Quality Handbooks, Storm Water Project Planning and Design Guide*. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-10-254.03.

blank for double-sided printing

APPENDIX A: BMP FACT SHEET DESCRIPTION AND FORMAT

This appendix describes the content of the fact sheets in Appendices B and C. It also describes evaluation criteria for performance assessments. Each fact sheet is divided into a standard series of topics, which are described below in the order in which they occur in the fact sheets.

A.1 Header Information: BMP Category, Name and Quick Reference Symbols

The left side of the header contains a broad BMP category and more specific subcategory. If necessary, a more specific name is found on the right side. Reference symbols are located in the upper right corner of fact sheets. The symbols and the attributes they represent follow:

Special material handling requirements or potential toxicity

Power is required for this technology

Vactor equipment recommended for maintenance

Vector concern because of standing water

A.2 BMP Description

The BMP description provides a summary of the configuration of the BMP and a general overview of the treatment process, how the BMP operates, and considerations that need to be addressed to promote maximum treatment effectiveness and functionality.

A.3 Constituent Removal

This section identifies the constituents expected to be removed by the BMP when present at levels typical of Caltrans stormwater runoff. The groups of constituents examined were previously identified as pollutants of concern (Caltrans 2010).

A.3.1 Constituent Groups

Estimates of the technology's performance removal abilities are made for each of the following constituent groups:

- Sediment (total suspended solids [TSS])
- Total nitrogen

- Total phosphorus
- Pesticides
- Total metals
- Dissolved metals
- Microbiological (including pathogens)
- Litter
- Biochemical oxygen demand (BOD)
- Total dissolved solids (TDS)

A.3.2 Constituent Removal

Unapproved BMPs

The fact sheets for BMPs that are not approved (Appendix B) report whether removal is expected for each of the 10 constituents (or constituent groups) listed in A.3.1. For a given constituent:

- A check mark is used if the removal efficiency is statistically significant or expected to be based on best professional judgment.
- A blank cell is used if there is insufficient data or the removal efficiency is not statistically significant.

Approved BMPs

The fact sheets for approved BMPs (Appendix C) report both constituent removal and level of confidence. The level of confidence reflects the certainty that the reported performance is applicable to typical Caltrans conditioning (e.g., influent concentrations). The level of confidence is based on the quality of monitoring studies. To ensure that data is of the highest quality, stormwater monitoring must be conducted according to scientific procedures, such as those listed in the *Stormwater Monitoring Protocols* (Caltrans 2003a), or equivalent protocols. The level of confidence assessments are defined as:

High: The constituent removal information came from either the Department's research or a study that met the Department's quality assurance and quality control monitoring protocols. Test conditions were typical of the Department's facilities and all of the following criteria were met:

- Full-scale field testing of a stabilized (erosion-free) post-construction transportation-related impervious drainage area
- Sampling and analysis in accordance to the *Guidance Manual: Stormwater Monitoring Protocols* (Caltrans 2003a), or other recognized protocol, such as that required for the International BMP Database (www.bmpdatabase.org)
- Testing at flow rates and volumes typical of Caltrans' drainage areas (areas vary, but usually are between 0.1 and 15 acres. Flow and volumes can be found by using Caltrans' Basin Sizer [www.owp.csus.edu/research/stormwatertools/])

- Mean influent concentrations below the 90th percentile of statewide characterization data (see Table A-1)
- At least eight storm events over a minimum period of two years, but data must also demonstrate a statistically significant removal ($p \leq 0.1$), which may require monitoring additional storm events
- Particle size distribution (PSD) similar to the proposed field conditions (e.g., state whether or not traction sand was applied)
- A mean removal estimate that corroborates the performance claim

Further, the study report must include the following:

- Rainfall record for the study area or its vicinity during the evaluation period
- Operation and maintenance records and costs for the evaluation period

Table A-1. The 90th Percentile Concentrations of Select Constituents.

Constituent	Units	90th percentile*	Constituent	Units	90th percentile*
TDS	mg/L	200	Ammonia nitrogen	mg/L as N	1.4
TSS	mg/L	300	Total Kjeldahl Nitrogen (TKN)	mg/L as N	4.4
Oil & Grease	mg/L	6.6	Nitrate	mg/L as N	2
Copper (dissolved)	µg/L	30	Phosphorus (dissolved)	mg/L as P	0.37
Copper (total)	µg/L	80	Phosphorus (total)	mg/L as P	0.84
Lead (dissolved)	µg/L	7	Orthophosphate	mg/L as P	0.3
Lead (total)	µg/L	100	Diazinon	µg/L	0.4
Zinc (dissolved)	µg/L	140	Diuron	µg/L	11
Zinc (total)	µg/L	400	Glyphosate	µg/L	50
			Pyrene	µg/L	0.96

* 90th percentile is the concentration at which 90% of all measurements are below. These values were estimated from Appendix B of the *Caltrans Discharge Characterization Study Report*, CTSW-RT-06-065 (Caltrans 2003b).

Alternatively, a high score is assigned to infiltration or reuse BMP technologies that provided "no discharge" to surface waters under design conditions. Constituent removal was assumed to be 100 percent removal although it was recognized that certain large storm events would not receive full treatment, and that infiltration may not provide complete removal of constituents for discharge to groundwater or subsequent re-entry to surface waters.

Medium: The criteria for a high level of confidence were not completely met; however, one of the following must apply:

- Statistically significant (p-value $\leq$ 0.1) constituent removal was established from independent stormwater field monitoring for at least one year
- Removal efficiency based on best professional evaluation of unit operations and processes that are well established for treatment of other waters
- Load reduction of nutrients or BOD due to partial infiltration
- Statistically significant (p-value $\leq$ 0.1) constituent removal was established from independent laboratory testing that follows the Technology Assessment Protocol – Ecology (TAPE) from Washington State (ECY 2008), and testing used a volume of water equivalent to one year of runoff for a typical installation. Alternatively, a laboratory loading using actual stormwater could be used as with the Tahoe Small Scale Research Facility (http://www.dot.ca.gov/hq/env/stormwater/ongoing/tahoe/index.htm).

Low: There are no available data or available data do not meet the above criteria for medium level of confidence assessment. For example, a manufacturer's performance claim, without supporting data, would get a low score.

Notes:

This section gives a brief explanation, if necessary, of the logic used to score approved BMP technologies for both removal efficiency and level of confidence.

A.4 Caltrans Evaluation Status [Appendix C Only]

This section documents the BMP's stage in the evaluation process.

A.5 Schematic

If appropriate, a schematic figure is provided to depict a typical installation, design plan, or a cross-section that identifies major components of the BMP.

A.6 Key Design Elements

This section identifies important design considerations that have been highlighted by vendors or discovered through testing. Ancillary facilities to be used in conjunction with each technology are also listed in this section. An example would be including a detention basin downstream of a chemical treatment technology to capture flocculated particles.

A.7 Advantages and Constraints

These sections list additional advantages and constraints of the BMP that are not covered in the previous sections. Information presented may include impacts from hydrologic characteristics and weather conditions in California, experiences from actual installations, and expansion of particular points discussed in previous sections of the fact sheet.

A.8 Cost Effectiveness Relative to Detention Basins [Appendix C Only]

This section provides an assessment of cost and pollutant removal effectiveness of approved BMPs relative to that for detention basins. Use this section for general comparisons of overall cost effectiveness but not for cost effectiveness comparison for treatment of an individual constituent. Detention basins were chosen because they are common BMPs that have relatively well-established cost and performance information. Relative cost assessments include the cost to build, operate, and maintain each BMP. Two pieces of information are provided on BMP costs:

- General assessment of the BMP's overall costs compared to detention basins
- Level of confidence in the available data

A.8.1 Cost Effectiveness Assessment

The cost for each BMP was assessed in terms of its 20-year, present worth cost relative to detention basins. The baseline cost of a detention basin is $673/m^3 of water quality volume (1999 dollars), as reported in Appendix D of the *BMP Retrofit Pilot Program* (Caltrans 2004, p. 14-14). The effectiveness of each BMP was also assessed in terms of its overall constituent removal expectations relative to a detention basin. A four-quadrant system was used as a tool to rate each BMP(e.g., One of the four quadrants is shaded based on the rating key (see Figure A-1). If the overall constituent removal was greater than that for detention basins, then the BMP was marked as having a greater benefit. Because of a multitude of constituents, this assessment is often based on the best professional judgment rather than on an overall numeric efficiency score.

Benefit	↑	**Benefit**	↑
Cost	↓	**Cost**	↑
Benefit	↓	**Benefit**	↓
Cost	↓	**Cost**	↑

Figure A-1. Rating Key for Cost Effectiveness.

Due to a lack of cost data for BMPs constructed in the highway environment, the relative cost to detention basins was estimated based on the size and complexity of the technology compared to a detention basin sized for the same drainage area. If annual cost data are available, the 4% discount rate over 20 years results in an annual cost multiplication factor of 13.59. The resulting 20-year, present worth cost is the average annual cost times the 13.59 multiplication factor plus the construction cost. Planning, design, and right-of-way costs are not included.

A.8.2 Level of Confidence

The level of confidence in the costs to build and operate a BMP depends on the type and quantity of information found in the literature. Use of cost information developed for municipal stormwater programs was not considered to be directly relevant to the Department's facilities.

The right-of-way costs and construction costs of major highway transportation projects are typically much greater than the typical suburban street or arterial road that might be constructed by a municipal public works department. Furthermore, operations and maintenance costs of facilities along major freeways are typically much more expensive than similar municipal facilities because of limited access and the need for traffic control. The level of confidence was assessed in terms of being high, medium, or low. The criteria applied for defining the confidence level of the cost estimates were:

- *High:* Unit cost information was available from a facility constructed by the Department or a similar state's department of transportation.
- *Medium*: Cost information was available from several similar facilities constructed under municipal stormwater programs or conservative costs estimates indicate an obvious unit cost difference compared to a detention basin.
- *Low*: No cost information was available from a similar BMP facility that could be independently verified. Construction costs were extrapolated from available pricing information.

The level of confidence only applies to cost since the level of confidence in the benefit of the BMP is evaluated in the "Constituent Removal" section of the fact sheets.

A.9. Issues and Concerns

This section presents issues and concerns to be considered when evaluating the appropriateness of a BMP for any of the Department's facilities. This information is divided into two categories: maintenance and project development. Within each category is a standard set of topics.

A.9.1 Maintenance Issues

- *Requirements:* Summarizes major maintenance tasks required to keep the BMP functional.
- *Special Training:* Identifies special or unusual training required to perform the maintenance, if applicable.

A.9.2 Project Development Issues

- *Right-of-Way Requirements:* Identifies relative space required to install the BMP.
- *Siting Constraints:* Identifies unique siting considerations and limitations, such as soil types, slope of the land, and distance from existing infrastructure or other natural features, power requirements, and regulatory requirements. Common siting constraints, such as maintenance access, are not listed.
- *Construction:* Identifies unique construction precautions and requirements, such as unwanted soil compaction, if applicable.

A.10 Design, Construction, Maintenance, and Cost Sources

This section lists design, construction, maintenance, and cost sources.

A.11 Performance Demonstration Literature Sources [Appendix C Only]

This section provides the references from which performance was evaluated for approved BMPs. It also contains a limited number of additional performance references.

A.12 Certifications, Verifications, or Designations [Appendix C Only]

This section lists the abbreviated names of selected state or federal agencies or cooperatives that issue statements of performance based on third-party review of test results. Agency abbreviations that are used in the fact sheets are defined below, along with a brief explanation of the performance statements typically made by each agency.

TAPE: Technology Assessment Protocol, Ecology

The Washington State Department of Ecology (Ecology) uses TAPE to designate levels of allowed BMP use based on performance. The three designated use levels described below relate to the confidence that Ecology has in a technology's ability to meet various performance goals.

- PULD: The "pilot use level designation" allows limited installations of promising technologies for the purpose of data collections.
- CULD: The "conditional use level designation" allows widespread use within a time period in which testing must be completed to make a determination for GULD.
- GULD: The "general use level designation" indicates that the technology has been proven compliant with TAPE's performance goals.

There are six performance goals that could apply to the designated use level. Brief summaries follow:

- *Basic treatment*: Requires 80% removal of influent TSS between 100 and 200 mg/L and an effluent limit of 20 mg/L for influent TSS less than 100 mg/L.
- *Enhanced treatment or metals treatment*: Requires performance levels to be significantly higher than basic treatment. Influent metals must fall within 0.003 to 0.02 mg/L for dissolved copper and between 0.02 to 0.3 mg/L for dissolved zinc.
- *Phosphorus treatment*: Requires 50% reduction of phosphorus with an influent range of 0.1 to 0.5 mg/L.
- *Oil treatment*: Requires no discharge of visible sheen or of concentrations above 10 mg/L (composite) or 15 mg/L (grab).

- *Pretreatment*: Requires 50% reduction of TSS influent between 100 and 200 mg/Land an effluent limit of 50 mg/L for TSS influent below 100 mg/L.

- *ETV*: Environmental Technology Verification, Environmental Protection Agency The ETV verifies performance under specific conditions and explicitly states that performance under any other condition may be different. ETV reviews are performed by cooperative agreement with the National Sanitation Foundation (NSF International).

NJCAT: New Jersey Corporation for Advanced Technology

NJCAT provides technical review of field studies and provides performance verification statements. NJCAT works with the Technology Acceptance and Reciprocity Partnership (TARP), which has been endorsed by the states of California, Massachusetts, Maryland, New Jersey, Pennsylvania, and Virginia.

NJDEP: New Jersey Department of Environmental Protection

NJDEP certifies TSS removal based on NJCAT verification reports.

LA RWQCB: Los Angeles Regional Water Quality Control Board

LA RWQCB issues Full Capture Certifications for trash TMDL compliance.

TCEQ: Texas Committee on Environmental Quality

TCEQ approves BMPs that are appropriate for the protection of sole-source groundwater resources.

References

Caltrans 2003a. *Caltrans Comprehensive Protocols Guidance Manual*. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-03-105.51.42.

Caltrans 2003b. *Discharge Characterization Study Report*. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-03-065.

Caltrans 2004. *BMP Retrofit Pilot Program Final Report*. Sacramento: Caltrans, Division of Environmental Analysis. p. 14-14. CTSW-RT-01-050.

Caltrans 2010. *Storm Water Quality Handbooks, Storm Water Planning and Design Guide*. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

Department of Ecology (ECY), Washington State. 2008. *Guidance for Evaluating Emerging Stormwater Treatment Technologies*. Publication number 02-10-037. Retrieved January 17, 2009 from http://www.ecy.wa.gov/pubs/0210037.pdf.

APPENDIX B: TECHNOLOGY FACT SHEETS

This appendix presents fact sheets for technologies that have *not* been approved by the Department. Evaluation of these technologies is ongoing and may be revised in future reports. The evaluations presented were derived from a review of available information and best professional judgment was used where information was lacking.

TABLE OF CONTENTS

BMP Category	Stormwater Technology	Page No.
Bioretention		B-3
	Linear Bioretention Trench	B-5
	Tree Box Filter	B-7
Detention/Sedimentation		
Chemical Treatment		B-9
Electrocoagulation		B-11
Permanent Pool		B-13
	Vegetated Rock Filter	B-15
Plate and Tube Settlers		B-17
Temporary Pool		B-19
	Hold and Release	B-21
	Infiltration Chambers	B-23
	Skimmer	B-25
Disinfection		
Chemical Treatment		B-27
Ultraviolet		B-29
Drain Inlet Insert		
Baffle Box		B-31
Basket/Box	Baffled Filtration Box	B-33
	GSR Basket (Mechanically Removed)	B-35
Fabric		B-37
Media		B-39
Screen		B-41
Skimmer		B-43
Filtration		
Bed		B-45
	Austin Filter with Alternative Media	B-47
	DC Sand Filter	B-49
	Infiltration Chambers	B-51
	Linear Filter Trench	B-53
	Media Filter Drain	B-55
Cartridge/Canister		B-57
Fabric		B-59
Pressure		B-61
Hydrodynamic Separator		B-63
Infiltration		
Below Grade		B-65
	Linear Infiltration Trench	B-67

BMP Category	Stormwater Technology	Page No.
Porous Surface		
Asphalt Overlay		B-69
Asphalt Pavement		B-71
Concrete Pavement		B-73
Permeable Pavers/Cellular Confinement		B-75
Screening		
Gross Solids Removal		B-77
Water Quality Inlet		
Oil/Water Separator		B-79

BMP Fact Sheet

Bioretention

Description

Bioretention cells consist of vegetated depressions that treat runoff by filtering through mulch and soil-based media. Physical straining, biological and chemical reactions in the mulch, root zone, and soil matrix, and infiltration into the underlying subsoil are the main treatment processes. Bioretention cells reduce peak discharge and runoff volume by detaining water through surface ponding and storage in soil and gravel layers, and by allowing it to infiltrate into the subsoil or dissipate through evapotranspiration.

Constituent Removal

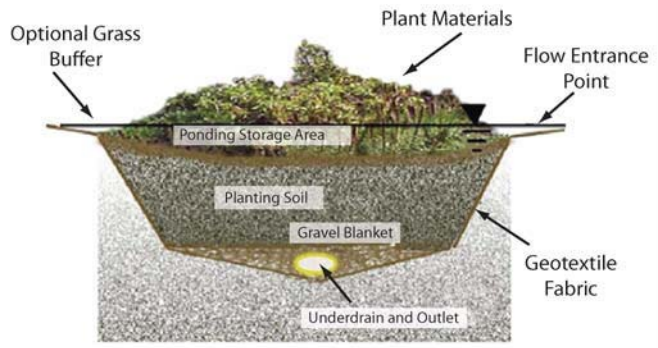
Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	✓
Total Phosphorus	✓
Pesticides	✓
Total Metals	✓
Dissolved Metals	✓
Microbiological	✓
Litter	✓
Biochemical Oxygen Demand (BOD)	✓
Total Dissolved Solids (TDS)	

* Based on performance of conventional bioretention systems or best professional judgment. Blank cells indicate data not available or poor treatment performance. Small bioretention systems operating at relatively high loading rates and/or with shallow media or soil depth may not provide treatment as indicated.

Advantages

- Pollutant removal effectiveness is typically high
- Can provide an aesthetic vegetated appearance
- Reduces peak discharge and runoff volume
- Can fit into narrow right-of-way

Schematic



Source: Maryland Water Resources Research Center

Key Design Elements

- Bioretention area and depth
- Water quality flow
- Ponding depth
- Underground drain system
- Vegetation
- Bioretention media
- Liner, if high seasonal groundwater

Constraints

- In areas with prolonged dry periods, vegetation may require irrigation
- Vegetation may develop slowly in a biorentention facility, though filtering still occurs

Maintenance Issues

Requirements:

- Periodic replacement of mulch and planting media
- Maintenance of irrigation system, if used in dry areas

Special Training:

Unknown

Project Development Issues

Right-of-Way Requirements:

Linear biotrench configuration is designed to fit narrow right-of-way

Siting Constraints:

May need irrigation in dry areas, depending on plant selection

Construction:

- Plant establishment period may be required
- Water should bypass until construction is complete and the BMP is stabilized

Design, Construction, Maintenance, and Cost Sources

US EPA. 1999. Stormwater Technology Fact Sheet: Bioretention. EPA 832-F-99-012.

Caltrans. 2003. SR-73 Stormwater BMP Replacement Project at CSF System 1149L Bioretention Area: Basis of Design Report. Division of Environmental Analysis. CTSW-RT-03-006.51.39.

Center for Watershed Protection. 2000. Bioretention as a Stormwater Treatment Practice. The Practice of Watershed Protection, Article 110, 548-550.

Engineering Technologies Associates (ETA). Design Manual for Use of Bioretention in Stormwater Management. Prepared for Prince George's County, Department of Environmental Resources, Maryland.

NCHRP. 2006a. Low Impact Development Design Manual for Highway Runoff Control (LID Design Manual). National Cooperative Highway Research Program, Project 25-20(01).

NCHRP. 2006b. User's Guide for BMP/LID Selection (Guidelines Manual). National Cooperative Highway Research Program, Project 25-20(01).

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

- DeepRoot® Silva Cell
- TreePod® Biofilter
- Filterra® Bioretention System
- UrbanGreen™ Biofilter

Alternative Designs

- Bioretention Basin
- Linear Bioretention Trench

Bioretention

Linear Biorentention Trench

Description

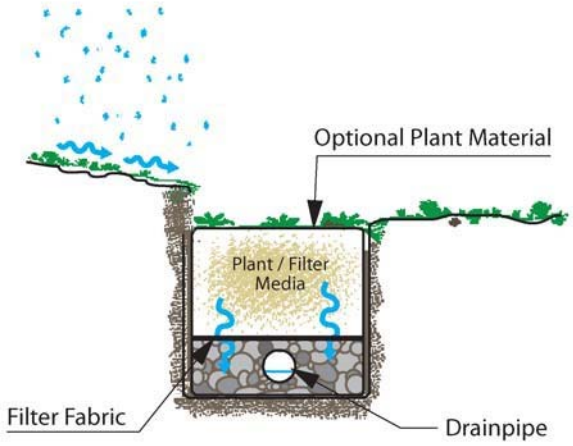
Bioretention cells consist of vegetated depressions that treat runoff by filtering through mulch and soil-based media. Physical straining, biological and chemical reactions in the mulch, root zone, and soil matrix, and infiltration into the underlying subsoil are the main treatment processes. A linear bioretention trench is an adaptation of existing biofiltration designs, consisting of a trench that filters sheet flow runoff through vegetation and a planting soil. It is designed for the narrow right-of-way typical of roadside areas. Removal mechanisms include filtration, infiltration, and plant uptake. Biofiltration strips can be used as pretreatment.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	✓
Total Phosphorus	✓
Pesticides	✓
Total Metals	✓
Dissolved Metals	✓
Microbiological	✓
Litter	✓
Biochemical Oxygen Demand (BOD)	✓
Total Dissolved Solids (TDS)	

* Based on performance of conventional bioretention systems or best professional judgment. Blank cells indicate data not available or poor treatment performance.

Schematic



Source: Caltrans

Key Design Elements

- Bioretention area and depth
- Water quality flow
- Ponding depth
- Underground drain system
- Vegetation
- Bioretention media
- Liner, if high seasonal groundwater

Advantages

- Fits in a narrow right-of-way
- Pollutant removal effectiveness is typically high
- Can provide an aesthetic vegetated appearance
- Reduces peak discharge and runoff volume

Constraints

- Vegetation may require irrigation in areas with prolonged dry periods
- Vegetation may develop slowly in a biorentention facility, though filtering still occurs
- If media clogs, resulting standing water may create mosquito habitat
- Avoid high groundwater
- Although narrow, could be a large footprint BMP depending on design constraints
- Maintenance activities may require traffic control

Linear Biorentention Trench

Maintenance Issues

Requirements:

- Periodic replacement of mulch or planting media
- Maintenance of irrigation system, if used in dry areas

Special Training:

Unknown

Project Development Issues

Right-of-Way Requirements:

Designed to fit in a narrow right-of-way

Siting Constraints:

- May need irrigation in dry areas, depending on plant selection
- Minimum head requirement of two feet

Construction:

- Vegetation establishment period may be required
- Water should bypass until construction is complete and the BMP is stabilized

Design, Construction, Maintenance, and Cost Sources

US EPA. 1999. Stormwater Technology Fact Sheet: Bioretention. EPA 832-F-99-012.

Caltrans. 2003. SR-73 Stormwater BMP Replacement Project at CSF System 1149L Bioretention Area: Basis of Design Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-03-006.51.39.

Center for Watershed Protection. 2000. Bioretention as a Stormwater Treatment Practice. The Practice of Watershed Protection, Article 110, 548-550.

Engineering Technologies Associates (ETA). Design Manual for Use of Bioretention in Stormwater Management. Prepared for Prince George's County, Department of Environmental Resources, Maryland.

NCHRP. 2006a. Low Impact Development Design Manual for Highway Runoff Control (LID Design Manual). National Cooperative Highway Research Program, Project 25-20(01).

NCHRP. 2006b. User's Guide for BMP/LID Selection (Guidelines Manual). National Cooperative Highway Research Program, Project 25-20(01).

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

Alternative Designs

Bioretention

Tree Box Filter

Description

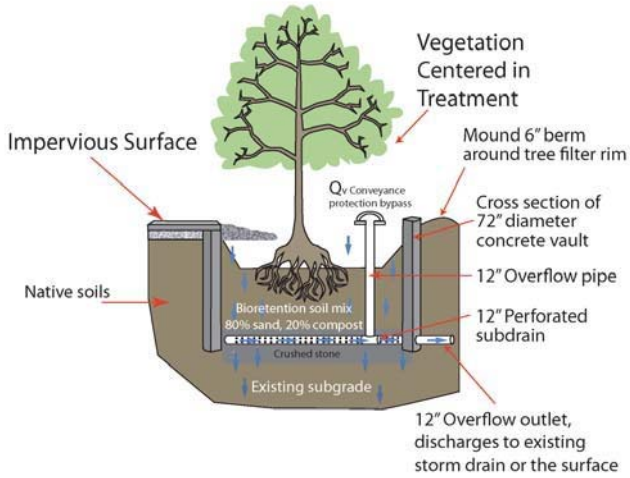
Bioretention cells consist of vegetated depressions that treat runoff by filtering through mulch and soil-based media. Physical straining, biological and chemical reactions in the mulch, root zone, and soil matrix, and infiltration into the underlying subsoil are the main treatment processes. Bioretention cells reduce peak discharge and runoff volume by detaining water through surface ponding and storage in soil and gravel layers, and by allowing it to infiltrate into the subsoil or dissipate through evapotranspiration. Tree box filters are mini bioretention systems that are typically installed along urban sidewalks.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	✓
Total Phosphorus	✓
Pesticides	✓
Total Metals	✓
Dissolved Metals	✓
Microbiological	✓
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on performance of conventional bioretention systems or best professional judgment. Blank cells indicate data not available or poor treatment performance. Small bioretention systems operating at relatively high loading rates and/or with shallow media or soil depth may not provide treatment as indicated.

Schematic



Source: University of New Hampshire Stormwater Center

Key Design Elements

- Bioretention area and depth
- Water quality flow
- Ponding depth
- Underground drain system
- Vegetation
- Bioretention media

Advantages

- Pollutant removal effectiveness is typically high
- Can provide an aesthetic vegetated appearance
- Reduces peak discharge and runoff volume
- Can fit into narrow right-of-way
- Small footprint bioretention devices such as tree box filters are most applicable in urban settings

Constraints

- In areas with prolonged dry periods, vegetation may require irrigation
- Vegetation may develop slowly in a biorentention facility, though filtering still occurs

Maintenance Issues

Requirements:

- Periodic replacement of mulch and planting media
- Maintenance of irrigation system, if used in dry areas

Special Training:

Unknown

Project Development Issues

Right-of-Way Requirements:

Tree box filters are small footprint devices that fit in sites where available space is limited

Siting Constraints:

May need irrigation in dry areas, depending on plant selection

Construction:

- Plant establishment period may be required
- Water should bypass until construction is complete and the BMP is stabilized

Design, Construction, Maintenance, and Cost Sources

US EPA. 1999. Stormwater Technology Fact Sheet: Bioretention. EPA 832-F-99-012.

Caltrans. 2003. SR-73 Stormwater BMP Replacement Project at CSF System 1149L Bioretention Area: Basis of Design Report. Division of Environmental Analysis. CTSW-RT-03-006.51.39.

Center for Watershed Protection. 2000. Bioretention as a Stormwater Treatment Practice. The Practice of Watershed Protection, Article 110, 548-550.

Engineering Technologies Associates (ETA). Design Manual for Use of Bioretention in Stormwater Management. Prepared for Prince George's County, Department of Environmental Resources, Maryland.

NCHRP. 2006a. Low Impact Development Design Manual for Highway Runoff Control (LID Design Manual). National Cooperative Highway Research Program, Project 25-20(01).

NCHRP. 2006b. User's Guide for BMP/LID Selection (Guidelines Manual). National Cooperative Highway Research Program, Project 25-20(01).

University of New Hampshire (UNH). 2008. Tree Box Filter. University of New Hampshire Stormwater Center. Http://www.unh.edu/erg/cstev/fact_sheets/tree_filter_fact_sheet_08.pdf (accessed January 20, 2010).

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

- DeepRoot® Silva Cell
- TreePod® Biofilter
- Filterra® Bioretention System
- UrbanGreen™ Biofilter

Alternative Designs

Chemical Treatment

Description

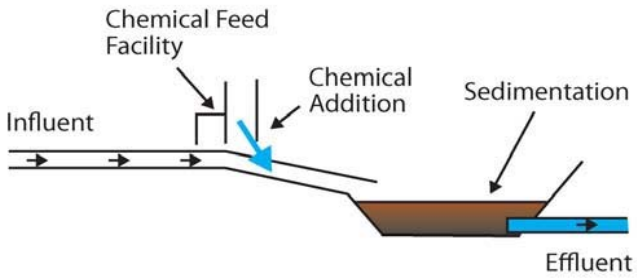
Adding chemical coagulants to stormwater influent can enhance removal of particulates, associated contaminants, and dissolved nutrients in a detention system. Chemical treatment results in floc formation, which increases the settling velocity of particles and improves sedimentation removal efficiencies. The effectiveness of this system largely depends on the type of chemical added, time allowed for sedimentation, and the particle size, density, and settling velocity of the floc that is produced. Typical chemicals used include alum, chitosan, and polyacrylamide (PAM). These chemicals are added either in liquid form upstream of the detention or as a solid (gel block) that is placed in the flow path.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	✓
Total Phosphorus	✓
Pesticides	
Total Metals	✓
Dissolved Metals	✓
Microbiological	✓
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on expected improvement over conventional dry detention basin performance. Blank cells indicate data not available or poor treatment performance. Small systems with relatively short detention times may not provide treatment as indicated.

Schematic



Source: Caltrans

Key Design Elements

- Chemical dose
- Chemical feed and storage facilities
- Chemical mixing facilities
- Capture volume and depth
- Drain time
- Debris screen to protect effluent control
- Maintenance access
- High flow routing

Advantages

- Increases performance of existing detention basins
- The accumulation rate of floc in sediments of quiescent receiving waters can be low due to floc consolidation over time and incorporation of floc into existing sediment
- Chemical treatment can remove nutrients, heavy metals, and fecal coliforms
- Dry alum sludge has chemical characteristics suitable for general land or agricultural application
- Construction costs for stormwater treatment feed systems are largely independent of the drainage area to be treated and depend primarily upon the number of outfalls to be retrofitted

Constraints

- Treated waters may require pH adjustment
- Safety issues related to the chemical storage facility need to be considered
- Alum forms voluminous metal hydroxides that are difficult to dewater
- Appropriate mixing must be provided at the point of chemical addition
- Sludge removal method and frequency need to be considered
- The optimum dose may vary with each storm
- Potential toxicity due to overdosing
- Requires higher level of operator observation than for other BMPs

Chemical Treatment

Maintenance Issues

Requirements:

- Chemical storage and dosing equipment must be inspected and maintained on a regular basis
- Effluent pH monitoring system must be maintained on a regular basis
- Sludge removal

Special Training:

- Training is required for maintenance of chemical addition and storage system
- Chemical handling

Project Development Issues

Right-of-Way Requirements:

- Small footprint for chemical addition system
- Downstream detention requirement increases footprint
- Other requirements as listed on the Detention Basin fact sheet (see Appendix C)

Siting Constraints:

- May require electrical power supply
- Space for a central housing unit and storage tank
- Need enough head for mixing
- Other requirements as listed on the Detention Basin fact sheet (see Appendix C)

Construction:

None identified

Design, Construction, Maintenance, and Cost Sources

Harper H.H. Current Research and Trends in Alum Treatment of Stormwater Runoff. Environmental Research & Design, Inc.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

None identified

Alternative Designs

None identified

Electrocoagulation

Description

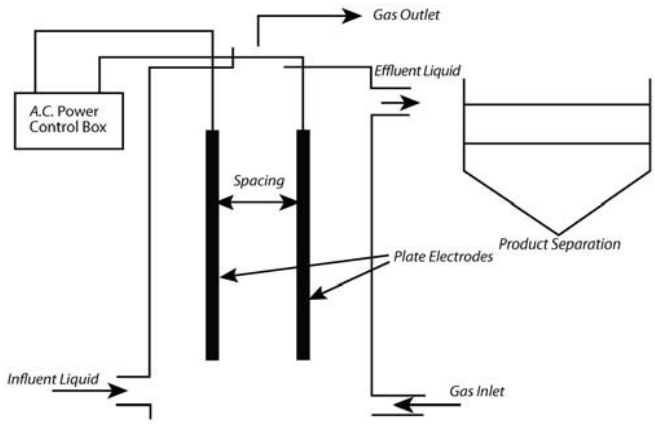
Electrocoagulation (EC) systems are effective for removal of emulsified oils, total petroleum hydrocarbons (TPH), suspended solids, and heavy metals from exceptionally polluted industrial wastewater and stormwater runoff. EC technology is an alternative to the use of chemical coagulants such as alum, metal salts, or polymers and polyelectrolyte addition(s). The EC process removes pollutants from aqueous media by introducing highly charged metal hydroxide species that neutralize suspended solids and oil droplets and facilitate agglomeration or coagulation. EC treatment is typically followed by sedimentation or filtration processes to remove flocculated material.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	
Total Phosphorus	✓
Pesticides	
Total Metals	✓
Dissolved Metals	
Microbiological	✓
Litter	
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on best professional judgment. Blank cells indicate data not available or poor treatment performance. Actual treatment will depend on a number of variables including current density, conductivity, and pollutant load of influent, as well as the type of electrodes.

Schematic



Source: EPA

Key Design Elements

- Facilities required upstream to capture runoff and provide flood flow routing and bypass
- Mode of operation (batch or continuous)
- Power supply
- Design flow
- Electrical conductivity of influent water
- Sludge storage and disposal
- Need for pretreatment
- Cleaning/replacement needs for electrodes
- Maintenance access

Advantages

- Sludge formed by EC tends to be readily settleable and easy to de-water because it is composed mainly of metallic oxides/hydroxides
- Gas bubbles produced during electrolysis can carry the pollutant to the top of the solution where it can be more easily concentrated, collected, and removed
- Electrolytic processes in the EC cell are controlled electrically with no moving parts
- EC may be feasible where electricity is not available if solar panels are used (Note: A 50 gpm EC system requires 480 volt power supply)

Constraints

- Sacrificial electrodes are dissolved into wastewater streams as a result of oxidation, and need to be regularly replaced
- Use of electricity may be expensive
- Impermeable oxide film may be formed on the cathode leading to loss of efficiency of the EC unit
- High conductivity of the water suspension is required
- Treated waters may have high pH, which may require remediation
- Potential toxicity concerns due to overdosing
- Requires higher level of operator observation than other BMPs

Electrocoagulation

Maintenance Issues

Requirements:

None identified

Special Training:

Requires training to maintain and operate equipment

Project Development Issues

Right-of-Way Requirements:

Space required for upstream capture and downstream sedimentation

Siting Constraints:

May require power nearby and, possibly, a sewer connection

Construction:

Significant capital costs and start-up/test requirements

Design, Construction, Maintenance, and Cost Sources

Beagles, A. 2004. Electrocoagulation - Science and Applications. http://www.eco-web.com/edi/index.htm (accessed October 19, 2009).

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

- E-Cell
- Kaselco EC
- FLUXCELL™
- Powell Water Systems EC

Alternative Designs

None identified

Permanent Pool

Description

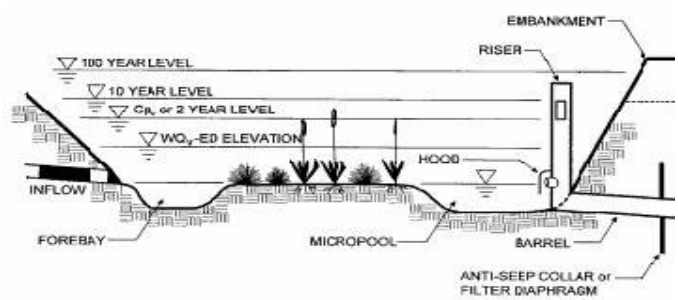
Detention systems provide treatment by detaining runoff to allow settling or sedimentation of particles under gravity. The effectiveness of these systems depends on the time allowed for sedimentation, the particle size, density, and settling velocity, and the extent to which contaminants are associated with the particulate fraction in the incoming water. In addition, systems with permanent pools support plant species that provide constituent removal by biological processes. The primary function of a permanent pool is energy dissipation and assuring a longer residence time for first flush of water. Examples of treatment systems with permanent pools include wet basins/ponds and constructed wetlands.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	✓
Total Phosphorus	
Pesticides	
Total Metals	✓
Dissolved Metals	✓
Microbiological	✓
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on conventional wet basin performance. Blank cells indicate data not available or poor treatment performance. Small permanent pool systems operating at relatively high loading rates may not provide treatment as indicated.

Schematic



Source: EPA

Key Design Elements

- Capture volume and depth
- Drawdown time
- Permanent pool to capture volume ratio
- Sedimentation forebay
- Vegetation
- Debris screen to protect effluent control
- Maintenance access
- High flow routing
- Liner requirements

Advantages

- Recreational and aesthetic benefits
- Enhances wildlife habitat
- High removal efficiencies for many constituents
- Particularly advantageous to first flush of storms

Constraints

- Relatively high construction costs in comparison to other BMPs
- Wetland must have a source flow
- Species may restrict maintenance
- There are potential problems associated with mosquitoes
- The device may become a regulated wetland if not consistently maintained on an established schedule
- Wet basins are larger than extended detention basins because of the additional volume of the permanent pool

Permanent Pool

Maintenance Issues

Requirements:

- Active management of the hydrology and vegetation during the first few years is necessary for plant establishment
- Mosquito fish planting or other vector control methods are needed
- Vegetation thinning or removal may be necessary for vector control, wildlife may limit activities to a particular season
- Sensitive species inspections
- Sediment removal (hand removal has been found to be more cost-effective than mechanical removal)
- Removing standing water for the dry season may be required if not augmented by dry weather flow

Special Training:

Unknown

Project Development Issues

Right-of-Way Requirements:

Space requirements are high for wet basins. The volume of the permanent pool should be at least three times the water quality volume

Siting Constraints:

- Soil should have a low infiltration rate or basin should be lined with a clay or geotextile liner so that water level is maintained in the basin
- Wet basins should be sited where a permanent pool of water can be maintained during the wet season
- Requires a minimum ten-foot separation between seasonal high groundwater and basin invert if a liner is not used

Construction:

- Plant establishment period is recommended
- Excavated soil surface should be suitable to support plant life
- If a pond liner is used, it must be carefully installed and maintained to avoid punctures

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

King County. 2005. Surface Water Design Manual, King County Surface Water Management Division, Washington. http://your.kingcounty.gov/dnrp/library/water-and-land/stormwater/surface-water-design-manual/SWDM-2009.pdf (accessed October 7, 2009).

NCHRP. 2006a. Low Impact Development Design Manual for Highway Runoff Control (LID Design Manual). National Cooperative Highway Research Program, Project 25-20(01).

NCHRP. 2006b. User's Guide for BMP/LID Selection (Guidelines Manual). National Cooperative Highway Research Program, Project 25-20(01).

Schueler, T. R. 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Washington, DC: Metropolitan Washington Council of Governments.

U.S. EPA. 1999. Wet Detention Pond Fact Sheet. EPA 832-F-99-048.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

- Airmaster Aerator
- AquaMaster®
- Kasco® Marine
- StormTreat™
- Aqua Control
- MWS Linear HYBRID
- SolarBee

Alternative Designs

- Vegetated wet channel
- Wet basin/pond
- Constructed wetland

Permanent Pool

Vegetated Rock Filter

Description

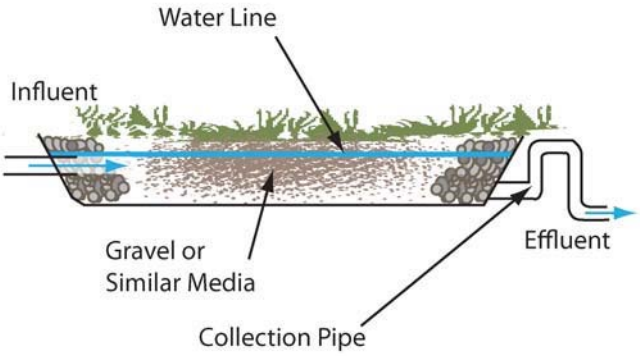
Detention systems provide treatment by detaining runoff to allow settling of particles under gravity. The effectiveness of these systems depends on the time allowed for settling, the particle size, density, and settling velocity, and the extent to which contaminants are associated with the particulate fraction in the incoming water. In addition, systems with permanent pools support plant species that provide constituent removal by biological processes. The Vegetated Rock Filter (also called Subsurface Wetland) consists of a sealed, shallow basin or channel filled with substrate media and emergent aquatic plants. The substrate, typically gravel, rock, or other material, provides support for plant and algae. Treatment is primarily accomplished via settling, biological uptake by plants, and microbial breakdown. An alternative to a basin configuration is a linear trench configuration which is more suitable for roadside application.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	✓
Total Phosphorus	
Pesticides	
Total Metals	✓
Dissolved Metals	✓
Microbiological	✓
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on conventional wet basin performance. Blank cells indicate data not available or poor treatment performance.

Schematic



Source: Caltrans

Key Design Elements

- High flow routing
- Media type and depth
- Liner requirements
- Forebay or other pretreatment method
- Permanent pool to capture volume ratio
- Maintenance access

Advantages

- Enhances aesthetics and wildlife habitat
- High removal efficiencies for many constituents
- Particularly advantageous to first flush of storms
- Minimal vector concerns because permanent water level is below the surface

Constraints

- Relatively high construction costs compared to other BMPs
- Must have a continuous source flow to maintain plant community
- Wildlife may restrict maintenance
- May become a regulated wetland if not consistently maintained on an established schedule
- Larger than an extended detention basin because of the additional volume of the permanent pool
- Requires long-term maintenance to remove metals and persistent organics that accumulate in sediments
- Anaerobic conditions may increase biological availability of some metals (e.g. methyl mercury)

Permanent Pool

Vegetated Rock Filter

Maintenance Issues

Requirements:

- Active management of the hydrology and vegetation during the first few years is necessary for plant establishment
- Vegetation thinning or removal may be necessary, but wildlife may limit such activities to a particular season
- Sensitive species inspections
- Inspect the gravel bed annually for sediment build-up. Remove sediment periodically
- Check inlet and outlet devices for clogging during the rainy season

Special Training:
Unknown

Project Development Issues

Right-of-Way Requirements:
Space requirements are high because of the volume of the permanent pool

Siting Constraints:
- Located on sites with less than two percent slope
- Soil should have a low infiltration rate or basin should be lined with a clay or geotextile liner so that water level is maintained in the basin
- Site where a permanent pool of water can be maintained
- Requires a minimum ten-foot separation between seasonal high groundwater and basin invert if a liner is not used

Construction:
- Plant establishment period is recommended
- Media surface should be suitable to support plant life
- If a pond liner is used, it must be carefully installed and maintained to avoid punctures

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

King County. 2005. Surface Water Design Manual, King County Surface Water Management Division, Washington. http://your.kingcounty.gov/dnrp/library/water-and-land/stormwater/surface-water-design-manual/SWDM-2009.pdf (accessed October 7, 2009).

NCHRP. 2006. User's Guide for BMP/LID Selection (Guidelines Manual). National Cooperative Highway Research Program, Project 25-20(01).

San Francisco Stormwater Design Guidelines Draft. 2009. http://sfwater.org/Files/FactSheets/DRAFT_AppenA.pdf (accessed November 18, 2009).

Schueler, T. R. 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Washington, DC: Metropolitan Washington Council of Governments.

US EPA. 1999. Wet Detention Pond Fact Sheet. EPA 832-F-99-048.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

Alternative Designs

BMP Fact Sheet

Detention/Sedimentation

Plate and Tube Settlers

Description

Plate and tube settlers typically consist of parallel plates or inclined tubes that permit solids to reach the plate or tube after only short distances of settling. This reduction in the distance particles must travel increases the rate of sedimentation. The effectiveness of these systems depends on the time allowed for sedimentation (controlled by the effective overflow rate), the particle size, density, and settling velocity, and the extent to which contaminants are associated with the particulate fraction in the incoming water. Sedimentation in the first chamber of an Austin sand filter or in a concrete detention basin can be improved by installing a plate or tube settler.

Constituent Removal

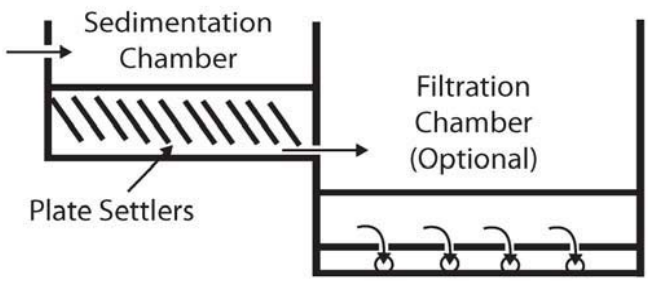
Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	
Total Phosphorus	✓
Pesticides	
Total Metals	✓
Dissolved Metals	
Microbiological	
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on conventional dry detention basin performance. Blank cells indicate data not available or poor treatment performance. Small plate and tube settlers operating at very high overflow rates may not provide treatment as indicated.

Advantages

- Enhances particle removal of detention/sedimentation BMPs
- May reduce footprint of a detention/sedimentation BMP or Austin sand filter when used as pretreatment
- May decrease maintenance frequency of downstream filters

Schematic



Source: Caltrans

Key Design Elements

- Effective overflow rate
- Size and mounting of plates or tubes
- Sludge collection and removal facilities
- Pretreatment for litter
- Maintenance access
- High flow routing

Constraints

- Maintenance is more difficult than in an open basin. May require confined space entry and hand cleaning of tubes or plates
- Water must be introduced so that it flows uniformly through the settlers
- Settled particulates can be resuspended if critical velocity is exceeded
- Requires litter removal before passing water through tubes or plates
- Other constraints as listed on the Detention Basin fact sheet (see Appendix C)

Detention/Sedimentation

Plate and Tube Settlers

Maintenance Issues

Requirements:

- Cleaning and maintenance of the plate or tube settlers may require removal of the settler structure
- May require hand cleaning of tubes or plates
- Litter may get trapped in the settler structure

Special Training:

Training may be required for confined space entry

Project Development Issues

Right-of-Way Requirements:

Reduces right-of-way requirements for a detention basin or Austin sand filter when used as pretreatment

Siting Constraints:

Similar to siting constraints for a detention basin or Austin sand filter (see Appendix C)

Construction:

None identified

Design, Construction, Maintenance, and Cost Sources

Terre Hill Concrete Products. www.terrestorm.com (accessed November 2, 2009).

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

- Hydro Quip IPS
- Terre Kleen™
- Lamella® Gravity Settler

Alternative Designs

None identified

BMP Fact Sheet

Detention/Sedimentation

Temporary Pool

Description

Detention systems provide treatment by detaining runoff to allow settling or sedimentation of particles under gravity. The effectiveness of these systems depends on the time allowed for sedimentation, the particle size, density, and settling velocity, and the extent to which contaminants are associated with the particulate fraction in the incoming water. Treatment systems with temporary pools, which are normally dry between events, include above ground dry detention ponds/basins and below grade storage.

Constituent Removal

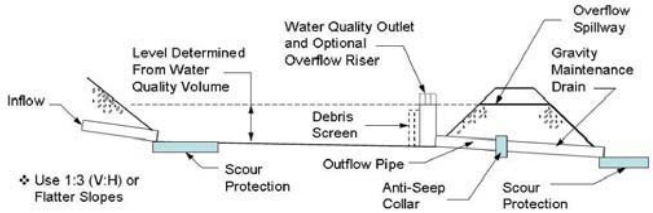
Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	
Total Phosphorus	✓
Pesticides	
Total Metals	✓
Dissolved Metals	
Microbiological	
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on conventional dry detention basin performance. Blank cells indicate data not available or poor treatment performance. Small systems with relatively short detention times may not provide treatment as indicated.

Advantages

- Relatively easy to operate and maintain
- Potential for substantial infiltration
- Can be sited more easily than Austin sand filters

Schematic



Source: Caltrans

Key Design Elements

- Capture volume and depth
- Drain time
- Debris screen to protect effluent control
- Maintenance access
- High flow routing

Constraints

- Limited pollutant removal for fine particles, nutrients, and dissolved constituents
- Can only be placed in areas with sufficient hydraulic head
- If outlet clogs, resulting standing water may create mosquito habitat
- May require confined space entry for below grade storage
- May require liner in areas with high seasonal groundwater

Detention/Sedimentation

Temporary Pool

Maintenance Issues

Requirements:

- Regular inspections for standing water, side slope stability, debris and sediment accumulation, and vegetative cover
- If vegetative cover is not established to acceptable thresholds, re-seeding or erosion control measures may need to be implemented
- Sediment removal

Special Training:

Training for confined space entry for below ground facilities

Project Development Issues

Right-of-Way Requirements:

Space requirements are relatively high

Siting Constraints:

- Site where there is sufficient hydraulic head to facilitate complete drainage
- Requires separation between seasonal high groundwater and basin invert if liner not used

Construction:

Minimize compaction of underlying soils to maintain infiltration capacity

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

NCHRP. 2006a. Low Impact Development Design Manual for Highway Runoff Control (LID Design Manual). National Cooperative Highway Research Program, Project 25-20(01).

NCHRP. 2006b. User's Guide for BMP/LID Selection (Guidelines Manual). National Cooperative Highway Research Program, Project 25-20(01).

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

- Con/Storm™
- Extention Basin™
- StormTrap™
- Watermann™
- Corrugated Pipe (various suppliers)
- Faircloth Skimmer®
- Thirsty Duck
- Weir Guard™

Alternative Designs

- Hold & Release Detention
- Detention Basin
- Skimmer

BMP Fact Sheet

Detention/Sedimentation

Temporary Pool

Hold and Release

Description

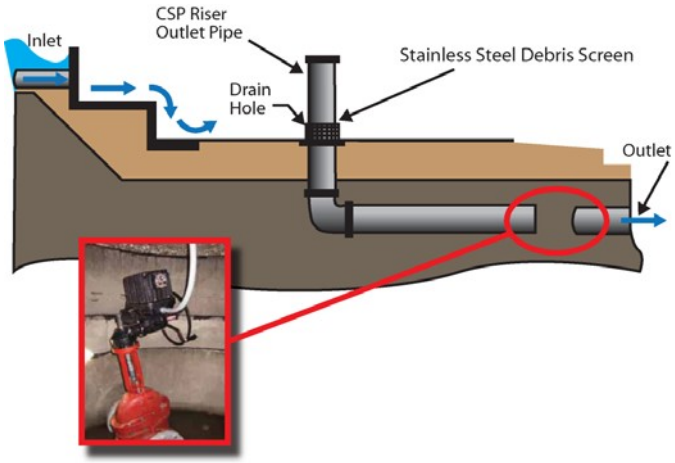
Detention systems provide treatment by detaining runoff to allow settling or sedimentation of particles under gravity. The effectiveness of these systems depends on the time allowed for sedimentation, the particle size, density, and settling velocity, and the extent to which contaminants are associated with the particulate fraction in the incoming water. Hold and release valves located on the outlet of the detention basin are used to provide a consistent detention time for a variety of storm sizes. Valves can be powered electrically or pneumatically. The timing of valve operations is adjusted by a logic controller and water depth sensors. Hold and release valves can also be used for infiltration basins in poorly infiltrating soils because they allow water that does not infiltrate to drain.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	✓
Total Phosphorus	✓
Pesticides	
Total Metals	✓
Dissolved Metals	
Microbiological	
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on field test results by Middleton and Barrett (2006) and removals observed for conventional dry detention basins. Blank cells indicate data not available or poor treatment performance.

Schematic



Source: Caltrans

Key Design Elements

- Valve type and size
- Power and controls system for operating outlet bladder or valve
- Maintenance access

Advantages

- Treatment for TSS and total metals is comparable to sand filtration, but with lower footprint and head requirements
- Increased infiltration potential compared to conventional detention basins

Constraints

- Reliability unknown
- Electric valves require power supply
- Pneumatic valves require high pressure gas source
- Orifice clogging may cause standing water, resulting in mosquito habitat
- Requires inspection and maintenance of hold and release valves, controller, and power supply

Maintenance Issues

Requirements:

- Valves and controller require inspection and periodic replacement. Determine inspection frequency during the first few years of operation
- Maintenance of battery sources and gas cylinders, if used

Special Training:
Training is required to inspect and maintain electric and pneumatic systems

Project Development Issues

Right-of-Way Requirements:
Similar to right-of-way requirements listed on the Detention Basin fact sheet (see Appendix C)

Siting Constraints:
- Equivalent to detention basin siting constraints
- Requires power supply

Construction:
Unknown

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2001. Detention Basin Optimization - Reconnaissance Study Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-029, pp. 3-7.

Caltrans. 2004. District 12 State Route 73 Pilot Program - Detention Basin Optimation and Retrofit. Basis of Design Report. CTSW-RT-04-090.09.1.

Middleton, J. R., J. F. Malina, and M. E. Barrett. 2006. Water Quality Performance of a Batch Type Stormwater Detention Basin. Center for Research in Water Resources On-Line Report 06-02. http://www.crwr.utexas.edu/reports/pdf/2006/rtp06-02.pdf (accessed November 6, 2009).

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

Alternative Designs

BMP Fact Sheet

Detention/Sedimentation

Temporary Pool

Infiltration Chambers

Description

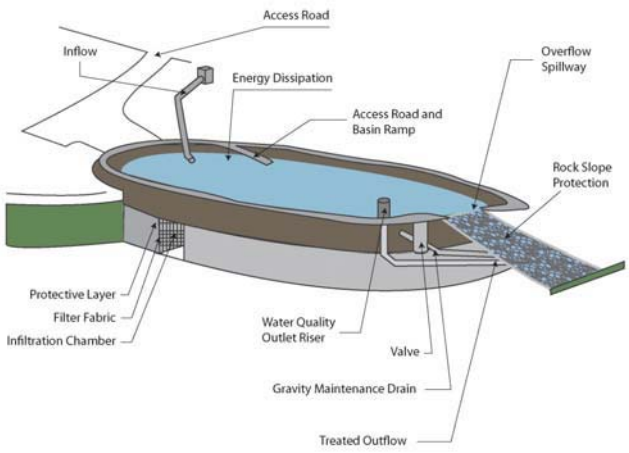
Detention systems provide treatment by detaining runoff to allow settling of particles under gravity. The effectiveness of these systems depends on the time allowed for settling, the particle size, density, and settling velocity, and the extent to which contaminants are associated with the particulate fraction in the incoming water. Treatment systems with temporary pools, which are normally dry between events, include above ground dry detention ponds/basins and below grade temporary storage. Infiltration chambers is a concept developed by Caltrans to increase infiltration in conventional BMPs. The addition of infiltration chambers below the invert of earthen detention systems is expected to capture and infiltrate the first flush of stormwater runoff. These infiltration chambers can consist of gravel, high porosity storage media with a sand overlay, or native soil that has been amended to improve infiltration. In soils that infiltrate well, raising the riser orifice may provide the same treatment benefit as the installation of infiltration chambers.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	
Total Phosphorus	✓
Pesticides	
Total Metals	✓
Dissolved Metals	
Microbiological	
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on conventional dry detention basin performance. Blank cells indicate data not available or poor treatment performance. Small systems with relatively short detention times may not provide treatment as indicated.

Schematic



Source: Caltrans

Key Design Elements

- Soil type and permeability
- Infiltration chamber volume capacity
- Infiltration chamber material (high porosity storage media, gravel, amended soil, etc.)
- High flow routing
- Capture volume and depth
- Drain time
- Debris screen to protect effluent control
- Maintenance access

Advantages

- Potential for substantial infiltration, even in poorly infiltrating soils
- Expected to improve treatment of fine particles, nutrients, and dissolved constituents relative to conventional detention

Constraints

- Not suitable in areas with high seasonal groundwater
- Increases construction and rehabilitation costs relative to conventional detention basins
- If outlet clogs, resulting standing water may create mosquito habitat

Maintenance Issues

Requirements:

- Regular inspections for standing water, side slope stability, debris and sediment accumulation, and vegetative cover
- May require construction equipment to rehabilitate clogged system
- If vegetative cover is not established to acceptable thresholds, re-seeding or erosion control measures may need to be implemented
- Sediment removal

Special Training:
Unknown

Project Development Issues

Right-of-Way Requirements:
Space requirements are the same as for conventional detention systems

Siting Constraints:
- Site where there is sufficient hydraulic head to facilitate drainage through the outlet riser
- Requires separation between seasonal high groundwater and basin invert

Construction:
- Minimize compaction of underlying soils to maintain infiltration capacity
- Bypass water until drainage area is stabilized

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

Caltrans. 2008. Adding Infiltration Chambers to Approved Best Management Practices: Concept Development. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSWRT-TM-08-172-46.1.

NCHRP. 2006a. Low Impact Development Design Manual for Highway Runoff Control (LID Design Manual). National Cooperative Highway Research Program, Project 25-20(01).

NCHRP. 2006b. User's Guide for BMP/LID Selection (Guidelines Manual). National Cooperative Highway Research Program, Project 25-20(01).

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

Alternative Designs

BMP Fact Sheet

Detention/Sedimentation

Temporary Pool

Skimmer

Description

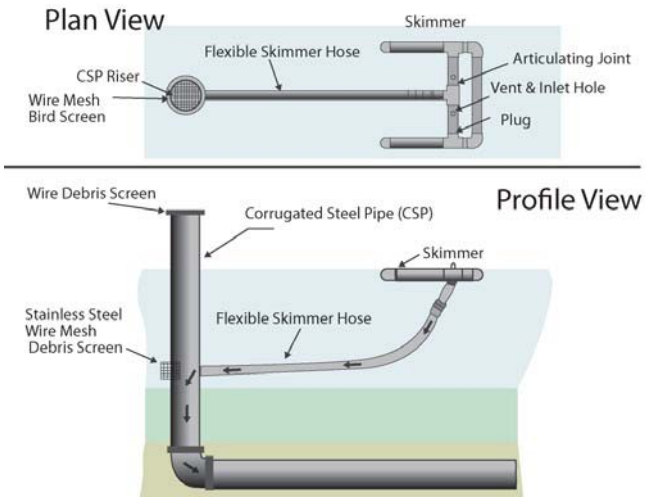
Detention systems provide treatment by detaining runoff to allow settling or sedimentation of particles under gravity. The effectiveness of these systems depends on the time allowed for sedimentation, the particle size, density, and settling velocity, and the extent to which contaminants are associated with the particulate fraction in the incoming water. Treatment systems with temporary pools, which are normally dry between events, include above ground dry detention ponds/basins and below grade storage. A skimmer drains water from just below the water's surface in a detention basin to improve sedimentation. Captured water is decanted to create a longer flow path compared to basins that drain from the invert.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	
Total Phosphorus	✓
Pesticides	
Total Metals	✓
Dissolved Metals	
Microbiological	
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on conventional dry detention basin performance. Blank cells indicate data not available or poor treatment performance.

Schematic



Source: Caltrans

Key Design Elements

- Means of removing water when skimmer is at its lowest position
- Orifice sizing of the skimmer
- Durability of materials used to construct skimmer
- Maintenance access

Advantages

- Potentially increased removal of suspended solids
- Can retain free oil and grease because clarified water is decanted from just below the water's surface

Constraints

- Limited pollutant removal for fine particles and dissolved constituents
- Secondary outlet may be required to drain water completely
- Prone to clogging by vegetation
- If clogged, resulting standing water can create mosquito habitat
- Frequent inspections may be required

Maintenance Issues

Requirements:

- Valves and controller require inspection and periodic replacement. Determine inspection frequency during the first few years of operation
- Maintenance includes removal of vegetation attached to skimmer to prevent clogging

Special Training:
Unknown

Project Development Issues

Right-of-Way Requirements:
Similar to right-of-way requirements listed on the Detention Basin fact sheet (see Appendix C)

Siting Constraints:
Similar to siting constraints listed on the Detention Basin fact sheet (see Appendix C)

Construction:
None identified

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2001. Detention Basin Optimization - Reconnaissance Study Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-029, pp. 3-7.

Caltrans. 2004. District 12 State Route 73 Pilot Program - Detention Basin Optimation and Retrofit. Basis of Design Report. CTSW-RT-04-090.09.1.

Jarrett, A. R. 2008. Controlling the Dewatering of Sedimentation Basins. Fact Sheet F253. Agricultural and Biological Engineering. College of Agricultural Sciences, Cooperative Extension. U.S. Department of Agriculture and Pennsylvania Counties Cooperating. University Park, PA.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

Alternative Designs

Chemical Treatment

Description

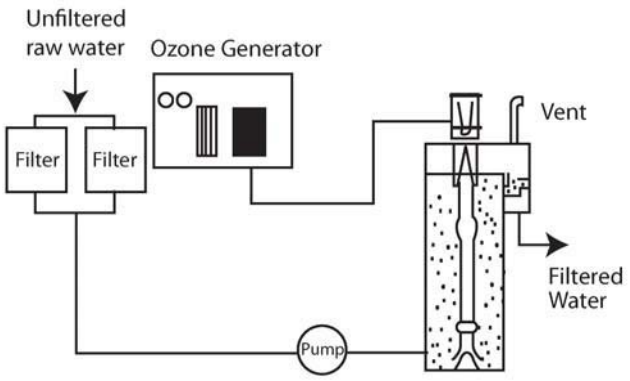
Chemical disinfection of stormwater can be achieved by the addition of a liquid (e.g., hypochlorous acid solution) or a gas (e.g., ozone). The basic treatment system consists of a chemical generation/storage system, a contact chamber, and a quenching chamber to remove residual chemical. For many years, chemical disinfection systems have been used successfully for inactivating pathogens and other microbial contaminants in drinking water and wastewater. For intermittent wet weather flow, a pretreatment device and an equalization/storage basin may be required.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	
Total Nitrogen	
Total Phosphorus	
Pesticides	
Total Metals	
Dissolved Metals	
Microbiological	✓
Litter	
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on performance for drinking water and wastewater disinfection. Blank cells indicate data not available or poor treatment performance. Small disinfection systems operating at relatively high flow rates may not provide treatment as indicated.

Schematic



Source: UN Food and Agricultural Organization

Key Design Elements

- Chemical dose and contact time
- Chemical feed and storage facilities
- Mixing facilities
- Pretreatment to remove particles is required to achieve reliable disinfection
- Contact time must be provided in a contact basin or sedimentation basin downstream
- Quenching system may be required

Advantages

- Specific use guidelines available
- Proven effectiveness on microbial contaminants
- Mosquitoes are not an issue with chlorinated water
- Ozone is a strong disinfectant and has a limited number of by-products
- Low doses are required to complete disinfection
- Low residual ozone concentration in the treated effluent, minimizing impact on receiving waters
- Although ozone systems are complex, use of instrumentation makes the process automated and reliable

Constraints

- Declorination may be required to prevent harmful effects to receiving waters
- Pretreatment (e.g., removal of suspended solids, and oil and grease) required
- Requires special handling procedures and chemical storage tank on site
- Some organics may be converted to other (possibly more harmful) products
- Ozone must be produced on site because it cannot be stored
- Ozonation technology has a very high energy requirement
- Some ozonation by-products may be harmful to the receiving water
- Ozone escaping to the atmosphere may contribute to air pollution problems
- Ozone diffusers can be damaged easily by debris and sediments

Chemical Treatment

Maintenance Issues

Requirements:

- Mechanical equipment must be maintained
- Chemicals must be replenished
- Chemical concentration must be monitored
- Check generators daily when in operation
- Manual start-up of the ozone generator is preferable because it needs to be purged before each start-up

Special Training:

- Needed for special materials handling
- Needed for inspection and maintenance of the chemical dosing system, mixing chamber, and other design elements
- Needed for operation and maintenance of gas feed system, ozone generator, and contact chamber

Project Development Issues

Right-of-Way Requirements:

- Space requirements will depend on size of contact chamber needed to accommodate design flow
- Pretreatment space required for sedimentation, filtration, and equalization of design flow

Siting Constraints:

- Restricted to sites with available power

Construction:

- Avoid sediments in the contact chamber during construction
- May have start-up and testing requirements

Design, Construction, Maintenance, and Cost Sources

James M. Montgomery Consulting Engineers. 1985. Water Treatment Principles and Design. New York: Wiley.

PCI-Wedeco Environmental Technologies. One Fairfield Crescent, West Caldwell, NJ 07006.

U.S. EPA. 1999. Alternative Disinfectants and Oxidants Guidance Manual. Office of Water. EPA 815-R-99-014.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

- Biocide Fabric
- Klorigen™
- ClorTec®
- Osec®

Alternative Designs

None identified

Ultraviolet

Description

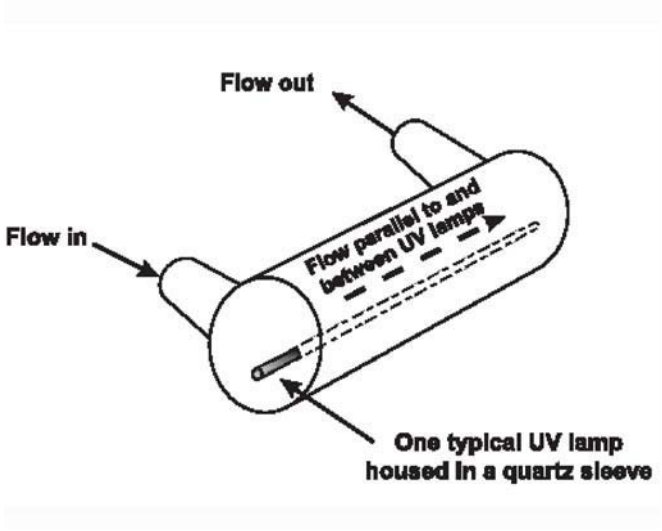
Ultraviolet (UV) light disinfects water by altering the genetic material (i.e., DNA) in the cells of bacteria, viruses, and other microorganisms so that they can no longer reproduce or infect. In UV disinfection systems, the light is produced by germicidal lamps enclosed in a pressure vessel or submerged in a water channel. As the water flows past the UV lamps, the microorganisms are exposed to a lethal dose of UV energy. The UV dose is the product of the light intensity and contact time. The UV disinfection treatment is downstream of pretreatment BMPs, such as a Multiple Chamber Treatment Train (MCTT) or a media filter.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	
Total Nitrogen	
Total Phosphorus	
Pesticides	
Total Metals	
Dissolved Metals	
Microbiological	✓
Litter	
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on performance for dry weather flow treatment (City of Santa Monica). Blank cells indicate data not available or poor treatment performance. Small disinfection systems operating at relatively high flow rates may not provide treatment as indicated.

Schematic



Source: EPA

Key Design Elements

- Light intensity and contact time
- Hydraulic system for moving water past lamps
- Facilities for cleaning lamps
- Pretreatment to remove particles is required to achieve reliable disinfection

Advantages

- Natural process that disinfects without chemicals and has low maintenance requirements
- Automated operations and controls
- Compact system with a small footprint compared to other disinfection technologies
- Suitable for retrofit to existing BMPs
- No impact on other processes following UV treatment
- No chemical residual, minimizing impact to receiving waters

Constraints

- Pretreatment requirement may be substantial
- Clumping microorganisms can impact disinfection by harboring pathogens in the aggregates
- Specific design parameters vary for individual waters (UV transmittance)
- Under certain conditions, some organisms are capable of repairing damaged DNA and reverting back to an active state to reproduce (photoreactivation). This can be minimized by shielding the process stream or limiting the exposure of disinfected water to sunlight immediately following disinfection
- Organic and inorganic fouling usually occurs on UV lamp sleeves. Inorganic fouling, which is related to high lamp temperature, is the most difficult to clean because inorganics, such as iron and manganese, bind to the quartz sleeve

Ultraviolet

Maintenance Issues

Requirements:

- Each lamp must be cleaned periodically-typically every two weeks for wastewater discharges, but probably less frequently for intermittent stormwater discharges
- Lamps have a short life span and may require frequent replacement
- Pumps must be maintained

Special Training:

Trained staff is required for mechanical equipment maintenance

Project Development Issues

Right-of-Way Requirements:

May be compact, but pretreatment space requirement may be large

Siting Constraints:

- Restricted to sites with power available nearby
- Requires a volume-capture BMP to provide flow control

Construction:

Significant start-up and testing requirements

Design, Construction, Maintenance, and Cost Sources

City of Santa Monica. 2009. Urban Runoff Water Quality Monitoring. http://www01.smgov.net/epd/scpr/EnvironmentalPubllicHealth/EPH8_UrbanRunoff.htm (accessed October 8, 2009).

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

- Aqua UltraViolet Viper Series
- WEDECO TAK
- Siemens Barrier® Series

Alternative Designs

None identified

Baffle Box

Description

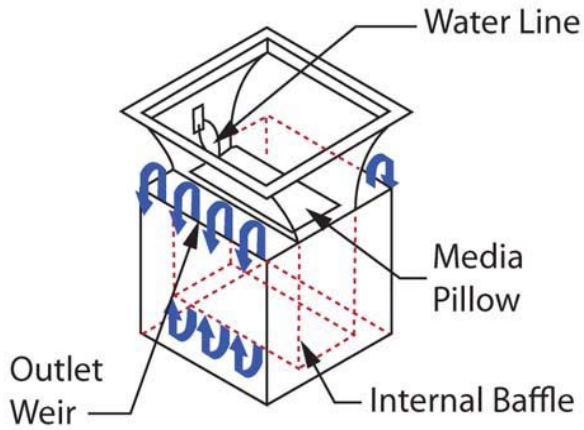
Drain inlets inserts, also known as catch basin or curb inlet inserts, are used to remove pollutants at the point of entry to the storm drain system. The effectiveness of drain inlet inserts depends on their design and on the frequency of maintenance to remove accumulated litter and sediment. Baffle type inserts utilize a series of baffles to force water to flow upwards before it is discharged, resulting in sedimentation of larger particles within the insert. Some inserts are designed to drop directly into existing drain inlets, while others may require attachment to drain inlet walls.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	
Total Phosphorus	
Pesticides	
Total Metals	
Dissolved Metals	
Microbiological	
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on best professional judgment. Blank cells indicate data not available or poor treatment performance. Some inserts may not provide treatment depending on size, configuration, and baffle specifications.

Schematic



Source: Caltrans

Key Design Elements

- Hydraulic capacity and pollutant storage capacity
- Provision for overflow or bypass

Advantages

- Range of sizes can be retrofitted to storm drain requirements
- The device can be installed relatively easily in new and existing facilities without structural modification
- Suitable for areas with low volume traffic, such as Park and Ride lots

Constraints

- Standing water of some products may create mosquito habitat
- A Caltrans study (2004) discourages the use of drain inlet inserts along highway drain inlets due to safety considerations
- High flows may flush accumulated material
- Capacity (size of basket) is constrained by the size of the drain inlet to be retrofitted
- May require frequent monitoring and maintenance because of limited capacity
- Maintenance activities may require traffic control if the device is installed along the traveled way

Baffle Box

Maintenance Issues

Requirements:

- Frequent inspection and maintenance may be required
- Vector control or abatement may be required

Special Training:

Unknown

Project Development Issues

Right-of-Way Requirements:

Installed within a stormwater inlet

Siting Constraints:

- Requires a grated drop inlet
- A previous Caltrans study (2004) of drain inlet inserts suggests limiting deployment to maintenance stations due to safety considerations

Construction:

A watertight installation of the product is important to capture low flows

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2004. BMP Retrofit Pilot Program Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-050.

US EPA. 2002. Storm Water O&M Fact Sheet, Catch Basin Cleaning. EPA 832-F-99-011.

NCHRP. 2006a. Low Impact Development Design Manual for Highway Runoff Control (LID Design Manual). National Cooperative Highway Research Program, Project 25-20(01).

University of Arkansas. 2003. Environmental Technology Verification Report of the Low-Cost Stormwater BMP Study. Civil Engineering Research Foundation (CERF) and the University of Arkansas.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

Hydro-Cartridge

Alternative Designs

None identified

Basket/Box

Baffled Filtration Box

Description

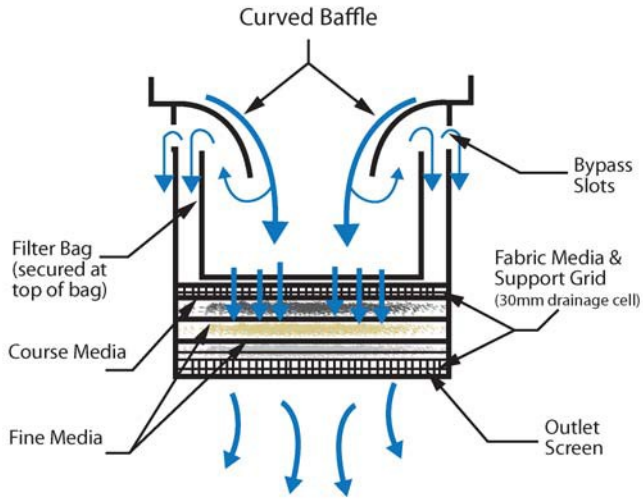
Drain inlets inserts, also known as catch basin or curb inlet inserts, are used to remove pollutants at the point of entry to the storm drain system. The effectiveness of drain inlet inserts depends on their design and on the frequency of maintenance to remove accumulated litter and sediment. The baffled filtration box is a non-proprietary open-bottom filtration drain inlet insert that is designed to optimize sedimentation, filtration, and adsorption. A curved baffle directs flows into a filter bag made of a non-woven geotextile fabric. Surface filtration occurs as water flows through the geotextile. Sedimentation occurs as water flow exceeds the capacity of the fabric bag and spills over the sides. Water flowing through the fabric and overtopping the bag is further filtered by an arrangement of fabric and media at the bottom of the insert. Adsorption of different pollutants varies according to the media used. Overflow is allowed through bypass slots below the inlet.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	
Total Phosphorus	
Pesticides	
Total Metals	
Dissolved Metals	
Microbiological	
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on laboratory testing by the Office of Water Programs at Sacramento State (unpublished preliminary results) and best professional judgment. Blank cells indicate data not available or poor treatment performance. Some inserts may not provide treatment depending on size, configuration, and media specifications.

Schematic



Source: Sacramento State, Office of Water Programs

Key Design Elements

- Hydraulic capacity and pollutant storage capacity
- Provision for overflow or bypass to avoid flooding when the insert is full or clogged
- Geotextile type
- Media type, grain size, area, and depth

Advantages

- Range of sizes can be retrofitted to storm drain requirements
- Can be installed relatively easily in new and existing facilities without much structural modification
- Suitable for areas with low volume traffic, such as Park and Ride lots

Constraints

- Device can clog, resulting in standing water that may create mosquito habitat
- A Caltrans study (2004) discourages the use of drain inlet inserts along highway drain inlets due to safety considerations
- Accumulated solids may be flushed out by high flows
- Capacity is constrained by the size of the drain inlet to be retrofitted
- May require frequent monitoring and maintenance because of limited capacity and potential clogging issues
- Maintenance activities may require traffic control if the device is installed along the traveled way

Basket/Box

Baffled Filtration Box

Maintenance Issues

Requirements:

- Frequent inspection and maintenance may be required, depending on solids loading and media grain size/area
- Vector control or abatement may be required

Special Training:
Unknown

Project Development Issues

Right-of-Way Requirements:
Install within a stormwater inlet

Siting Constraints:
- Requires a grated drop inlet
- A previous Caltrans study (2004) of drain inlet inserts suggests limiting deployment to maintenance stations due to safety considerations

Construction:
A watertight installation of the product is important to capture low flows

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2004. BMP Retrofit Pilot Program Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-050.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

Alternative Designs

BMP Fact Sheet

Drain Inlet Insert

Basket/Box

GSR Basket (Mechanically Removed)

Description

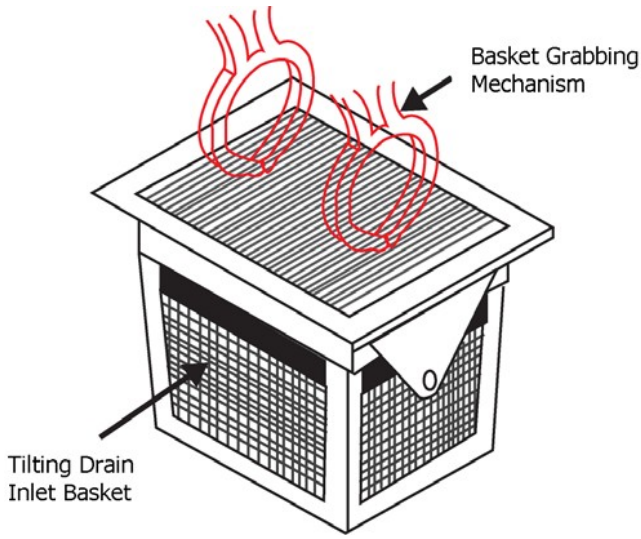
Drain inlets inserts, also known as catch basin or curb inlet inserts, are used to remove pollutants at the point of entry to the storm drain system. The effectiveness of drain inlet inserts depends on their design and on the frequency of maintenance to remove accumulated litter and sediment. The GSR Basket is a non-proprietary concept developed by Caltrans that is similar to other basket inserts that rest on the sidewalls of standard drain inlets. This insert has an integrated drop inlet grate, and a unique design that allows for automated removal of the entire basket by mechanisms similar to those used by garbage trucks. Flood flow bypass would occur by overflowing the basket.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	
Total Nitrogen	
Total Phosphorus	
Pesticides	
Total Metals	
Dissolved Metals	
Microbiological	
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on best professional judgement. Blank cells indicate data not available or poor treatment performance.

Schematic



Source: Caltrans

Key Design Elements

- Hydraulic capacity and pollutant storage capacity
- Provision for overflow or bypass to avoid flooding when the insert is full or clogged
- Screen type, area, and opening size
- Maintenance access

Advantages

- Maintenance can be simple and quick
- The device can be installed relatively easily in new and existing facilities without structural modification
- Suitable for areas with low traffic volumes, such as Park and Ride lots

Constraints

- Capacity (size of basket) is constrained by the size of the drain inlet to be retrofitted
- A Caltrans study (2004) discourages the use of drain inlet inserts along highway drain inlets due to safety considerations
- High flows may flush accumulated material
- May require frequent monitoring and maintenance because of limited capacity
- Maintenance activities may require traffic control if the device is installed along the traveled way

Maintenance Issues

Requirements:

- Frequent inspection and maintenance may be required if there is high solids loading (often caused by vegetation within the drainage area)
- Specially modified garbage trucks
- Vector control or abatement may be required

Special Training:
Operator training is necessary to operate mechanized removal equipment

Project Development Issues

Right-of-Way Requirements:
Install within a stormwater inlet

Siting Constraints:
- Requires a curb inlet
- A previous Caltrans study (2004) of drain inlet inserts suggests limiting deployment to maintenance stations due to safety considerations

Construction:
Replaces the inlet grate

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2004. BMP Retrofit Pilot Program Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-050.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

Alternative Designs

BMP Fact Sheet

Drain Inlet Insert

Fabric

Description

Drain inlets inserts, also known as catch basin or curb inlet inserts, are used to remove pollutants at the point of entry to the storm drain system. The effectiveness of drain inlet inserts depends on their design and on the frequency of maintenance to remove accumulated litter and sediment. Inserts typically consist of a filtering medium such as fabric, sand, or other media. Fabric type inserts utilize a fabric bag to capture gross solids and provide filtration. Some inserts are designed to drop directly into existing drain inlets, while others may require attachment to drain inlet walls.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	
Total Phosphorus	
Pesticides	
Total Metals	
Dissolved Metals	
Microbiological	
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on best professional judgment. Blank cells indicate data not available or poor treatment performance. Some inserts may not provide treatment depending on size, configuration, and fabric specifications.

Schematic

Source: Delaware Department of Transportation

Key Design Elements

- Hydraulic capacity and pollutant storage capacity
- Provision for overflow or bypass
- Fabric type, area, number of layers, and apparent opening size

Advantages

- Range of sizes can be retrofitted to storm drain requirements
- The device can be installed relatively easily in new and existing facilities without structural modification
- Suitable for areas with low volume traffic, such as Park and Ride lots

Constraints

- Device can clog resulting in standing water that may create mosquito habitat
- A Caltrans study (2004) discourages the use of drain inlet inserts along highway drain inlets due to safety considerations
- Accumulated solids may be flushed out by high flows
- Capacity is constrained by the size of the drain inlet to be retrofitted
- May require frequent monitoring and maintenance because of limited capacity and potential clogging issues
- Maintenance activities may require traffic control if the device is installed along the traveled way

Drain Inlet Insert

Fabric

Maintenance Issues

Requirements:

- Frequent inspection and maintenance may be required, depending on solids loading, fabric type, and fabric area
- Vector control or abatement may be required

Special Training:

Unknown

Project Development Issues

Right-of-Way Requirements:

Installed within a stormwater inlet

Siting Constraints:

- Requires a grated drop inlet
- A previous Caltrans study (2004) of drain inlet inserts suggests limiting deployment to maintenance stations due to safety considerations

Construction:

A watertight installation of the product is important to capture low flows

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2004. BMP Retrofit Pilot Program Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-050.

US EPA. 2002. Storm Water O&M Fact Sheet, Catch Basin Cleaning. EPA 832-F-99-011.

NCHRP. 2006a. Low Impact Development Design Manual for Highway Runoff Control (LID Design Manual). National Cooperative Highway Research Program, Project 25-20(01).

University of Arkansas. 2003. Environmental Technology Verification Report of the Low-Cost Stormwater BMP Study. Civil Engineering Research Foundation (CERF) and the University of Arkansas.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

- Catch-All
- DrainPac™
- FloGard+PLUS®
- Sewer Eco-Collar
- Ultra-Drain Guard®
- Water Decontaminator WD-10X18A
- Drain Diaper™
- Ecosol™ RSF 100
- SeaLife Saver®
- StreamSaver™
- Flexstorm Inlet Filter

Alternative Designs

None identified

BMP Fact Sheet

Drain Inlet Insert

BMP Fact Sheet

Drain Inlet Insert

Media

Description

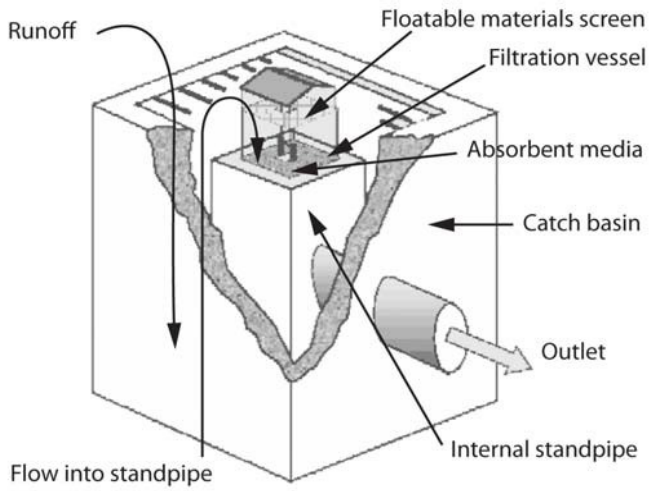
Drain inlets inserts, also known as catch basin or curb inlet inserts, are used to remove pollutants at the point of entry to the storm drain system. The effectiveness of drain inlet inserts depends on their design and on the frequency of maintenance to remove accumulated litter and sediment. Inserts typically consist of a filtering medium such as fabric, sand, or other media. Media type inserts use granular inert or absorbent media in bags/pillows, canisters, or trays. Some inserts are designed to drop directly into existing drain inlets, while others may require attachment to drain inlet walls.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	
Total Phosphorus	
Pesticides	
Total Metals	
Dissolved Metals	
Microbiological	
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on best professional judgment. Blank cells indicate data not available or poor treatment performance. Some inserts may not provide treatment depending on size, configuration, and media specifications.

Schematic



Source: Connecticut Stormwater Quality Manual (2004).

Key Design Elements

- Hydraulic capacity and pollutant storage capacity
- Provision for overflow or bypass
- Media type, grain size, area, and depth

Advantages

- Range of sizes can be retrofitted to storm drain requirements
- The device can be installed relatively easily in new and existing facilities without structural modification
- Suitable for areas with low volume traffic, such as Park and Ride lots

Constraints

- Device can clog resulting in standing water that may create mosquito habitat
- A Caltrans study (2004) discourages the use of drain inlet inserts along highway drain inlets due to safety considerations
- Accumulated solids may be flushed out by high flows
- Capacity is constrained by the size of the drain inlet to be retrofitted
- May require frequent monitoring and maintenance because of limited capacity and potential clogging issues
- Maintenance activities may require traffic control if the device is installed along the traveled way

Media

Maintenance Issues

Requirements:

- Frequent inspection and maintenance may be required, depending on solids loading and media grain size/area
- Vector control or abatement may be required

Special Training:

Unknown

Project Development Issues

Right-of-Way Requirements:

Installed within a stormwater inlet

Siting Constraints:

- Requires a grated drop inlet
- A previous Caltrans study (2004) of drain inlet inserts suggests limiting deployment to maintenance stations due to safety considerations

Construction:

A watertight installation of the product is important to capture low flows

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2004. BMP Retrofit Pilot Program Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-050.

US EPA. 2002. Storm Water Technology Fact Sheet, Sorbent Materials in Storm Water Applications. EPA 832-F-02-020.

US EPA. 2002. Storm Water O&M Fact Sheet, Catch Basin Cleaning. EPA 832-F-99-011.

NCHRP. 2006a. Low Impact Development Design Manual for Highway Runoff Control (LID Design Manual). National Cooperative Highway Research Program, Project 25-20(01).

University of Arkansas. 2003. Environmental Technology Verification Report of the Low-Cost Stormwater BMP Study. Civil Engineering Research Foundation (CERF) and the University of Arkansas.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

- Aqua Filtration Unit
- Clean Way
- EcoSense™
- Envirosafe™
- Inceptor®
- Piranha
- SIFT Filter™
- StormBasin®/StormPod®
- Triton Curb Inlet Filter™
- Triton TT3 Filter™ (Trench Drain)
- Aqua-Guardian™
- Diamond-Flow™
- Enviro-Drain®
- Hydro-Kleen™
- Manhole Filter
- Raynfiltr®
- Storm PURE™
- Triton Catch Basin Filter™
- Triton T-DAM Filter™ (Trench Drain)
- Ultra-Urban® Filter

Alternative Designs

Baffled Filtration Box

BMP Fact Sheet

Drain Inlet Insert

Screen

Description

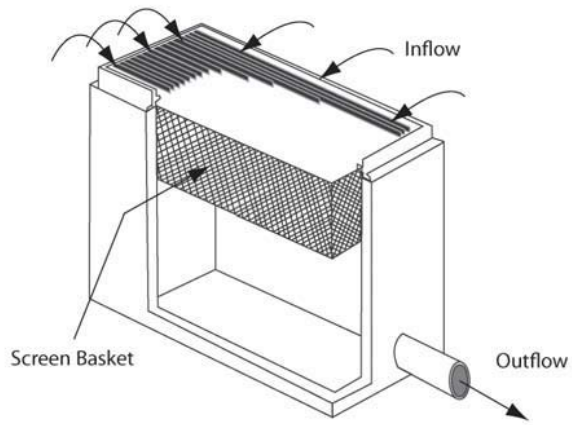
Drain inlets inserts, also known as catch basin or curb inlet inserts, are used to remove pollutants at the point of entry to the storm drain system. The effectiveness of drain inlet inserts depends on their design and on the frequency of maintenance to remove accumulated litter and sediment. Inserts typically consist of a filtering medium such as fabric, sand, or other media. Screen type inserts utilize one or more screens to filter out gross solids and coarse particulates. Some inserts are designed to drop directly into existing drain inlets, while others may require attachment to catch basin sidewalls.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	
Total Nitrogen	
Total Phosphorus	
Pesticides	
Total Metals	
Dissolved Metals	
Microbiological	
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on best professional judgment. Blank cells indicate data not available or poor treatment performance. Some inserts may not provide treatment depending on size, configuration, and screen specifications.

Schematic



Source: Caltrans

Key Design Elements

- Hydraulic capacity and pollutant storage capacity
- Provision for overflow or bypass
- Screen type, area, and opening size

Advantages

- Range of sizes can be retrofitted to storm drain requirements
- Some configurations can be installed relatively easily in new and existing facilities without structural modification
- Suitable for areas with low volume traffic, such as Park and Ride lots

Constraints

- Capacity (size of basket) is constrained by the size of the drain inlet to be retrofitted
- A Caltrans study (2004) discourages the use of drain inlet inserts along highway drain inlets due to safety considerations
- Maintenance activities may require traffic control if the device is installed along the traveled way
- High flows may flush accumulated material
- May require frequent monitoring and maintenance because of limited capacity

Drain Inlet Insert

Screen

Maintenance Issues

Requirements:

● Frequent inspection and maintenance may be required if there is high solids loading (often caused by vegetation within the drainage area)
● Vector control or abatement may be required

Special Training:

Unknown

Project Development Issues

Right-of-Way Requirements:

Installed within a stormwater inlet

Siting Constraints:

● Requires a curb inlet
● A previous Caltrans study (2004) of drain inlet inserts suggests limiting deployment to maintenance stations due to safety considerations

Construction:

● May require attachment to sidewalls
● A watertight installation is important to capture low flows

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2004. BMP Retrofit Pilot Program Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-050.

US EPA. 2002. Storm Water O&M Fact Sheet, Catch Basin Cleaning. EPA 832-F-99-011.

NCHRP. 2006a. Low Impact Development Design Manual for Highway Runoff Control (LID Design Manual). National Cooperative Highway Research Program, Project 25-20(01).

University of Arkansas. 2003. Environmental Technology Verification Report of the Low-Cost Stormwater BMP Study. Civil Engineering Research Foundation (CERF) and the University of Arkansas.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

- ClearWater BMP
- Grate Inlet Skimmer Box
- SuperFlo II Downspout
- Curb Inlet Basket
- HydroScreen

Alternative Designs

GSR Basket

Skimmer

Description

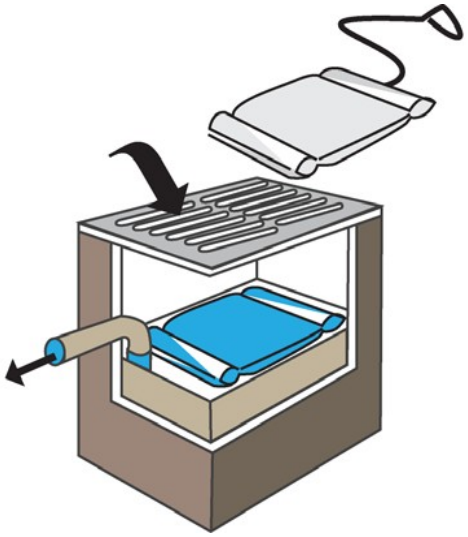
Drain inlets inserts, also known as catch basin or curb inlet inserts, are used to remove pollutants at the point of entry to the storm drain system. The effectiveness of drain inlet inserts depends on their design and on the frequency of maintenance to remove accumulated litter and sediment. Skimmer type inserts consist of a media pillow that floats directly on the water surface within a drain inlet and absorbs floating hydrocarbons. The hydrocarbons are transformed into manageable solid waste when captured by the media pillows.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	
Total Nitrogen	
Total Phosphorus	
Pesticides	
Total Metals	
Dissolved Metals	
Microbiological	
Litter	
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Blank cells indicate data not available or poor treatment performance.

Schematic



Source: EPA

Key Design Elements

- Hydraulic capacity and pollutant storage capacity
- Provision for overflow or bypass
- Skimmer size and media type

Advantages

- May absorb hydrocarbons with minimal leaching, so skimmers can remain in place for long periods
- Can be installed relatively easily in new and existing facilities without structural modification
- Maintenance is quick and simple

Constraints

- Skimmers trap only hydrocarbons and do not contribute to sediment control
- A Caltrans study (2004) discourages the use of drain inlet inserts along highway drain inlets due to safety considerations
- Maintenance activities may require traffic control if the device is installed along the traveled way
- If a skimmer has absorbed to its maximum capacity, additional hydrocarbons will not be captured until the device is replaced

Skimmer

Maintenance Issues

Requirements:

- Must be inspected annually
- Maintenance consists of removing and replacing the skimmer
- Vector control or abatement may be required

Special Training:

Unknown

Project Development Issues

Right-of-Way Requirements:

Installed within a stormwater inlet

Siting Constraints:

A previous Caltrans study (2004) of drain inlet inserts suggests limiting deployment to maintenance stations due to safety considerations

Construction:

Simple installation

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2004. BMP Retrofit Pilot Program Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-050.

US EPA. 2002. Storm Water O&M Fact Sheet, Catch Basin Cleaning. EPA 832-F-99-011.

NCHRP. 2006a. Low Impact Development Design Manual for Highway Runoff Control (LID Design Manual). National Cooperative Highway Research Program, Project 25-20(01).

University of Arkansas. 2003. Environmental Technology Verification Report of the Low-Cost Stormwater BMP Study. Civil Engineering Research Foundation (CERF) and the University of Arkansas.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

- AbTech Passive Skimmer
- Ultra-Passive Skimmer®
- StreamGuard Passive Skimmer

Alternative Designs

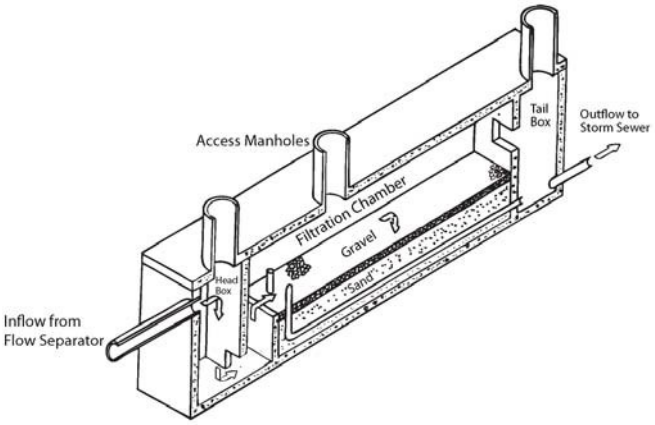
None identified

Bed

Description

Filtration systems provide treatment by filtering out or straining particles and associated pollutants in the stormwater. In bed filters, stormwater flows through one or more layers of open-bed granular media before discharging through an underdrain system. The media can be inert, such as sand or gravel, or adsorptive, such as peat or a manufactured media. The effectiveness of the system depends on the loading rate on the filter, the type, size and porosity of the media, and the type and size distribution of the particles in the incoming stormwater. If the media is adsorptive, the water chemistry will also determine the effectiveness of the filter in removing dissolved constituents. Pretreatment may be necessary prior to filtration to prevent clogging and premature failure of the media.

Schematic



Source: EPA

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	
Total Phosphorus	✓
Pesticides	
Total Metals	✓
Dissolved Metals	✓
Microbiological	✓
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on performance of an Austin Sand Filter (see Appendix C). Blank cells indicate data not available or poor treatment performance. Small filtration devices operating at relatively high loading rates may not provide treatment as indicated.

Key Design Elements

- Flood flow routing and bypass
- Water quality design flow
- Media type, grain size, and area
- Pollutant storage capacity
- Need for pretreatment
- Maintenance access

Advantages

- Typically smaller than basin type BMPs
- Can be installed below grade
- Media can be selected to target specific constituents of concern

Constraints

- Media may be proprietary
- A permanent pool of water in the treatment vault of some configurations can provide mosquito breeding opportunities
- No infiltration and volume reduction, when constructed within a concrete vault
- Confined space entry
- Entry needs to be kept accessible
- Footprint increased if pretreatment required

Bed

Maintenance Issues

Requirements:

● Routine maintenance may include periodic sediment and debris removal as well as spent media replacement. Layered media may complicate maintenance
● Vector control or abatement may be required

Special Training:

● Requires training for media maintenance/replacement
● May require confined space entry training

Project Development Issues

Right-of-Way Requirements:

Space requirements depend on sizing criteria, typically smaller than for basins

Siting Constraints:

Head requirements for gravity drain

Construction:

None identified

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

NCHRP. 2006a. Low Impact Development Design Manual for Highway Runoff Control (LID Design Manual). National Cooperative Highway Research Program, Project 25-20(01).

NCHRP. 2006b. User's Guide for BMP/LID Selection (Guidelines Manual). National Cooperative Highway Research Program, Project 25-20(01).

US EPA. 2002. Storm Water Technology Fact Sheet, Sorbent Materials in Storm Water Applications. EPA 832-F-02-020.

WSDOT. 2008. Highway Runoff Manual. Washington State Department of Transportation. Document Number M31-16.01.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

● Aqua-Filter™
● Aquip™

Alternative Designs

● Austin Filter
● DC Filter
● Media Filter Drain
● Delaware Filter
● Granular Activated Carbon Filter

Filtration Bed

Austin Media Filter with Activated Alumina

Description

The Austin media filter with alternative media is similar to an Austin sand filter but uses a sacrificial sand layer over an activated alumina adsorptive media instead of just sand. The filter includes a sedimentation basin and a filtration basin. The sedimentation basin captures and detains the design water quality runoff volume (typically for 24 hrs.) prior to discharge to the filtration basin, and removes floatable debris and coarse suspended solids, and prevents premature clogging of the media surface. The sedimentation chamber effluent discharges to the filtration basin typically through a perforated riser. In the filtration basin, the water first passes through a 6-inch sacrificial sand layer, then through a geotextile layer, an activated alumina media layer, and finally into a gravel underdrain. Pollutant removal is achieved primarily by physical filtration of pollutants through the filtration media, adsorption within the activated alumina media, and the settling of solids in the sedimentation basin.

Constituent Removal - Activated Alumina

Constituent Group	Removal Efficiency	Level of Confidence
Total Suspended Solids (TSS)	●	●
Total Nitrogen	◒	●
Total Phosphorus	●	●
Pesticides	NA	
Total Metals	◒	◒
Dissolved Metals	◒	◒
Microbiological	NA	
Litter	●	◒
Biochemical Oxygen Demand (BOD)	NA	
Total Dissolved Solids (TDS)	NA	
Selenium	◒	○

Rating Key for Constituent Removal Efficiency and Level of Confidence

● High ◒ Medium ○ Low

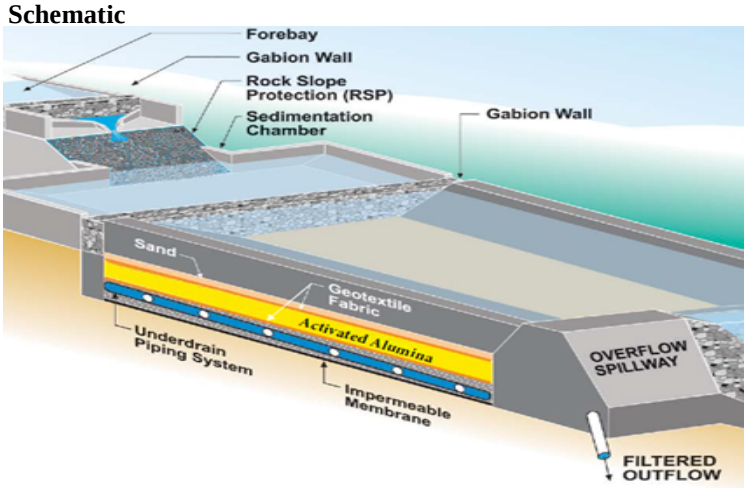
Notes:

TSS performance is expected to be comparable or better than that for Austin sand filters. Phosphorus and fine sediment particle (FSP) removals are expected to be significantly better than for Austin sand filters. Nitrate export is expected to be similar to Austin sand filters. Performance for other constituents is expected to be comparable or better than that for Austin sand filters. Although the metals removals shown above are similar to those for Austin sand filters, removals are expected to be better because of the superior fine particle removal by the media. Litter removal ratings are based on best professional judgment. Selenium removals and level of confidence based on literature studies. Sand filter comparisons are with B103 activated alumina filter in Tahoe.

Caltrans Evaluation Status

Further research needed, not approved

Schematic



The media filter can also be designed so that the sedimentation and filtration sections are combined into one basin. In this design, gabions are used to disperse water and encourage sedimentation prior to the media bed.

Source: Caltrans

Key Design Elements

- Capture volume
- Orifice plate on effluent pipe to enhance sand media contact time
- Media area and depth

Cost Effectiveness Relative to Detention Basins

Cost Effectiveness	Level of Confidence
◪	●

Rating Key for Cost Effectiveness Relative to Detention Basins

Benefit ↑ Cost ↓	Benefit ↑ Cost ↑
Benefit ↓ Cost ↓	Benefit ↓ Cost ↑

Rating Key for Cost Effectiveness Level of Confidence

● High ◒ Medium ○ Low

Notes:

Initial costs are expected to be higher because of the increased cost of the alternative media. However, in view of the improved FSP and phosphorus treatment performance relative to an Austin sand filter, this BMP may be a viable option in TMDL areas where the Department can get compliance credits for these constituents (e.g., Lake Clarity Credits in Tahoe).

Filtration Bed

Austin Filter with Activated Alumina

Maintenance Issues

Requirements:
- Media scraping
- Sediment removal
- Media replacement

Special Training:
Media handling, removal, and replacement would be performed by contractors

Project Development Issues

Right-of-Way Requirements:
Space requirements are similar to full or partial sedimentation (reduced footprint) Austin sand filters.

Siting Constraints:
- Head requirement of about 4 feet
- Avoid locations with base flow because of clogging due to algae growth

Construction:
If exposed to construction site runoff, remove and replace sacrificial sand layer after drainage area has been completely stabilized

Advantages

- High constituent removal for total and dissolved phosphorus, fine sediment particles (FSP), suspended solids, total metals, and selenium (based on literature studies)
- Provides consistent pollutant removal when properly maintained
- Treats runoff from drainage areas up to 20 hectares

Constraints

- Media will need to be washed and conditioned to avoid substantial pH changes and dissolved aluminum leaching. However, this would be performed by qualified contractors
- Effluent may require monitoring during first year for elevated pH and dissolved aluminum
- More expensive to construct than a Austin sand filter because of higher cost of alternative media and cost associated with conditioning of media before use

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2007. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSWRT-07-172.19.1.

US EPA. 1999. Storm Water Technology Fact Sheet, Sand Filters. EPA 832-F-99-007.

Performance Demonstrations Literature Sources

Caltrans. 2012. Monitoring for the Highway 50 and State Route 267 Full-Scale Alternative Media Filter Pilots, 2011-12 Monitoring Report and Cumulative Data Analysis. October 2012. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-12-289.7.1.

Faria, J and S. Lalvani. 2004. Selenium Removal from Agricultural Drainage Water: Lab Scale Studies. Agreement Number: 4600001985. Sacramento: Department of Water Resources.

Jegadeesan, G., et al. 2003. Comparative Study of Selenite Adsorption on Carbon Based Adsorbents and Activated Alumina. Environ. Technol., 24(8): 1049-1059.

Certifications, Verifications, or Designations

None identified

Bed

DC Sand Filter

Description

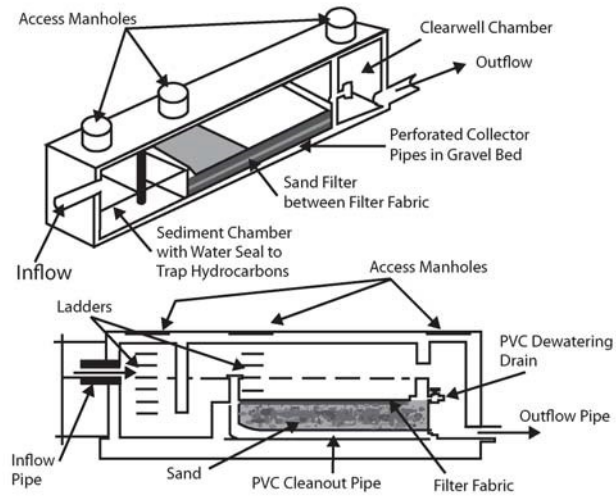
Filtration systems provide treatment by filtering out or straining particles and associated pollutants in the stormwater. In bed filters, stormwater flows through one or more layers of open-bed granular media before discharging through an underdrain system. The effectiveness of the system depends on the loading rate on the filter, the type, size and porosity of the media, and the type and size distribution of the particles in the incoming stormwater. DC Sand Filters are typically designed to handle runoff from completely impervious drainage areas of 0.4 hectares (1 acre) or less. This filter design incorporates three chambers. Runoff flows through a sedimentation chamber before it enters a filter chamber where it passes through an open sand bed. Filtered water is collected in a gravel underdrain and flows into a clearwell chamber before discharging.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	
Total Phosphorus	✓
Pesticides	
Total Metals	✓
Dissolved Metals	✓
Microbiological	✓
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on Delaware Sand Filter performance (see Appendix C), and data presented by Young et al. (1996). Blank cells indicate data not available or poor treatment performance.

Schematic



Source: EPA

Key Design Elements

- Flood flow routing and bypass
- Media area and depth
- Media grain size

Advantages

- DC Sand Filters are installed in urban settings with covers appropriate for the intended above ground land use such as sidewalks or landscaping
- Performance is similar to the Delaware Sand Filter and Austin Sand Filter, but DC Sand Filters have a narrower footprint and require less head than Austin Sand Filters. They are also designed to receive concentrated flows at one end, whereas Delaware Sand Filters are designed for sheet flows along one side

Constraints

- Designed to treat impervious areas of one acre or less
- If media clogs, resulting standing water may create mosquito habitat
- No infiltration and volume reduction when constructed within a concrete vault
- Confined space entry
- Entry needs to be kept accessible
- The sedimentation basin holds a permanent pool of water that has the potential to provide breeding opportunities for mosquitoes

Maintenance Issues

Requirements:

- Routine maintenance may include periodic sediment and debris removal as well as spent media replacement
- Vector control or abatement may be required

Special Training:

- Requires training for media maintenance/replacement
- Requires confined space entry training

Project Development Issues

Right-of-Way Requirements:

Space requirements are similar to Delaware Sand Filters

Siting Constraints:

- Do not site where runoff from bare soil or construction activities can enter filter
- Head requirements for gravity drain

Construction:

None identified

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

Connecticut Stormwater Quality Manual. 2004. http://www.ct.gov/dep/lib/dep/water_regulating_and_discharges/stormwater/manual/Table_of_Contents.pdf (accessed November 11, 2009).

NCHRP. 2006a. Low Impact Development Design Manual for Highway Runoff Control (LID Design Manual). National Cooperative Highway Research Program, Project 25-20(01).

NCHRP. 2006b. User's Guide for BMP/LID Selection (Guidelines Manual). National Cooperative Highway Research Program, Project 25-20(01).

Young, G. K., S. Stein, P. Cole, T. Kammer, F. Graziano, and F. Bank. 1996. Evaluation and Management of Highway Runoff Water Quality. U.S. Department of Transportation.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

Alternative Designs

Bed

Infiltration Chambers

Description

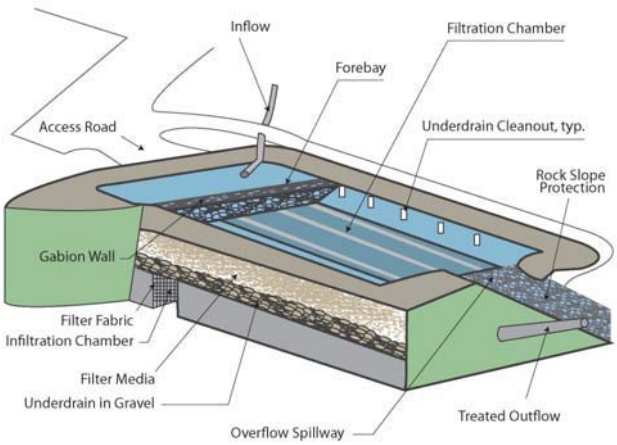
Filtration systems provide treatment by filtering out or straining particles and associated pollutants in the stormwater. In bed filters, stormwater flows through one or more layers of open-bed granular media before discharging through an underdrain system. The effectiveness of the system depends on the loading rate on the filter, the type, size and porosity of the media, and the type and size distribution of the particles in the incoming stormwater. Infiltration chambers is a concept developed by Caltrans to increase infiltration in conventional BMPs. Addition of infiltration chambers below the invert of bed filters is expected to capture and infiltrate the first flush of stormwater runoff. These infiltration chambers can consist of gravel, high porosity storage media with a sand overlay, or native soil that has been amended to improve infiltration.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	
Total Phosphorus	✓
Pesticides	
Total Metals	✓
Dissolved Metals	✓
Microbiological	
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on performance of an Austin Sand Filter (see Appendix C). Blank cells indicate data not available or poor treatment performance. Small filtration devices operating at relatively high loading rates may not provide treatment as indicated.

Schematic



Source: Caltrans

Key Design Elements

- Soil type and permeability
- Infiltration chamber volume capacity
- Infiltration chamber material (high porosity storage media, gravel, amended soil, etc.)
- Flood flow routing and bypass
- Media grain size, area, and depth
- Outlet orifice plate to control media contact time
- Maintenance access

Advantages

- Potential for improved infiltration, even in poorly infiltrating soils
- Expected to improve treatment of fine particles, nutrients, and dissolved constituents relative to conventional sand filters

Constraints

- Not suitable in areas with high seasonal groundwater
- Increases construction and rehabilitation costs relative to conventional sand filters
- If media clogs, resulting standing water may create mosquito habitat

Bed Infiltration Chambers

Maintenance Issues

Requirements:

- Routine maintenance may include periodic sediment and debris removal as well as spent media replacement
- Vector control or abatement may be required
- May require construction equipment to rehabilitate clogged system
- Sediment removal

Special Training:
Unknown

Project Development Issues

Right-of-Way Requirements:
Space requirements are the same as those for conventional filters

Siting Constraints:
- Site where there is sufficient hydraulic head to facilitate drainage through the sand bed
- Requires separation between seasonal high groundwater and basin invert
- Avoid locations with base flow because of possible clogging due to algae growth

Construction:
- If exposed to construction site runoff, remove and replace media after drainage area has been completely stabilized
- Minimize compaction of underlying soils to maintain infiltration capacity
- Bypass water until drainage area is stabilized

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2007. Caltrans Tahoe Basin Highway 50 Activated Alumina Media Filter Pilot Study - Final Monitoring Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-06-157.02.1.

Caltrans. 2008. Adding Infiltration Chambers to Approved Best Management Practices: Concept Development. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSWRT-TM-08-172-46.1.

US EPA. Storm Water Technology Fact Sheet, Sand Filter. EPA 832-F-99-007.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

Alternative Designs

BMP Fact Sheet

Filtration Bed

Linear Filter Trench

Description

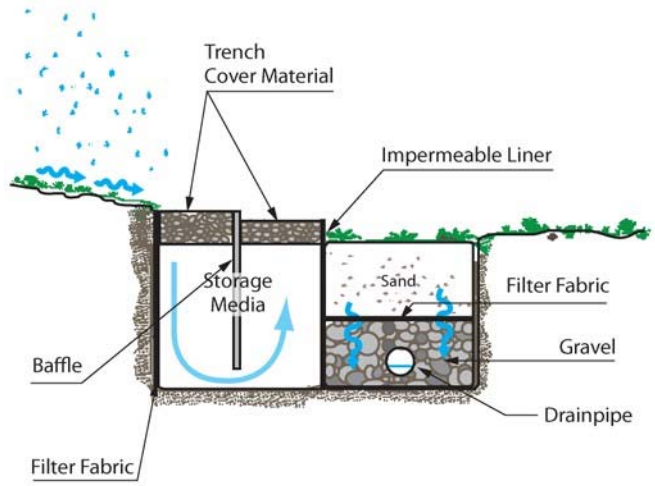
Filtration systems provide treatment by filtering out or straining particles and associated pollutants in the stormwater. The Linear Filter Trench, a concept developed by Caltrans that is based on the Delaware Sand Filter, is intended for the narrow right-of-way that is typical of roadside areas. It consists of a sedimentation chamber with a permanent pool of water and a filter chamber with an underdrain. The Linear Filter Trench, however, would be constructed away from load-bearing areas so that trench construction can help reduce cost. A trench cover material on top of the sedimentation area prevents mosquito access to standing water. The use of a high-porosity storage media supports the overlay while maintaining the capture volume of the sedimentation chamber.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	
Total Phosphorus	✓
Pesticides	
Total Metals	✓
Dissolved Metals	✓
Microbiological	✓
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on performance of a Delaware Sand Filter (see Appendix C). Blank cells indicate data not available or poor treatment performance.

Schematic



Source: Caltrans

Key Design Elements

- Flood flow routing
- Water quality flow and detention time (if flow-based design)
- Storage volume and sand/gravel pore space (if volume-based design)
- Media type, grain size, and area
- Ponding depth above filter
- Traffic rating
- Maintenance access

Advantages

- Fits in a narrow right-of-way
- Lower construction costs than conventional below grade filters because of minimal use of concrete
- Can provide infiltration and volume reduction
- Can be constructed without pretreatment by a grass filter strip

Constraints

- The sedimentation chamber holds a permanent pool of water and has the potential to provide breeding opportunities for mosquitoes
- May require confined space entry
- Unknown maintenance frequency
- Maintenance activities may require traffic control

Maintenance Issues

Requirements:

- Disposal of accumulated trash and replacement of the upper few inches of sediment and sand when the filter clogs
- Vector control or abatement may be required

Special Training:
Requires training for media maintenance/replacement

Project Development Issues

Right-of-Way Requirements:
Designed to fit in a narrow right-of-way

Siting Constraints:
- Do not site where runoff from bare soil or construction activities will be allowed to impact the filter
- Minimum head requirement of two feet

Construction:
None identified

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2004. BMP Retrofit Pilot Program Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-050.

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

Horner, R. R. and Horner, C. R. 1995. Design, Construction, and Evaluation of a Sand Filter Stormwater Treatment System. Part III. Performance Monitoring. Report to Alaska Marine Lines, Seattle, WA.

US EPA. Sand Filter Fact Sheet. www.epa.gov/owm/mtb/sandfltr.pdf (accessed November 11, 2009).

Young, G. K., S. Stein, P. Cole, T. Kammer, F. Graziano, and F. Bank. 1996. Evaluation and Management of Highway Runoff Water Quality. U.S. Department of Transportation.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

Alternative Designs

BMP Fact Sheet

Filtration

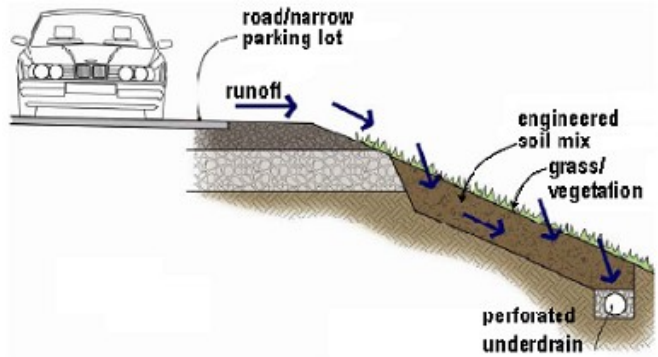
Bed

Media Filter Drain

Description

Filtration systems provide treatment by filtering out or straining particles and associated pollutants in the stormwater. In bed filters, stormwater flows through one or more layers of open-bed granular media before discharging through an underdrain system. The effectiveness of the system depends on the loading rate on the filter, the type, size and porosity of the media, and the type and size distribution of the particles in the incoming stormwater. The Media Filter Drain is a bed filtration system that can be integrated into slopes adjacent to roadways. The concept, developed by the State of Washington's Department of Transportation, is typically constructed to accept sheet flow along its length. Water passes into a porous, alkalinity-generating media that is placed in a shallow excavation running parallel to the roadway. An underdrain carries filtered water downstream.

Schematic



Source: Pierce County, Washington State

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	
Total Phosphorus	✓
Pesticides	
Total Metals	✓
Dissolved Metals	✓
Microbiological	
Litter	
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on monitoring by Washington State DOT (2008). Blank cells indicate data not available or poor treatment performance.

Key Design Elements

- Preferable lateral slopes less than 25% (4:1)
- Preferable longitudinal slope less than 5%
- Design water quality flow rate
- Bed mixture and dimensions
- Pretreatment needs by biofiltration strips
- Slope stability
- Underdrain
- Maintenance access

Advantages

- Fits in a narrow right-of-way
- No vector concerns, because water treatment is accomplished below surface

Constraints

- Requires sheet flow
- Not suitable for steep lateral and longitudinal slopes
- Vegetation may develop slowly, though filtering still occurs
- Media mix may require washing before installation
- Must avoid concentrated flows
- Maintenance activities may require traffic control

Maintenance Issues

Requirements:

- Maintain uniform sheetflow distribution
- Periodic media maintenance

Special Training:

None identified

Project Development Issues

Right-of-Way Requirements:

Designed to fit in a narrow right-of-way

Siting Constraints:

Not advised in longitudinal slopes steeper than 5%, wetlands, wetland buffers, or unstable slopes

Construction:

Certain soil types may require perforated pipe in the underdrain trench to ensure proper flow through media bed

Design, Construction, Maintenance, and Cost Sources

Washington Department of Transportation (WA DOT). 2008. Highway Runoff Manual. M 31-16.01.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

Alternative Designs

Cartridge/Canister

Description

Filtration systems provide treatment by filtering out or straining particles and associated pollutants in the stormwater. In cartridge/canister systems, the filter media is placed inside cartridges or canisters that are typically enclosed in an underground vault. The media used can be inert, such as sand or gravel, or adsorptive, such as peat or a manufactured media. The effectiveness of these systems depends on the loading rate on the cartridges/canisters, the type, size and porosity of the media, and the type and size distribution of the particles in the incoming stormwater. If the media is adsorptive, the water chemistry will also determine the effectiveness of the filter in removing dissolved constituents. Pretreatment may be necessary prior to filtration to prevent clogging and premature failure of the media.

Constituent Removal

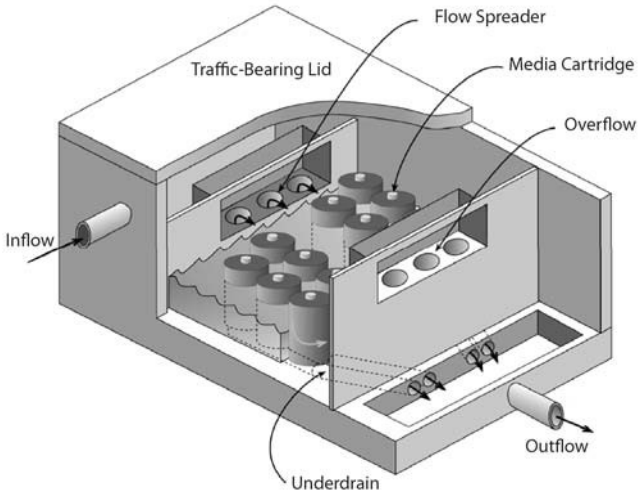
Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	
Total Phosphorus	✓
Pesticides	
Total Metals	✓
Dissolved Metals	
Microbiological	
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on performance of a StormFilter™ (Caltrans 2004), and best professional judgment. Blank cells indicate data not available or poor treatment performance. Cartridges/canisters operating at relatively high loading rates (about 2 gpm per square foot for each cartridge/canister) may not provide treatment as indicated.

Advantages

- Can be applied in confined urban areas and areas with limited space if placed in an underground vault
- Suitable for wide range of drainage areas
- Media can be selected to target specific constituents of concern

Schematic



Source: City of Medford, Oregon

Key Design Elements

- Flood flow routing and bypass
- Water quality design flow
- Flow restriction for maximum operational flow
- Media type, grain size, and area (determined by size, configuration, and number of cartridges/canisters)
- Pollutant storage capacity
- Need for pretreatment
- Maintenance access

Constraints

- Can be expensive to construct
- Major maintenance may be costly due to the large number of filter canisters required
- Proprietary device
- Media may be proprietary
- Requires pretreatment
- A permanent pool of water in the treatment vault of some configurations can provide mosquito breeding opportunities
- Small storm events may not actuate the floats in some systems, and the water will reside in the unit until the next storm
- May require confined space entry
- Entry needs to be kept accessible

Cartridge/Canister

Maintenance Issues

Requirements:

- Periodic sediment removal and canister replacement required
- Vector control or abatement may be required
- May require hand cleaning following removal of media canisters

Special Training:

- Training in use of equipment needed to remove media canisters and clean out pretreatment vault
- Must be trained to repair or replace any cartridge filter or part, or plan to contract for maintenance
- Training needed for confined space entry

Project Development Issues

Right-of-Way Requirements:

Space requirements depend on sizing criteria, but typically smaller than basins

Siting Constraints:

- Do not allow runoff from bare soil or construction activities to enter filter
- Sufficient hydraulic head is needed to operate filter

Construction:

None identified

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2004. BMP Retrofit Pilot Program Final Report. Division of Environmental Analysis, Sacramento. CTSW-RT-01-050

US EPA. 2002. Storm Water Technology Fact Sheet, Sorbent Materials in Storm Water Applications. EPA 832-F-02-020.

NCHRP. 2006a. Low Impact Development Design Manual for Highway Runoff Control (LID Design Manual). National Cooperative Highway Research Program, Project 25-20(01).

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

- BayFilter™
- Perk Filter™
- StormPlex™
- Up-Flo™
- Media Filtration System (MFS)
- Puristorm™
- VortFilter™

Alternative Designs

None identified

BMP Fact Sheet

Filtration

Fabric

Description

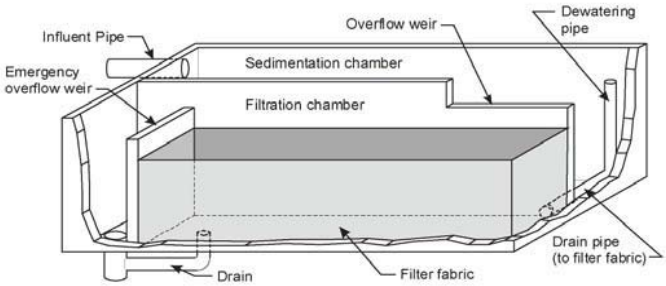
Filtration systems provide treatment by filtering out or straining particles and associated pollutants in the stormwater. In fabric filters, stormwater flows through fabric, typically in the form of a sequence of baffles. The effectiveness of the system depends on the loading rate on the fabric, the type, number of layers, and apparent opening size of the fabric, and the type and size distribution of the particles in the incoming stormwater. A fabric filtration system can be used as pretreatment for a subsurface detention or infiltration system.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	
Total Phosphorus	
Pesticides	
Total Metals	
Dissolved Metals	
Microbiological	
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on best professional judgment. Blank cells indicate data not available or poor treatment performance. Small filtration devices operating at relatively high loading rates may not provide treatment as indicated.

Schematic



Source: Caltrans

Key Design Elements

- Flood flow routing and bypass
- Fabric type, area, and apparent opening size
- Pollutant storage capacity
- Maintenance access

Advantages

- No negative aesthetic impact if installed below grade
- Can be used to provide pretreatment for other BMPs

Constraints

- May be difficult to achieve complete draining in a buried system
- Difficult to inspect and maintain because it is buried
- May require confined space entry
- Fabric panels may clog quickly
- A permanent pool of water in the treatment vault of some configurations can provide mosquito breeding opportunities

Filtration

Fabric

Maintenance Issues

Requirements:

- Replace fabric panels
- Because of site-specific loading, several wet season inspections may be required to determine maintenance frequency

Special Training:

Training needed for confined space entry

Project Development Issues

Right-of-Way Requirements:

Small footprint BMP

Siting Constraints:

May not be feasible in areas with high sediment and organic load because of premature clogging of fabric

Construction:

None identified

Design, Construction, Maintenance, and Cost Sources

None identified

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

- Stormfilter 400®
- Helix Filter
- Jellyfish™

Alternative Designs

None identified

Pressure

Description

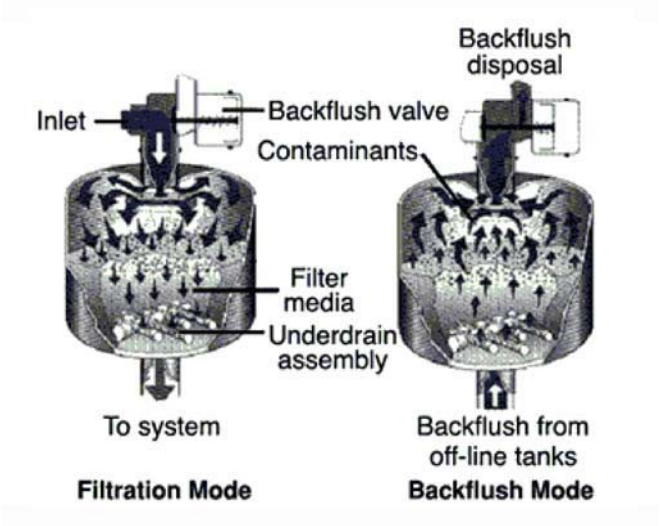
Filtration systems provide treatment by filtering out or straining particles and associated pollutants in stormwater. In pressurized filtration systems, an external pump is used to force water through a media, fabric, or micro-discs. The media can be inert, such as sand or gravel, or adsorptive, such as peat or a manufactured media. The effectiveness of the system depends on the loading rate on the media or fabric, the type, size and porosity of the media or fabric, and the type and size distribution of the particles in the incoming stormwater. If the media is adsorptive, the water chemistry will also determine the effectiveness of the filter to remove dissolved constituents. Pressure filtration is more common for construction site runoff than for post-construction.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	
Total Phosphorus	✓
Pesticides	
Total Metals	✓
Dissolved Metals	
Microbiological	✓
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on best professional judgment. Blank cells indicate data not available or poor treatment performance.

Schematic



Source: Virginia Cooperative Extension

Key Design Elements

- Facilities required upstream to capture runoff and provide pretreatment
- Power supply
- Flood flow routing and bypass
- Design flow
- Media type, grain size, and area
- Backwash cycle water storage and disposal
- Maintenance access

Advantages

- Using pressure rather than gravity to force water through a media bed allows a smaller footprint
- Backwashing cycle cleans sediment from the filter media as opposed to periodically excavating a portion of the media as required for slow-rate sand filters
- Pressure filter technology uses pumps, which allow more layout flexibility than gravity filtration systems

Constraints

- Connection to sewer or drying bed needed for backwashed wastewater
- Connection to a clean water tank is needed for backwashing
- Power supply required for pump
- More maintenance is needed for a pressure filter than for a gravity filter because of the use of mechanical equipment
- Requires a pretreatment system for litter and debris
- Requires a higher level of operator observation than that for other BMPs

Pressure

Maintenance Issues

Requirements:

- Mechanical equipment must be maintained
- Pretreatment may be necessary prior to filtration to prevent clogging and premature failure
- Pressure filters require backwashing, a process in which water is forced through the media bed in an opposite direction. The backwashed wastewater must be disposed if a sanitary sewer connection is not available

Special Training:

Crews need to be trained to operate and maintain equipment

Project Development Issues

Right-of-Way Requirements:

Total footprint may be high (including facilities required upstream to capture runoff and provide pretreatment)

Siting Constraints:

- Restricted to sites with available power nearby
- Space required for upstream pretreatment system
- Requires a sanitary sewer connection or dry beds

Construction:

Unknown

Design, Construction, Maintenance, and Cost Sources

US EPA. 2002. Storm Water Technology Fact Sheet, Sorbent Materials in Storm Water Applications. EPA 832-F-02-020.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

- Arkal Filter
- Purmutit® CD Series
- DynaSand®

Alternative Designs

None identified

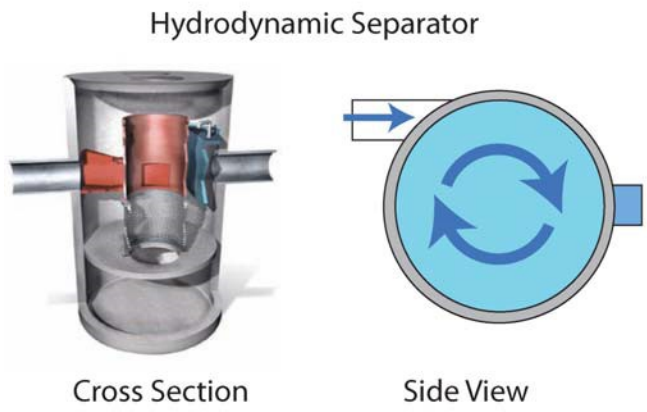
BMP Fact Sheet

Hydrodynamic Separator

Description

Hydrodynamic separators, also called vortex separators or swirl concentrators, are cylindrical structures in which water moves in a centrifugal fashion rather than in a straight line. Stormwater enters the separator tangentially and creates a swirling vortex flow pattern that allows larger particles to settle out by gravity around the outer edges of the main chamber. Differences between configurations include the nature and type of internal flow-modifying components and the location of inlets and outlets. Hydrodynamic separators are small footprint devices that can be used in small spaces. The effectiveness of these devices depends on the flow rate, the size and configuration of the device, and the sediment characteristics (i.e., type and size distribution of the particles) of the incoming stormwater.

Schematic



Source: University of New Hampshire Stormwater Center

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	
Total Phosphorus	
Pesticides	
Total Metals	
Dissolved Metals	
Microbiological	
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on best professional judgment. Blank cells indicate data not available or poor treatment performance. Treatment for separators operating at relatively high flow rates or with poor sediment retention ability may not be as indicated.

Key Design Elements

- Flood flow routing and bypass
- Water quality design flow
- Detention time
- Maximum operational flow
- Sediment storage capacity and ability to prevent scouring
- Maintenance access

Advantages

- Relatively limited head is needed to operate device
- Can be used to provide pretreatment for other BMPs

Constraints

- A permanent pool of water is often maintained in the unit, creating a breeding opportunity for mosquitoes
- Not effective for removing dissolved constituents or fine particles
- Can be a source of pollutants due to decomposition of previously captured material unless maintained regularly
- Maintenance activities may require traffic control if the device is installed along the traveled way
- Proprietary device

Hydrodynamic Separator

Maintenance Issues

Requirements:

- Usually requires vactor truck
- Vector control or abatement may be required

Special Training:

Unknown

Project Development Issues

Right-of-Way Requirements:

Small footprint

Siting Constraints:

Low head requirement

Construction:

None Identified

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2004. BMP Retrofit Pilot Program Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-050.

Connecticut Department of Environmental Protection. 2002. Stormwater Treatment Devices, Section 319 Project # 99-07, Final Report.

NCHRP. 2006b. User's Guide for BMP/LID Selection (Guidelines Manual). National Cooperative Highway Research Program, Project 25-20(01).

US EPA. 1999. Hydrodynamic Separators. Storm Water Technology Fact Sheet. EPA 832-F-99-017.

US EPA. 2004. The Use of Best Management Practices (BMPs) in Urban Watersheds. EPA/600/R-04/184.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

- Aqua-Swirl™
- Continuous Deflective Separation™ (CDS)
- EcoStorm Plus™
- Hydrofilter
- Storm Trooper®
- Terre Kleen™
- V2B1™
- VortSentry™
- Downstream Defender™
- EcoStorm™
- FloGard Dual-Vortex™
- Hydroguard
- Stormceptor®
- Unistorm™
- Vortechs®

Alternative Designs

None identified

BMP Fact Sheet

Infiltration

Below Grade

Description

Infiltration BMPs provide treatment by allowing the stormwater runoff to infiltrate surrounding soils. Pollutants are filtered out as the water percolates through the soils. Infiltration BMPs are assumed to provide 100% treatment of the design water quality volume because no water is discharged to surface waters. An overflow mechanism is recommended in case of clogging.

Constituent Removal

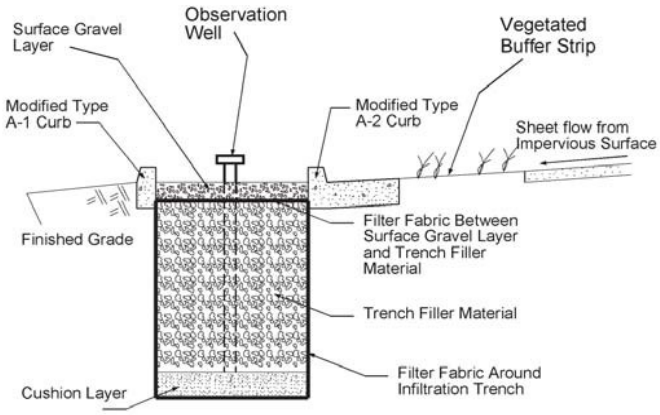
Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	✓
Total Phosphorus	✓
Pesticides	✓
Total Metals	✓
Dissolved Metals	✓
Microbiological	✓
Litter	✓
Biochemical Oxygen Demand (BOD)	✓
Total Dissolved Solids (TDS)	✓

* Based on the assumption that most water is infiltrated and does not overflow, and litter is captured within the BMP. Removal ability reported in the literature is usually based on overflow discharge (Young et al. 1996).

Advantages

- When properly sized in suitable soils, infiltration BMPs eliminate surface discharge up to the design storm
- Below grade infiltration inhibits access for mosquitoes
- Underground BMPs have limited aesthetic impacts
- Caltrans modeling indicates that underlying soils are not likely to become hazardous within five or more years, and typical Caltrans concentrations will not likely impact groundwater quality (Caltrans 2010)

Schematic



Source: Caltrans

Key Design Elements

- Water quality volume
- Permeability of soil
- Distance to groundwater
- Class V injection well determination may be required
- Overhead cover requirements and load-bearing capacity
- Maintenance access

Constraints

- High rehabilitation cost when clogging occurs at the bottom of the trench
- Water percolation may impact structural integrity and stability
- Avoid high groundwater
- Avoid areas prone to spills of groundwater contaminants
- Potential EPA Class V injection well regulations
- Higher construction costs per capture volume than infiltration basins
- Although narrow, could be a large footprint BMP depending on design constraints

Infiltration
Below Grade

Maintenance Issues

Requirements:

- Rehabilitation is required when the system clogs. Rehabilitation requires construction equipment
- Young et al. (1996) report that below grade infiltration (trenches, specifically) may require reconstruction every 10 years

Special Training:

Training in confined space entry

Project Development Issues

Right-of-Way Requirements:

- Space requirements are less than infiltration basins because of vertical side walls
- Pretreatment is recommended

Siting Constraints:

Permeable soils and adequate separation to groundwater

Construction:

- Avoid clogging the underlying soils by compaction from vehicles, or by fine particles introduced during or after construction
- Bypass water until drainage area is stabilized

Design, Construction, Maintenance, and Cost Sources

ASCE/WEF. 1998. Urban Runoff Quality Management. ASCE No. 87, WEF No. 23.

Caltrans. 2007. Mathematical Modeling of Fate and Transport of Aqueous Species in Stormflow Entering Infiltration Basin. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-06-168-17.2.

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

NCHRP. 2006a. Low Impact Development Design Manual for Highway Runoff Control (LID Design Manual). National Cooperative Highway Research Program, Project 25-20(01).

NCHRP. 2006b. User's Guide for BMP/LID Selection (Guidelines Manual). National Cooperative Highway Research Program, Project 25-20(01).

US EPA. 2003. When are Storm Water Discharges Regulated as Class V Wells? http://www.epa.gov/npdes/pubs/sw_class_v_wells_fs.pdf (accessed January 22, 2010).

Young, G. K., S. Stein, P. Cole, T. Kammer, F. Graziano, and F. Bank. 1996. Evaluation and Management of Highway Runoff Water Quality. US Department of Transportation.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

- Eljen In-Drain™
- Rainstore®
- StormTank™
- Cultec Contacter® and HVLV™ Recharger®
- EcoRain™
- SAGES™
- Terre Arch™
- VersiCell®
- Matrix™
- StormChamber™
- StormTech® Chambers
- D-Raintank®
- Rotondo Detention with Recharge
- Stormcell®
- Triton™ Chamber
- CUDO

Alternative Designs

- Infiltration Vault
- Infiltration Trench
- Linear Infiltration Filter Trench

BMP Fact Sheet

Infiltration

Below Grade

Linear Infiltration Filter Trench

Description

Infiltration BMPs provide treatment by allowing stormwater runoff to infiltrate surrounding soils. Pollutants are filtered out as the water travels through the soils. Infiltration BMPs are assumed to provide 100% treatment because the design water quality volume is not discharged to surface waters. An overflow mechanism is recommended in case of clogging. The Linear Infiltration Filter Trench is a non-proprietary design developed by Caltrans in which stormwater flows as sheet flow through a sand filter prior to infiltration. Treatment within the sand layer reduces clogging of the trench, inhibits mosquito access in areas where slow soil infiltration results in standing water, and may eliminate the need for pretreatment. The trench is backfilled with gravel or a high porosity media that is available from several suppliers.

Constituent Removal

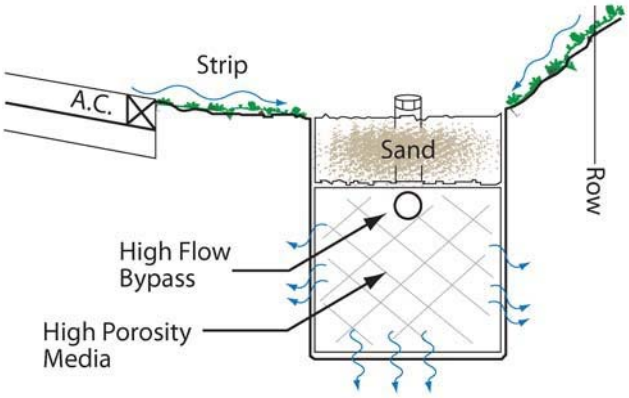
Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	✓
Total Phosphorus	✓
Pesticides	✓
Total Metals	✓
Dissolved Metals	✓
Microbiological	✓
Litter	✓
Biochemical Oxygen Demand (BOD)	✓
Total Dissolved Solids (TDS)	✓

* Based on the assumption that most water is infiltrated and does not overflow, and that litter is captured within the BMP.

Advantages

- Designed to fit a narrow right-of-way
- When properly sized in suitable soils, infiltration BMPs eliminate surface discharge up to the design storm
- Below grade infiltration inhibits access for mosquitoes
- Underground BMPs have limited aesthetic impact
- Caltrans modeling indicates that underlying soils are not likely to become hazardous within five or more years, and that typical Caltrans concentrations will not likely impact groundwater quality (Caltrans 2010)

Schematic



Source: Caltrans

Key Design Elements

- Water quality volume
- Permeability of soil and sand
- Distance to groundwater
- Load-bearing capacity
- Maintenance access
- Ponding depth above the sand

Constraints

- High rehabilitation cost when clogging occurs at the bottom of the trench
- Water percolation may impact structural integrity and stability
- Avoid high groundwater
- Avoid areas prone to spills of groundwater contaminants
- Higher construction costs per capture volume than infiltration basins
- Although narrow, could be a large footprint BMP depending on design constraints

Maintenance Issues

Requirements:

- May require construction equipment to rehabilitate clogged system

- Young et al. (1996) report that below grade infiltration (trenches, specifically) may require reconstruction every 10 years

Special Training:

Unknown

Project Development Issues

Right-of-Way Requirements:

- Space requirements are less than infiltration basins because of vertical side walls
- Pretreatment is recommended

Siting Constraints:

Permeable soils and adequate separation to groundwater

Construction:

- Avoid clogging the underlying soils by compaction from vehicles or by fine particles introduced during or after construction
- Bypass water until drainage area is stabilized

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2007a. Mathematical Modeling of Fate and Transport of Aqueous Species in Stormflow Entering Infiltration Basin. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-06-168-17.2.

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

Alternative Designs

BMP Fact Sheet

Porous Surface

Asphalt Overlay

Description

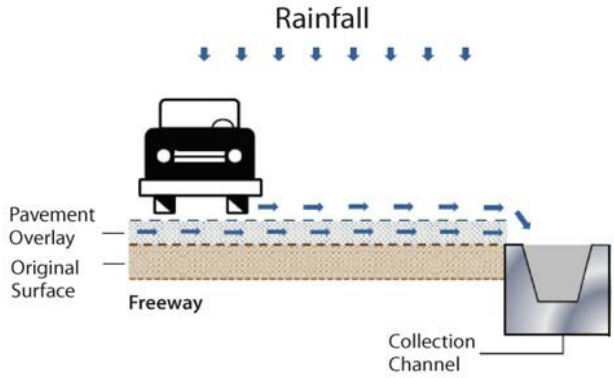
A porous asphalt overlay, also called a open graded or permeable friction course, is a layer of porous asphalt applied on top of conventional pavement. Stormwater drains through the porous asphalt layer to the conventional road surface below, and then travels along the boundary between the pavement types until it emerges as runoff at the edge of the pavement. The porous layer reduces traffic noise and improves safety by reducing splash and draining water away from the surface. Studies suggest that porous asphalt overlays may also provide water quality benefits by trapping particulates and by reducing the amount of pollutants washed from vehicles.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	
Total Phosphorus	✓
Pesticides	
Total Metals	✓
Dissolved Metals	
Microbiological	
Litter	
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on removals found by Stanard et al. (2008). Blank cells indicate data not available or poor treatment performance.

Schematic



Source: Caltrans

Key Design Elements

- Load requirements
- Gradation of asphalt mix
- Thickness of porous layer

Advantages

- Reduces or eliminates space needed for other BMPs
- Increases road safety and reduces traffic noise
- Suitable for highway application

Constraints

- Not feasible where traction sand is applied
- More costly than traditional asphalt concrete
- Durability affected by temperature and traffic load
- Water quality benefit expected to deteriorate with overlay age due to clogging of pores

Porous Surface

Asphalt Overlay

Maintenance Issues

Requirements:

- Inspect porous pavements annually
- Vacuum-style street sweepers are recommended, but not required

Special Training:

Unknown

Project Development Issues

Right-of-Way Requirements:

Requires no additional right-of-way

Siting Constraints:

May not be suitable in areas with highly erosive soils

Construction:

Construction requires special care and some changes to normal practices and scheduling

Design, Construction, Maintenance, and Cost Sources

National Asphalt Pavement Association (NAPA). 2008. http://www.hotmix.org (accessed October 19, 2009).

NCHRP. 2006a. Low Impact Development Design Manual for Highway Runoff Control (LID Design Manual). National Cooperative Highway Research Program, Project 25-20(01).

NCHRP. 2006b. User's Guide for BMP/LID Selection (Guidelines Manual). National Cooperative Highway Research Program, Project 25-20(01).

Stanard, C.E., M. E., Barrett, and R.J. Charbeneau. 2008. Stormwater Quality Benefits of a Permeable Friction Course. Center for Research in Water Resources. University of Texas. CEWR Online Report 08-03. http://www.utexas.edu/research/ctr/pdf_reports/0_5220_1.pdf (accessed January 22, 2010).

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

None identified

Alternative Designs

None identified

BMP Fact Sheet

Porous Surface Asphalt Pavement

Description

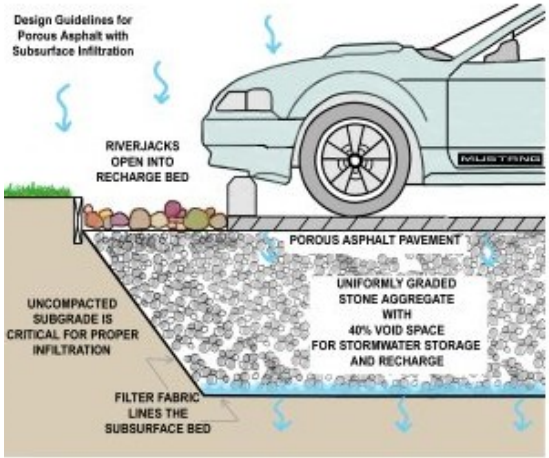
Porous asphalt pavement, with a life span of 20 years or more, provides stormwater storage and infiltration. Porous asphalt pavement is composed of a permeable asphalt surface placed over a granular "choke" course that is on top of a reservoir of large stone. The lower reservoir layer is designed for load requirements and water storage capacity. An overflow for the reservoir layer is recommended in case of insufficient infiltration. The pavement may also be designed to receive off-site runoff.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	✓
Total Phosphorus	✓
Pesticides	✓
Total Metals	✓
Dissolved Metals	✓
Microbiological	✓
Litter	
Biochemical Oxygen Demand (BOD)	✓
Total Dissolved Solids (TDS)	✓

* Removals are assumed to be due to 100% infiltration of the design water quality volume because no water is discharged to surface waters. Blank cells indicate data not available or poor treatment performance. Removals reported in literature are usually based on overflows from the reservoir course (UNH 2007).

Schematic



Source: Cahill Associates

Key Design Elements

- Water quality volume
- Permeability of soil
- Distance to groundwater
- Load requirements
- Gradation of asphalt mix

Advantages

- Eliminates surface discharge up to the design storm when properly sized in suitable soils
- Below grade infiltration inhibits access for mosquitoes
- Reduces or eliminates space needed for other BMPs
- Infiltration addresses all pollutants, except litter
- Caltrans modeling indicates that underlying soils will not likely become hazardous within five or more years, and typical Caltrans concentrations will not likely impact groundwater quality (Caltrans 2010)

Constraints

- Only suitable for low traffic areas, such as Park and Ride lots
- Low permeability in the subgrade will increase discharge through the over drain and decrease removal efficiency
- Not feasible where traction sand is applied
- More costly than traditional asphalt concrete
- Durability affected by temperature
- Potential contamination from spills
- Water quality benefit expected to deteriorate with pavement age due to clogging of pores in the porous asphalt

Porous Surface

Asphalt Pavement

Maintenance Issues

Requirements:

- Inspect porous pavements annually
- Vacuum-style street sweepers are recommended, but not required

Special Training:

Unknown

Project Development Issues

Right-of-Way Requirements:

Requires no additional right-of-way

Siting Constraints:

- Similar to siting constraints for infiltration BMPs
- Some considerations are depth to groundwater, subgrade permeability, and soil type

Construction:

- Construction requires special care and some changes to normal practices and scheduling
- Minimize sub grade compaction to maintain soil permeability
- Before installation, erosion control should be in place until vegetation is established. Porous surface installation is recommended as the last item of construction

Design, Construction, Maintenance, and Cost Sources

Cahill Associates. 2006. Porous Asphalt with Subsurface Infiltration/Storage Bed. http://www.thcahill.com/pasphalt.html (accessed October 19, 2009).

Caltrans. 2007a. Mathematical Modeling of Fate and Transport of Aqueous Species in Stormflow Entering Infiltration Basin. Sacramento: Caltrans-Division of Environmental Analysis. CTSW-RT-06-168-17.2.

National Asphalt Pavement Association (NAPA). 2008. http://www.hotmix.org (accessed October 19, 2009).

NCHRP. 2006a. Low Impact Development Design Manual for Highway Runoff Control (LID Design Manual). National Cooperative Highway Research Program, Project 25-20(01).

NCHRP. 2006b. User's Guide for BMP/LID Selection (Guidelines Manual). National Cooperative Highway Research Program, Project 25-20(01).

University of New Hampshire (UNH). 2007. 2007 Annual Report. University of New Hampshire, Stormwater Center. http://ciceet.unh.edu/unh_stormwater_report_2007/index.php (accessed October 19, 2009).

Yoko, G. 2005. From the Ground Up (Article #331). http://www.sldtonline.com/content/view/213/70 (accessed October 19, 2009).

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

None identified

Alternative Designs

None identified

BMP Fact Sheet

Porous Surface Concrete Pavement

Description

Concrete porous surfaces allow infiltration into either storage basins or, more typically, into underlying soils. This unique cement-based concrete product with a porous structure is comprised of Portland cement, coarse aggregate rock, and water. The porous texture allows water to drain through it and into the underlying soils or reservoir. Because water infiltrates, hazards associated with standing water are less likely. An overflow mechanism is recommended in case of clogging of the underlying soils or reservoir. Suppliers of traditional concrete can usually mix and deliver porous concrete.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	✓
Total Phosphorus	✓
Pesticides	✓
Total Metals	✓
Dissolved Metals	✓
Microbiological	✓
Litter	
Biochemical Oxygen Demand (BOD)	✓
Total Dissolved Solids (TDS)	✓

* Removals are assumed to be due to 100% infiltration of the design water quality volume because no water is discharged to surface waters. Blank cells indicate data not available or poor treatment performance. Removals reported in literature are usually based on overflows from the reservoir course (UNH 2007).

Schematic

Source: Puget Sound Partnership

Key Design Elements

- Water quality volume
- Permeability of soil
- Distance to groundwater
- Load requirements
- Gradation of concrete mix

Advantages

- Eliminates surface discharge up to the design storm when properly sized in suitable soils
- Below grade infiltration inhibits access for mosquitoes
- Reduces or eliminates space needed for other BMPs
- Infiltration addresses all pollutants, except litter
- Caltrans modeling indicates that underlying soils will not likely become hazardous within five or more years, and typical Caltrans concentrations will not likely impact groundwater quality (Caltrans 2010)

Constraints

- Only suitable for low traffic areas, such as Park and Ride lots
- Low permeability in the subgrade will increase discharge through the over drain and decrease removal efficiency
- Not feasible where traction sand is applied
- More costly than traditional asphalt concrete
- Potential contamination from spills
- Water quality benefit expected to deteriorate with pavement age due to clogging of pores in the porous concrete

Porous Surface
Concrete Pavement

Maintenance Issues

Requirements:
- Inspect porous pavements annually
- Vacuum-style street sweepers are recommended, but not required

Special Training:
Unknown

Project Development Issues

Right-of-Way Requirements:
Requires no additional right-of-way

Siting Constraints:
- Similar to siting constraints for infiltration BMPs
- Some considerations are depth to groundwater, subgrade permeability, and soil type

Construction:
- Construction requires special care and some changes to normal practices and scheduling
- Minimize sub grade compaction to maintain soil permeability
- Before installation, erosion control should be in place until vegetation is established. Porous surface installation is recommended as the last item of construction.

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2007a. Mathematical Modeling of Fate and Transport of Aqueous Species in Stormflow Entering Infiltration Basin. Sacramento: Caltrans. Division of Environmental Analysis. CTSW-RT-06-168-17.2.

Sustainable Land Development Today. 2005. From the Ground Up (Article #331). www.sldtonline/content/view/213 (accessed October 30, 2009).

National Ready Mixed Concrete Association. 2008. www.pervious pavement.org (accessed October 30, 2009).

NCHRP. 2006a. Low Impact Development Design Manual for Highway Runoff Control (LID Design Manual). National Cooperative Highway Research Program, Project 25-20(01).

NCHRP. 2006b. User's Guide for BMP/LID Selection (Guidelines Manual). National Cooperative Highway Research Program, Project 25-20(01).

Portland Cement Association & National Ready Mixed Concrete Association. Pervious Concrete Pavements (brochure). www.cement.org and www.nrmca.org (accessed October 30, 2009).

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

None identified

Alternative Designs

None identified

BMP Fact Sheet

Porous Surface

Permeable Pavers/Cellular Confinement

Description

Permeable pavers allow infiltration into either storage basins or, more typically, into underlying soils. Permeable pavers are fairly durable with a life span of approximately 20 years, and possibly more with proper maintenance. Typically built on an open-graded, crushed stone base, permeable pavers interlock or have a minimal sand-filled gap between them. As with most permeable surfaces, the lower reservoir layer is designed for load requirements and water storage capacity. An overflow mechanism for the underlying soils or reservoir is recommended in case of clogging. The pavement may also be designed to receive off-site runoff.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	✓
Total Phosphorus	✓
Pesticides	✓
Total Metals	✓
Dissolved Metals	✓
Microbiological	✓
Litter	
Biochemical Oxygen Demand (BOD)	✓
Total Dissolved Solids (TDS)	✓

* Removals are assumed to be due to 100% infiltration of the design water quality volume because no water is discharged to surface waters. Blank cells indicate data not available or poor treatment performance.

Schematic

Source: National Resource Conservation Service

Key Design Elements

- Water quality volume
- Permeability of soil
- Distance to groundwater
- Load requirements

Advantages

- Eliminates surface discharge up to the design storm when properly sized in suitable soils
- Below grade infiltration inhibits access for mosquitoes
- Reduces or eliminates space needed for other BMPs
- Infiltration addresses all pollutants, except litter
- Caltrans modeling indicates that underlying soils will not likely become hazardous within five or more years, and typical Caltrans concentrations will not likely impact groundwater quality (Caltrans 2010)

Constraints

- Only suitable for low traffic areas, such as Park and Ride lots
- Low permeability in the subgrade will increase discharge through the over drain and decrease removal efficiency
- Not feasible where traction sand is applied
- More costly than traditional asphalt concrete
- Potential contamination from spills

Porous Surface

Permeable Pavers/Cellular Confinement

Maintenance Issues

Requirements:

- Inspect annually
- Vacuum-style street sweepers are recommended, but not required

Special Training:

Unknown

Project Development Issues

Right-of-Way Requirements:

Requires no additional right-of-way

Siting Constraints:

- Similar to siting constraints for infiltration BMPs
- Some considerations are depth to groundwater, subgrade permeability, and soil type

Construction:

- Construction requires special care and some changes to normal practices and scheduling
- Minimize sub-grade compaction maintain soil permeability
- Before installation, erosion control should be in place until vegetation is established. Porous surface installation is recommended as the last item of construction.

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2007a. Mathematical Modeling of Fate and Transport of Aqueous Species in Stormflow Entering Infiltration Basin. Sacramento: Caltrans-Division of Environmental Analysis. CTSW-RT-06-168-17.2.

Interlocking Concrete Pavement Institute. 2005. http://www.icpi.org (accessed October 29, 2009).

NCHRP. 2006a. Low Impact Development Design Manual for Highway Runoff Control (LID Design Manual). National Cooperative Highway Research Program, Project 25-20(01).

NCHRP. 2006b. User's Guide for BMP/LID Selection (Guidelines Manual). National Cooperative Highway Research Program, Project 25-20(01).

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

A large variety of products are available (too many to list)

Alternative Designs

None identified

BMP Fact Sheet

Screening

Gross Solids Removal

Description

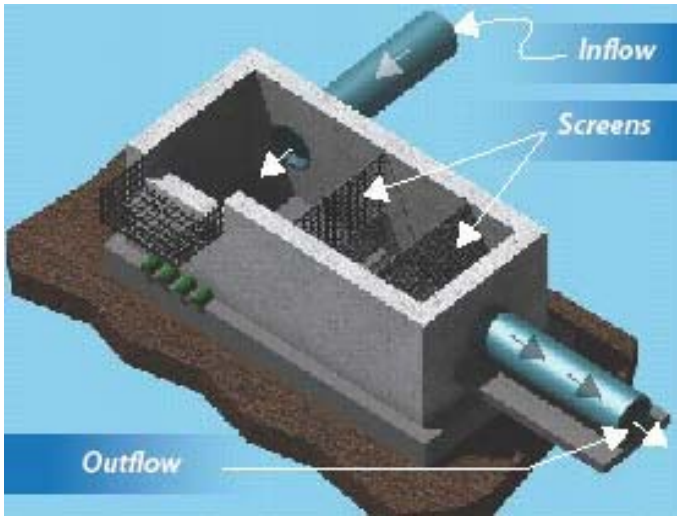
Gross solids, which consist of litter, debris, and vegetation, can be removed by passing the stormwater runoff through metal or fabric screens. Screens provide treatment by preventing solids larger than the screen opening from passing through. The effectiveness of screening systems depends on the flow rate, the type and opening size of the screen, and the type and size distribution of the gross solids in the incoming stormwater.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	
Total Nitrogen	
Total Phosphorus	
Pesticides	
Total Metals	
Dissolved Metals	
Microbiological	
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on best professional judgment. Blank cells indicate data not available or poor treatment performance. Removal by small screening devices with insufficient storage capacity may not be as indicated.

Schematic



Source: Caltrans

Key Design Elements

- Flood flow routing and bypass
- Gross solids storage capacity
- Maintenance access
- Screen type and opening size

Advantages

- Can be retrofitted onto stormwater outfalls, pipe culverts, and channels of any shape
- Simple maintenance

Constraints

- Frequent maintenance or inspection may be required
- Requires access road for maintenance
- Maintenance activities may require traffic control if the device is installed along the traveled way

Screening

Gross Solids Removal

Maintenance Issues

Requirements:

- Requires access road for maintenance
- Frequent inspections may be required to check on the nets or screens
- Requires mechanical (Vactor) cleaning, and may require hand cleaning for some trapped solids

Special Training:

Unknown

Project Development Issues

Right-of-Way Requirements:

Increases space requirements if used for pretreatment

Siting Constraints:

Little or no site development needed to implement

Construction:

None identified

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2004. BMP Retrofit Pilot Program Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-050.

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

- Bandalong Litter Trap
- Net Cassette™
- Nutrient Separating Baffle Box
- StormTEE®
- Gross Pollutant Trap (GPT)
- Netting TrashTrap™
- StormScreen™
- Trashmaster™
- Bay Separator

Alternative Designs

- GSRD - Inclined Screen
- GSRD - Linear Radial

BMP Fact Sheet

Water Quality Inlet

Oil/Water Separator

Description

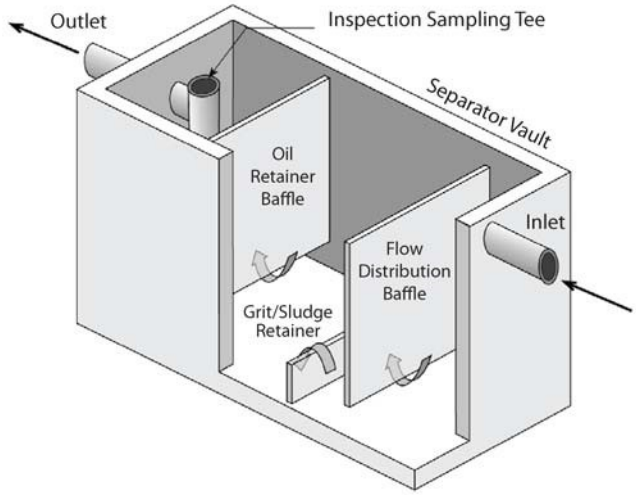
Water quality inlets, also called oil/grit separators or oil/water separators, consist of a series of chambers that promote sedimentation of coarse materials and separation of free oil (as opposed to emulsified or dissolved oil) from stormwater. Most water quality inlets also contain screens to help retain larger or floating debris, and may include a coalescing unit that helps to promote oil/water separation. Water quality inlets typically capture only the first portion of runoff for treatment, and are generally used for pretreatment of runoff before discharging to other BMPs.

Constituent Removal

Constituent Group	Removal*
Total Suspended Solids (TSS)	✓
Total Nitrogen	
Total Phosphorus	
Pesticides	
Total Metals	
Dissolved Metals	
Microbiological	
Litter	✓
Biochemical Oxygen Demand (BOD)	
Total Dissolved Solids (TDS)	

* Based on best professional judgment. Blank cells indicate data not available or poor treatment performance.

Schematic



Source: City of Medford, Oregon

Key Design Elements

- Hydraulic capacity and pollutant storage capacity
- Provision for overflow or bypass
- Detention time
- Vector control if permanent pool present
- Maintenance access

Advantages

- Relatively small footprint
- Simple maintenance

Constraints

- Limited pollutant removal, especially for fine particles and dissolved constituents
- Vector concern if permanent pool present
- Can be a source of pollutants due to decomposition of previously captured material unless maintained regularly
- May require confined space entry

Water Quality Inlet

Oil/Water Separator

Maintenance Issues

Requirements:

- Because of site-specific loading, several wet season inspections may be required to determine appropriate maintenance frequency
- Vactor equipment is recommended for cleaning, but is not required
- Vector control or abatement may be required

Special Training:

Training may be required for confined space entry

Project Development Issues

Right-of-Way Requirements:

Relatively small footprint

Siting Constraints:

- Minimal head requirement
- Effective oil removal by similar technologies usually requires influent concentrations above 50 mg/L (Caltrans 2004)

Construction:

None identified

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2004. BMP Retrofit Pilot Program Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-050.

US EPA. 1999. Storm Water Technology Fact Sheet, Water Quality Inlets. EPA 832-F-99-029.

Available Vendor Products

The names of vendor products that appear here are for information only. The vendor products listed below are NOT APPROVED FOR USE by the California Department of Transportation. Their appearance here IS NOT AN ENDORSEMENT OF THE PRODUCTS BY CALTRANS OR THE STATE OF CALIFORNIA.

- ADS® Water Quality Unit
- BioSTORM™
- CrystalStream™
- First Flush - 1640FF
- Hanson Oil and Grit Separator Unit
- Kleerwater™
- SNOUT®
- VortClarex™
- BaySaver® BaySeparator
- Clara™
- EcoSep®
- Hancor®-Storm Water Quality Unit
- HD Q-Pac®
- PSI Separator
- StormVault™

Alternative Designs

None identified

APPENDIX C: CALTRANS-APPROVED BMP FACT SHEETS

Appendix C presents fact sheets for BMPs approved for installation on Caltrans facilities. Implementation of these BMPs should follow the guidelines in the Storm Water Management Plan and the Storm Water Project Planning and Design Guide (PPDG).

TABLE OF CONTENTS

BMP Category	*Stormwater Technology*	*Page No.*
Biofiltration		
	Strip	C-3
	Swale	C-5
Detention Basin		C-7
Dry Weather Flow Diversion		C-9
Filtration		
Bed	Austin Sand Filter	C-11
	Delaware Sand Filter	C-13
Infiltration		
Basin		C-15
Trench		C-17
Litter and Debris Removal		
GSRD–Inclined Screen		C-19
GSRD–Linear Radial		C-21
Multi-Chambered Treatment Train		C-23
Traction Sand Trap		
Double Barrel		C-25
Wet Basin/Pond		C-27

blank for double sided printing

Biofiltration

Strip

Description

Biofiltration strips are relatively flat, vegetated areas that accept stormwater runoff as sheet flow. Removal mechanisms include sedimentation, filtration, and infiltration. Strips can be used as pretreatment to infiltration trenches and basins, and sand filters. They can also be used in treatment trains with other BMPs.

Constituent Removal

Constituent Group	Removal Efficiency	Level of Confidence
Total Suspended Solids (TSS)	◒	●
Total Nitrogen	◒	◒
Total Phosphorus	○	◒
Pesticides	○	○
Total Metals	◒	●
Dissolved Metals	◒	●
Microbiological	◒	◒
Litter	NA	
Biochemical Oxygen Demand (BOD)	○	○
Total Dissolved Solids (TDS)	NA	

Rating Key for Constituent Removel Efficiency and Level of Confidence

● High ◒ Medium ○ Low

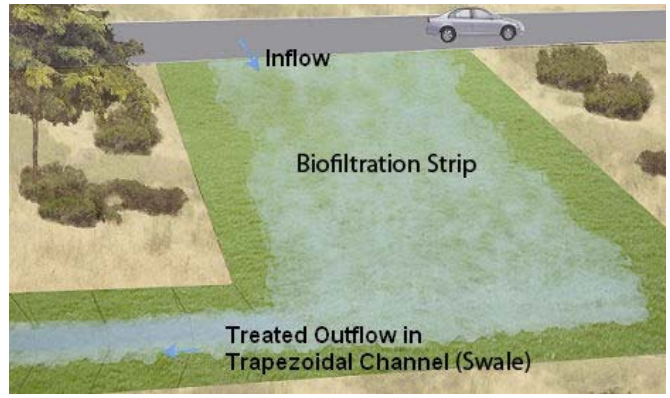
Notes:

Three biofiltration strips were sited, constructed, and monitored as part of the Caltrans BMP Retrofit Pilot Program (2004). Total nitrogen load removal is mostly dependent on infiltration losses. Phosphorus concentrations increased but infiltration compensated so that there was no net export of phosphorus load. This may be due to the vegetation selection of salt grass, which can uptake phosphorus and excrete it on its leaves. Phosphorus removal efficiency may be higher with alternative vegetation. BOD ratings are based on metadata compiled by Young et al. (1996). Pesticide ratings are based on the "Evaluation of Factors Controlling Herbicide Runoff to Surface Water" report (Caltrans 2005). Load removal analysis has been performed for a variety of roadside conditions (Caltrans 2008). Microbiological ratings are based on Rifai (2006) and Clary (2008).

Caltrans Evaluation Status

Approved

Schematic



Source: Caltrans

Key Design Elements

- Maximize flow paths to maximize treatment
- Specify vegetation that occurs naturally to minimize establishment and maintenance costs
- Size the strips as long (in direction of flow) and flat as the site will reasonably allow, up to sheet flow boundaries (maximum length of biofiltration strips is approximately 100 ft)
- Minimum of 70% vegetation coverage
- Caltrans designers should follow the Project Planning and Design Guide (Caltrans 2010)

Cost Effectiveness Relative to Detention Basins

Cost Effectiveness	Level Confidence
◪	●

Rating Key for Cost Effectiveness Relative to Detention Basins

Benefit ↑ Cost ↓	Benefit ↑ Cost ↑
Benefit ↓ Cost ↓	Benefit ↓ Cost ↑

Rating Key for Cost Effectiveness Level of Confidence

● High ◒ Medium ○ Low

Notes:

Biofiltration

Strip

Maintenance Issues

Requirements:

- Regular inspections for side slope stability, debris and sediment accumulation, vegetative cover, and presence of burrowing animals
- If acceptable cover is not achieved, re-seeding or some type of erosion control will be needed

Special Training:

None identified

Project Development Issues

Right-of-Way Requirements:

Large footprint, but can be placed on fill slopes and occupy the clear recovery zone

Siting Constraints:

- Requires sheet flow, so site in areas where sheet flow predominates
- Climate and soil conducive to sustainable plant growth

Construction:

Minimize soil compaction

Advantages

- High removal efficiencies for total suspended solids and total metals
- Generally inexpensive relative to other BMPs
- Potential for substantial infiltration

Constraints

- Soil may need to be conditioned to allow vegetation to establish
- Climate may preclude vegetation establishment

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

Young, G. K., S. Stein, P. Cole, T. Kammer, F. Graziano, and F. Bank. 1996. Evaluation and Management of Highway Runoff Water Quality. U.S. Department of Transportation.

Performance Demonstrations Literature Sources

Barrett, M. E. 2008. Comparison of BMP Performance Using the International BMP Database. Journal of Irrigation and Drainage Engineering, 134(5), 556-561.

Caltrans. 2004. BMP Retrofit Pilot Program Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-050.

Caltrans. 2005. Evaluation of Factors Controlling Herbicide Runoff to Surface Water. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-03-084-73.04.

Caltrans. 2008. Roadside Vegetated Treatment Sites (RVTS) Study Final Summary Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-08-208-03-1.

Clary, J., J. E. Jones, E. R. Urbonas, M. M. Quigley, E. Strecker, and T. Wagner. 2008. Can Stormwater BMPs Remove Bacteria? New Findings from the International Stormwater BMP Database. Stormwater Magazine, 9(3). http://www.stormh2o.com/may-2008/bacterm/may-2008/bacterial-research-bmps.aspx

Read, J., T. Wevill, T. Fletcher, and A. Deletic. 2008. Variation Among Plant Species in Pollutant Removal from Stormwater in Biofiltration Systems. Water Research, 42, 893-902.

Rifai, H. 2006. Study on the Effectiveness of BMPs to Control Bacteria Loads. Austin, TX: Texas Commission on Environmental Quality.

Certifications, Verifications, or Designations

None identified

Biofiltration

Swale

Description

Biofiltration swales are vegetated conveyance channels that concentrate flow. Removal mechanisms include filtration, infiltration, and sedimentation. Swales can be integrated into treatment trains with other type of BMPs.

Constituent Removal

Constituent Group	Removal Efficiency	Level of Confidence
Total Suspended Solids (TSS)	◒	●
Total Nitrogen	◒	◒
Total Phosphorus	○	◒
Pesticides	○	○
Total Metals	◒	●
Dissolved Metals	◒	●
Microbiological	○	◒
Litter	NA	
Biochemical Oxygen Demand (BOD)	○	○
Total Dissolved Solids (TDS)	○	○

Rating Key for Constituent Removel Efficiency and Level of Confidence

● High ◒ Medium ○ Low

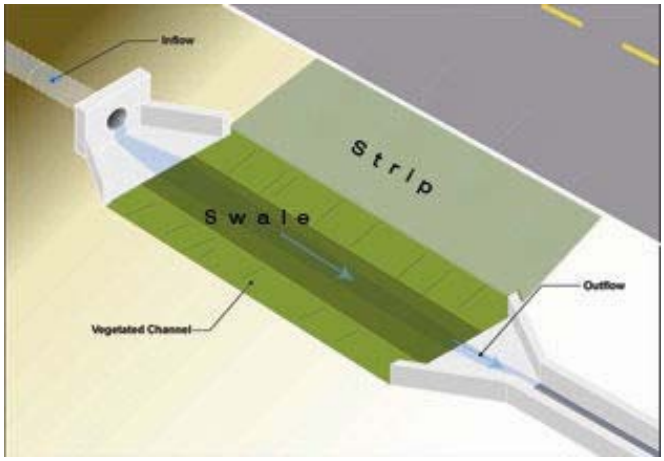
Notes:

Six biofiltration swales were sited, constructed, and monitored as part of the Caltrans BMP Retrofit Pilot Program (Caltrans 2004). Total nitrogen load removal is highly dependent on infiltration losses. Phosphorus concentrations increased but infiltration compensated so that there was no net export of phosphorus load. This may be due to the vegetation selection of salt grass, which can uptake phosphorus and excrete it on its leaves. Phosphorus removal efficiency may be higher with alternative vegetation, though analysis of the international BMP database by Barrett (2008) suggests a low removal rate. BOD ratings are based on metadata compiled by Young et al. (1996). Pesticide ratings are based on the findings in the "Evaluation of Factors Controlling Herbicide Runoff to Surface Water" report (Caltrans 2005).

Caltrans Evaluation Status

Approved

Schematic



Source: Caltrans

Key Design Elements

- Length slope and width as quantified by the hydraulic residence time
- Specify vegetation that occurs naturally to minimize establishment and maintenance costs
- Minimum vegetation cover
- Energy dissipaters
- Side slopes constructed of narrow berms are not recommended because they are prone to damage by gophers or other burrowing animals
- Scour velocity
- Check dams may enhance infiltration
- Caltrans designers should follow the Project Planning and Design Guide (Caltrans 2010)

Cost Effectiveness Relative to Detention Basins

Cost Effectiveness	Level of Confidence
◪	●

Rating Key for Cost Effectiveness Relative to Detention Basins

Benefit ↑ Cost ↓	Benefit ↑ Cost ↑
Benefit ↓ Cost ↓	Benefit ↓ Cost ↑

Rating Key for Cost Effectiveness Level of Confidence

● High ◒ Medium ○ Low

Notes:

Based on retrofit costs. Cost for new construction may be substantially lower.

Biofiltration

Swale

Maintenance Issues

Requirements:

● Regular inspections for side slope stability, debris and sediment accumulation, vegetation height, vegetative cover, and presence of burrowing animals
● If acceptable cover is not achieved, re-seeding or some type of erosion control will be needed

Special Training:

None identified

Project Development Issues

Right-of-Way Requirements:

Sufficient space required to achieve the target hydraulic residence time

Siting Constraints:

● Place in areas of natural lows or cut sections to minimize damage caused by gophers or other burrowing animals
● Climate and soil conducive to sustainable plant growth

Construction:

None identified

Advantages

● Incorporates well into the environment
● Effective removal efficiencies for total suspended solids and total metals
● Potential for substantial infiltration

Constraints

● Soil may need to be conditioned to allow vegetation to establish
● Climate may preclude vegetation establishment

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

Young, G. K., S. Stein, P. Cole, T. Kammer, F. Graziano, and F. Bank. 1996. Evaluation and Management of Highway Runoff Water Quality. U.S. Department of Transportation.

Performance Demonstrations Literature Sources

Barrett, M. E. 2008. Comparison of BMP Performance Using the International BMP Database. Journal of Irrigation and Drainage Engineering, 134(5), 556-561.

Caltrans. 2004. BMP Retrofit Pilot Program Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-050.

Caltrans. 2005. Evaluation of Factors Controlling Herbicide Runoff to Surface Water. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-03-084-73.04.

Read, J., T. Wevill, T. Fletcher, and A. Deletic. 2008. Variation Among Plant Species in Pollutant Removal from Stormwater in Biofiltration Systems. Water Research, 42, 893-902.

Certifications, Verifications, or Designations

None identified

BMP Fact Sheet

Detention Basin

Description

A detention basin is an impoundment that collects stormwater via storm drain inlets. The basin captures and detains the design runoff volume (typically for 48 hours). Discharges from the basin typically occur through a perforated riser. The basin removes floatable debris and coarse suspended solids. Pollutant removal is achieved primarily through settling of sediments and particulate forms of pollutants.

Constituent Removal

Constituent Group	Removal Efficiency	Level of Confidence
Total Suspended Solids (TSS)	◒	●
Total Nitrogen	○	◒
Total Phosphorus	◒	◒
Pesticides	NA	
Total Metals	◒	●
Dissolved Metals	○	◒
Microbiological	○	○
Litter	●	◒
Biochemical Oxygen Demand (BOD)	NA	
Total Dissolved Solids (TDS)	NA	

Rating Key for Constituent Removel Efficiency and Level of Confidence

● High ◒ Medium ○ Low

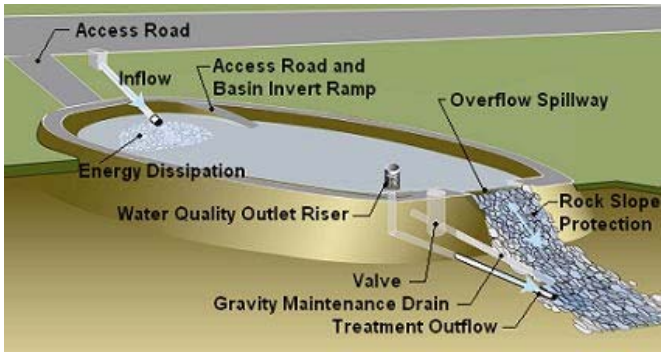
Notes:

Removal efficiency and levels of confidence ratings are based on results from unlined detention basins. The Caltrans Retrofit Pilot Program (2004) constructed five detention basins for study. The litter removal rating is based on best professional judgment.

Caltrans Evaluation Status

Approved

Schematic



Source: Caltrans

Key Design Elements

- Capture volume
- Drain time
- Debris screen to protect orifice
- Maintenance access
- Side slopes
- High flow routing
- Caltrans designers should follow the Project Planning and Design Guide (Caltrans 2010)

Cost Effectiveness Relative to Detention Basins

Cost Effectiveness	Level of Confidence

Rating Key for Cost Effectiveness Relative to Detention Basins

Benefit ↑ Cost ↓	Benefit ↑ Cost ↑
Benefit ↓ Cost ↓	Benefit ↓ Cost ↑

Rating Key for Cost Effectiveness Level of Confidence

● High ◒ Medium ○ Low

Notes:

Cost assessment is not applicable because cost effectiveness is relative to detention basins. Cost comparisons to other BMPs are based on a 20-year life cycle cost of $673/m³ (1999 dollars) (Caltrans 2004).

Detention Basin

Maintenance Issues

Requirements:

● Regular inspections for standing water, side slope stability, debris and sediment accumulation, and vegetative cover
● If vegetative cover of the basin invert or side slopes is not established to acceptable thresholds, re-seeding or erosion control measures may need to be implemented
● Sediment removal

Special Training:

None identified

Project Development Issues

Right-of-Way Requirements:

Space requirements are relatively high

Siting Constraints:

● Site where there is sufficient hydraulic head to facilitate complete drainage
● Do not site in areas where groundwater contamination is a concern, unless lined (and anchored to combat floatation)

Construction:

None identified

Advantages

● Relatively easy to operate and maintain
● Potential for substantial infiltration
● Can be sited more easily than Austin filters

Constraints

● Limited pollutant removal for nutrients and dissolved constituents
● Can only be placed in areas with sufficient hydraulic head

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

Performance Demonstrations Literature Sources

Caltrans. 2004. BMP Retrofit Pilot Program Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-050.

Glick, R., G. C. Chang, and M. E. Barrett. 1998. Monitoring and Evaluation of Stormwater Quality Control Basins, in Watershed Management: Moving from Theory to Implementation, Denver, CO, May 3-6, 1998, pp. 369-376.

Young, G. K., S. Stein, P. Cole, T. Kammer, F. Graziano, and F. Bank. 1996. Evaluation and Management of Highway Runoff Water Quality. U.S. Department of Transportation.

Certifications, Verifications, or Designations

None identified

BMP Fact Sheet

Dry Weather Flow Diversion

Description

A dry weather flow diversion device can divert dry weather flows from the storm drain system to the sanitary sewer system, and convey it to a publicly-owned treatment works (POTW). During wet weather, this diversion is suspended because stormwater flows can be greater than the flow the POTW is designed to manage.

Constituent Removal

Constituent Group	Removal Efficiency	Level of Confidence
Total Suspended Solids (TSS)	●	●
Total Nitrogen	●	●
Total Phosphorus	●	●
Pesticides	●	●
Total Metals	●	●
Dissolved Metals	●	●
Microbiological	●	●
Litter	●	●
Biochemical Oxygen Demand (BOD)	●	●
Total Dissolved Solids (TDS)	●	●

Rating Key for Constituent Removel Efficiency and Level of Confidence

● High ◒ Medium ○ Low

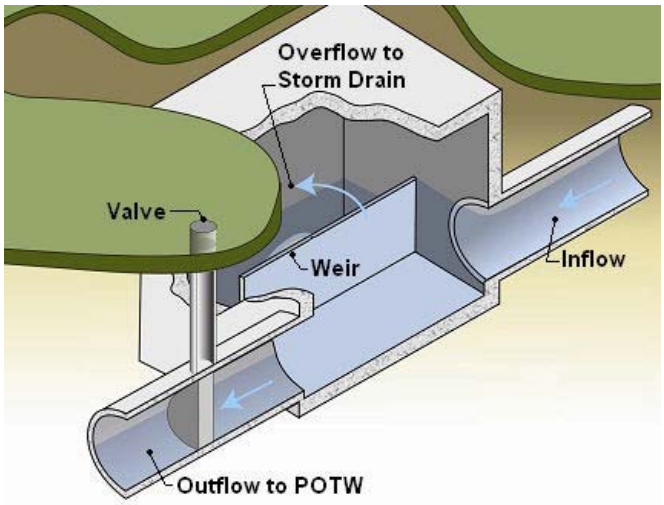
Notes:

Removal efficiency ratings are based on the diversion of dry weather flow events. The device does not treat stormwater flows when closed during wet weather.

Caltrans Evaluation Status

Approved

Schematic



Source: Caltrans

Key Design Elements

Caltrans designers should follow the Project Planning and Design Guide (Caltrans 2010)

Cost Effectiveness Relative to Detention Basins

Cost Effectiveness	Level of Confidence
◪	○

Rating Key for Cost Effectiveness Relative to Detention Basins

Benefit ↑ Cost ↓	Benefit ↑ Cost ↑
Benefit ↓ Cost ↓	Benefit ↓ Cost ↑

Rating Key for Cost Effectiveness Level of Confidence

● High ◒ Medium ○ Low

Notes:

BMP Fact Sheet

Dry Weather Flow Diversion

Maintenance Issues

Requirements:
Depends on the complexity of the diversion

Special Training:
May require special training for inspection and maintenance of pumped diversions

Project Development Issues

Right-of-Way Requirements:
Small footprint

Siting Constraints:
Must be able to convey diverted flow to a POTW sewer

Construction:
Coordination required with local POTW

Advantages

Advanced treatment of the diverted flow

Constraints

- Must have agreement with POTW
- Cost is highly variable depending on site conditions

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

Performance Demonstrations Literature Sources

None identified

Certifications, Verifications, or Designations

None identified

Filtration Bed

Austin Sand Filter

Description

The Austin Sand Filter includes a sedimentation basin and a filtration basin. The sedimentation basin captures and detains the design water quality runoff volume (typically for 24 hrs.) prior to discharge to the filtration basin. The sedimentation basin removes floatable debris and coarse suspended solids, and prevents premature clogging of the filter media surface. The sedimentation chamber effluent discharges to the filtration basin typically through a perforated riser. In the filtration basin, the water first passes through a sand layer, then through a geotextile layer, and finally into a gravel underdrain. Pollutant removal is achieved primarily by physical filtration of pollutants through the filtration media, and the settling of solids in the sedimentation basin. An Austin Sand Filter can also be designed so that the sedimentation and filtration sections are combined into one basin. In this design, gabions are used to disperse water and encourage sedimentation prior to the sand bed.

Constituent Removal

Constituent Group	Removal Efficiency	Level of Confidence
Total Suspended Solids (TSS)	●	●
Total Nitrogen	○	●
Total Phosphorus	◒	●
Pesticides	NA	
Total Metals	◒	●
Dissolved Metals	◒	◒
Microbiological	◒	○
Litter	●	◒
Biochemical Oxygen Demand (BOD)	◒	◒
Total Dissolved Solids (TDS)	NA	

Rating Key for Constituent Removel Efficiency and Level of Confidence

● High ◒ Medium ○ Low

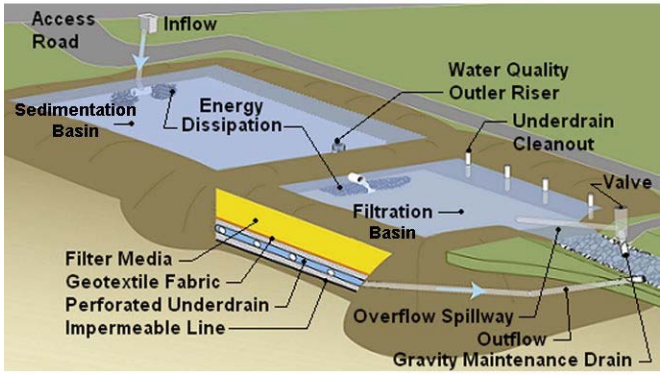
Notes:

Except where noted, removal efficiency and levels of confidence ratings are based on the Caltrans Retrofit Pilot Program Final Report (2004). Five Austin Sand Filters were constructed and monitored. While nitrate concentrations increased by 35%, total nitrogen decreased by 32%. The phosphorus removal efficiency rating is based on the average of results from Caltrans and Glick et al. (1998). BOD ratings are based on metadata compiled by Young et al. (1996). Litter removal ratings are based on best professional judgment.

Caltrans Evaluation Status

Approved

Schematic



Source: Caltrans

Key Design Elements

- Capture volume
- Orifice plate on effluent pipe to enhance sand media contact time
- Media area and depth
- Caltrans designers should follow the Project Planning and Design Guide (Caltrans 2010)

Cost Effectiveness Relative to Detention Basins

Cost Effectiveness	Level of Confidence
◪	●

Rating Key for Cost Effectiveness Relative to Detention Basins

Benefit ↑ Cost ↓	Benefit ↑ Cost ↑
Benefit ↓ Cost ↓	Benefit ↓ Cost ↑

Rating Key for Cost Effectiveness Level of Confidence

● High ◒ Medium ○ Low

Notes:

Cost effectiveness determination pending further evaluation.

Filtration Bed

Austin Sand Filter

Maintenance Issues

Requirements:

- Media scraping
- Sediment removal
- Media replacement

Special Training:

Training required for media removal and replacement

Project Development Issues

Right-of-Way Requirements:

Space requirements are marginally higher than those for a detention basin

Siting Constraints:

- Head requirement of about 4 feet
- Avoid locations with base flow because of clogging due to algae growth

Construction:

If used for construction site runoff, remove and replace sand after drainage area has been completely stabilized

Advantages

- High constituent removal for suspended solids, total metals, and bacteria
- Provides consistent pollutant removal when properly maintained
- Treats runoff from drainage areas up to 20 hectares

Constraints

- Limited pollutant removal for nutrients
- More expensive to construct than a detention basin

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

US EPA. Storm Water Technology Fact Sheet, Sand Filters. EPA 832-F-99-007.

Performance Demonstrations Literature Sources

Caltrans. 2004. BMP Retrofit Pilot Program Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-050.

Caltrans. 2007. Caltrans Statewide [Austin] Sand Filter Study Final 2006 Stormwater Monitoring Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-06-128.01.1.

Erickson, A. J., J. S. Gulliver, and P. T. Weiss. 2007. Enhanced Sand Filtration for Storm Water Phosphorus Removal. Journal of Environmental Engineering, 10.1061, (ASCE) 0733-9372 133:5(485).

Glick, R., G. C. Chang, and M. E. Barrett. 1998. Monitoring and Evaluation of Stormwater Quality Control Basins, in Watershed Management: Moving from Theory to Implementation, Denver, CO, May 3-6, 1998, pp. 369-376.

Young, G. K., S. Stein, P. Cole, T. Kammer, F. Graziano, and F. Bank. 1996. Evaluation and Management of Highway Runoff Water Quality. U.S. Department of Transportation.

Certifications, Verifications, or Designations

None identified

Filtration Bed

Delaware Sand Filter

Description

Delaware Sand Filters are often located at the curbside edge of a paved area or parking lot, and consist of two parallel concrete chambers: a sedimentation chamber and a sand filter chamber. The sedimentation chamber holds a permanent pool of water. The sedimentation chamber removes coarse suspended solids and prevents premature clogging of the filter media surface. The sedimentation effluent discharges over a weir into the sand filter chamber where water is filtered first through a 12- to 18-inch sand filter, then through a geotextile layer, and finally into an under-drain. These on-line devices process all runoff leaving the site up to the point where the overflow limit is reached. The typical shape of the device is narrower (but longer) than some other treatment BMPs, which can be advantageous in some situations.

Constituent Removal

Constituent Group	Removal Efficiency	Level of Confidence
Total Suspended Solids (TSS)	●	●
Total Nitrogen	○	◒
Total Phosphorus	◒	●
Pesticides	NA	
Total Metals	●	●
Dissolved Metals	◒	●
Microbiological	◒	◒
Litter	●	◒
Biochemical Oxygen Demand (BOD)	○	○
Total Dissolved Solids (TDS)	NA	

Rating Key for Constituent Removel Efficiency and Level of Confidence

● High ◒ Medium ○ Low

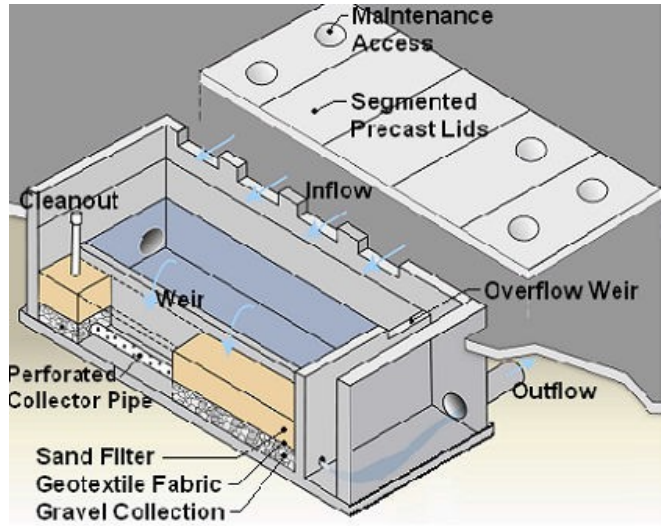
Notes:

This device was sited as part of the Caltrans BMP Retrofit Pilot Program (2004). Although not thought to be effective for removing dissolved constituents, some removal was observed. The litter removal rating is based on best professional judgment. Caltrans (2004) reported that nitrate concentrations increased by 78%, and a high removal efficiency for dissolved zinc. BOD ratings are based on metadata compiled by Young et al. (1996).

Caltrans Evaluation Status

Approved

Schematic



Source: Caltrans

Key Design Elements

- The Delaware unit that was evaluated was designed and installed according to the guidelines described by Young et al. (1996), which requires the sedimentation volume to equal 5 mm of runoff (0.2 inches). Consequently, if it is desired to treat a larger water quality volume, the unit must act as a flow-through device
- Size the filter based on unit values for the sedimentation chamber volume and filter bed area per acre of tributary area treated
- Caltrans designers should follow the Project Planning and Design Guide (Caltrans 2010)

Cost Effectiveness Relative to Detention Basins

Cost Effectiveness	Level of Confidence
◪	●

Rating Key for Cost Effectiveness Relative to Detention Basins

Benefit ↑ Cost ↓	Benefit ↑ Cost ↑
Benefit ↓ Cost ↓	Benefit ↓ Cost ↑

Rating Key for Cost Effectiveness Level of Confidence

● High ◒ Medium ○ Low

Notes:

Filtration
Bed

Delaware Sand Filter

Maintenance Issues

Requirements:

● Maintenance for smaller, underground filters is usually best done manually
● Disposal of accumulated trash and replacement of the upper few inches of sand when the filter clogs
● Vector control or abatement

Special Training:

Training required for media removal

Project Development Issues

Right-of-Way Requirements:

Space requirements are relatively high

Siting Constraints:

● Do not site where runoff from bare soil or construction activities will be allowed to enter the filter
● Minimum head requirement of 3 feet
● Avoid locations with base flow

Construction:

None identified

Advantages

● Can be installed underground in urban settings with covers appropriate for the intended above ground land use, such as sidewalk or landscaping
● Similar in performance to the Austin Filter design with the principal advantage being narrower footprint that requires less head
● Waste media from the filters does not appear to be toxic and is likely to be environmentally safe for landfill disposal

Constraints

● The sedimentation basin holds a permanent pool of water and has the potential to provide breeding opportunities for mosquitoes
● Relatively expensive to construct compared to other approved BMPs (Caltrans 2004)
● Limited pollutant removal capability for nutrients

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

US EPA. Storm Water Technology Fact Sheet, Sand Filters. EPA 832-F-99-007.

Performance Demonstrations Literature Sources

Bell, W., L. Stokes, L. J. Gavan,and T. N. Nguyen. 1995. Assessment of the Pollutant Removal Efficiencies of Delaware Sand Filter BMPs. Department of Transportation and Environmental Services. Alexandria, VA. p. 140.

Caltrans. 2004. BMP Retrofit Pilot Program Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-050.

Horner, R. R., and C. R. Horner. 1995. Design, Construction, and Evaluation of a Sand Filter Stormwater Treatment System. Part III. Performance Monitoring. Report to Alaska Marine Lines, Seattle, WA.

Shaver, E., and R. Baldwin. 1991. Sand Filter Design for Water Quality Treatment. Delaware Department of Natural Resources and Environmental Control. Dover, DE. 14 pp.

Young, G. K., S. Stein, P. Cole, T. Kammer, F. Graziano, and F. Bank. 1996. Evaluation and Management of Highway Runoff Water Quality. U.S. Department of Transportation.

Certifications, Verifications, or Designations

None identified

BMP Fact Sheet

Infiltration Basin

Description

Infiltration basins are depressions used to detain stormwater runoff until it percolates into the groundwater table. Pollutant removal occurs through the infiltration of runoff and the adsorption of pollutants into the soil and vegetation. Infiltration basins are designed to infiltrate within 72 hours to prevent vector problems due to standing water. There needs to be sufficient space between the basin invert and the seasonally high groundwater elevation to allow infiltration to occur.

Constituent Removal

Constituent Group	Removal Efficiency	Level of Confidence
Total Suspended Solids (TSS)	●	●
Total Nitrogen	●	●
Total Phosphorus	●	●
Pesticides	●	●
Total Metals	●	●
Dissolved Metals	●	●
Microbiological	●	●
Litter	●	●
Biochemical Oxygen Demand (BOD)	●	●
Total Dissolved Solids (TDS)	●	●

Rating Key for Constituent Removel Efficiency and Level of Confidence

● High ◒ Medium ○ Low

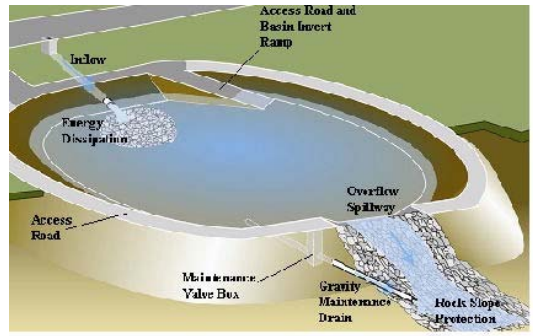
Notes:

The removal rating for infiltration is assumed to be 100% for the design water quality volume because no water is discharged to surface waters. Removal efficiencies reported in the literature are usually based on overflow discharge (Young et al. 1996). Litter is assumed to be captured within the basin.

Caltrans Evaluation Status

Approved

Schematic



Source: Caltrans

Key Design Elements

- Capture volume
- Basin invert area
- Maintenance access
- High flow routing
- Caltrans designers should follow the Project Planning and Design Guide (Caltrans 2010)

Cost Effectiveness Relative to Detention Basins

Cost Effectiveness	Level of Confidence
◪	●

Rating Key for Cost Effectiveness Relative to Detention Basins

Benefit ↑ Cost ↓	Benefit ↑ Cost ↑
Benefit ↓ Cost ↓	Benefit ↓ Cost ↑

Rating Key for Cost Effectiveness Level of Confidence

● High ◒ Medium ○ Low

Notes:

Based on Caltrans data (2004)

Infiltration
Basin

Maintenance Issues

Requirements:

● Conduct regular inspections for standing water, debris and sediment accumulation, and slope stability
● Avoid rubber tired vehicles in basin to reduce compaction
● Tracked equipment recommended for major maintenance

Special Training:

None identified

Project Development Issues

Right-of-Way Requirements:

Space requirements are relatively high for infiltration basins

Siting Constraints:

● Infiltration basins can only be placed in areas where soil is hydrologic soil group type A, B, or C soils and that meet permeability requirements
● Soil cannot have more than 30% clay or more than 40% clay and silt combined
● Minimum infiltration rate of 0.5 in/hr is preferred
● Distance between the groundwater elevation and the basin invert should be at least 4 feet, but 10 feet is preferable

Construction:

● Stabilize area draining into the facility. If possible, place a diversion berm to prevent sediment from entering the facility
● Build the basin without driving heavy equipment over the infiltration surface. Any equipment should have "low pressure" treads or tires
● After final grading, deeply till the infiltration surface
● Use appropriate erosion control seed mix

Advantages

Due to the infiltration of the entire water quality volume, the constituent removal is considered to be 100%

Constraints

● Site only in areas with the appropriate soil type/content and distance from the groundwater elevation to facilitate infiltration
● Restrict use if the runoff does not meet the requirement of a RWQCB-issued Basin Plan, or if the potential site is above a known pollutant plume

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

Young, G. K., S. Stein, P. Cole, T. Kammer, F. Graziano, and F. Bank. 1996. Evaluation and Management of Highway Runoff Water Quality. U.S. Department of Transportation.

Performance Demonstrations Literature Sources

Caltrans. 2004. BMP Retrofit Pilot Program Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-050.

Gaus, J. 1993. Soils of Infiltration Basins in the Puget Sound Region: Trace Metals and Concentrations. Masters Thesis. Univ. of Washington.

Hilding, K. 1993. A Study of Infiltration Basins in the Puget Sound Region. Masters Thesis. Dept. of Biological and Agricultural Engineering. Univ. of California, Davis.

Young, G. K., S. Stein, P. Cole, T. Kammer, F. Graziano, and F. Bank. 1996. Evaluation and Management of Highway Runoff Water Quality. U.S. Department of Transportation.

Certifications, Verifications, or Designations

None identified

BMP Fact Sheet

Infiltration Trench

Description

An infiltration trench is typically a long and narrow excavation that is lined with filter fabric and backfilled with stone aggregate or gravel to form an underground basin. Runoff is diverted to the trench and infiltrates into the soil. Pollutants are filtered out of the runoff as it infiltrates the surrounding soils. Infiltration trenches must be sited in areas where soils meet the minimum infiltration rate. Regulators may caution against installation of this device in highly industrial areas or areas where highly soluble constituents may be discharged to the trench.

Constituent Removal

Constituent Group	Removal Efficiency	Level of Confidence
Total Suspended Solids (TSS)	●	●
Total Nitrogen	●	●
Total Phosphorus	●	●
Pesticides	●	●
Total Metals	●	●
Dissolved Metals	●	●
Microbiological	●	●
Litter	●	●
Biochemical Oxygen Demand (BOD)	●	●
Total Dissolved Solids (TDS)	●	●

Rating Key for Constituent Removel Efficiency and Level of Confidence

● High ◒ Medium ○ Low

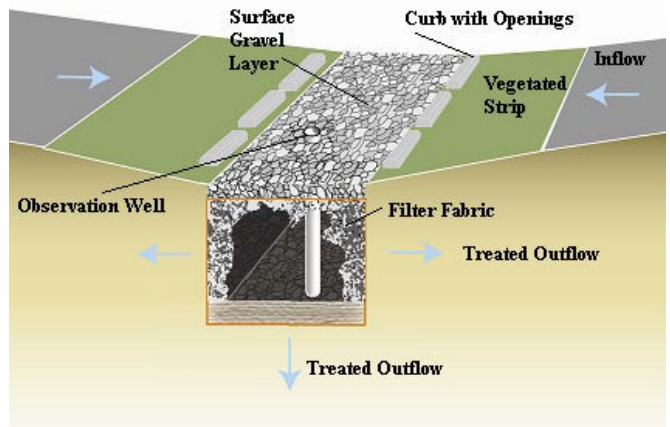
Notes:

Two infiltration trenches were evaluated as part of the Caltrans BMP Retrofit Pilot Program (2004). The removal rating for infiltration is assumed to be 100% for the design water quality volume because no water is discharged to surface waters. Removal efficiencies reported in the literature are usually based on overflow discharge (Young et al. 1996). Litter is assumed to be captured within the basin.

Caltrans Evaluation Status

Approved

Schematic



Source: Caltrans

Key Design Elements

- Trench depth and invert area
- Capture volume
- Backfill material
- Caltrans designers should follow the Project Planning and Design Guide (Caltrans 2010)

Cost Effectiveness Relative to Detention Basins

Cost Effectiveness	Level of Confidence
◪	●

Rating Key for Cost Effectiveness Relative to Detention Basins

Benefit ↑ Cost ↓	Benefit ↑ Cost ↑
Benefit ↓ Cost ↓	Benefit ↓ Cost ↑

Rating Key for Cost Effectiveness Level of Confidence

● High ◒ Medium ○ Low

Notes:

Infiltration

Trench

Maintenance Issues

Requirements:

- Remove trash and debris from the site on a regular basis
- Sediment accumulation should be inspected and, if visible on top of the trench, the top layer of trench, silt, filter fabric, and stone should be removed
- Replace fabric; stone can be reinstalled after it is washed

Special Training:

None identified

Project Development Issues

Right-of-Way Requirements:

Space requirements are relatively high, but it can fit in a narrow right-of-way

Siting Constraints:

- Do not site within about 100 feet of building or bridge foundations. Infiltration trenches sited within about 100 feet would require detailed site structural and geotechnical investigation. Infiltration trenches are suitable for drainage areas up to 4 hectares. Trenches work best at sites with an up-gradient drainage area slope of less then 5%
- Trenches should be sited where infiltration rates are at least one-half in/hr and there is at least about 10 feet separation between trench invert and the groundwater
- Trenches are not recommended in industrial land use areas or in locations were soluble constituents may impact ground water quality

Construction:

- During excavation for trench construction, light equipment should be used to avoid compaction of the soil
- Stabilize the entire area draining to the facility before construction begins. If impossible, place a diversion berm around the perimeter of the infiltration site to prevent sediment entrance during construction

Advantages

- Due to the infiltration of the entire water quality volume, the constituent removal is considered to be 100%
- Infiltration trenches can be narrow and are not highly visible

Constraints

- Infiltration trenches must have soils with adequate permeability and suitable groundwater separation
- Major maintenance (removal and replacement of the rock matrix) is relatively costly
- Pretreatment is recommended to reduce the amount of influent sediment
- Construction costs per capture volume are higher than infiltration basins
- Can clog prematurely if not properly maintained

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

US EPA. Storm Water Technology Fact Sheet, Infiltration Trench. EPA 832-F-99-019.

Young, G. K., S. Stein, P. Cole, T. Kammer, F. Graziano, and F. Bank. 1996. Evaluation and Management of Highway Runoff Water Quality. U.S. Department of Transportation.

Performance Demonstrations Literature Sources

Caltrans. 2004. BMP Retrofit Pilot Program Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-050.

Certifications, Verifications, or Designations

None identified

BMP Fact Sheet

Litter and Debris Removal

GSRD–Inclined Screen

Description

The Gross Solids Removal Device (GSRD) Inclined Screen (IS) is a non-proprietary device whose primary function is to remove gross solids (litter and vegetative material) from stormwater runoff. Currently, there is one IS configuration approved as a full capture treatment device. This GSRD IS has a parabolic wedge-wire screen with spacing up to 5 mm (Caltrans 2007). The device is configured with an influent trough to allow some solids to settle (see schematic).

Constituent Removal

Constituent Group	Removal Efficiency	Level of Confidence
Total Suspended Solids (TSS)	NA	
Total Nitrogen	NA	
Total Phosphorus	NA	
Pesticides	NA	
Total Metals	NA	
Dissolved Metals	NA	
Microbiological	NA	
Litter	●	●
Biochemical Oxygen Demand (BOD)	NA	
Total Dissolved Solids (TDS)	NA	

Rating Key for Constituent Removel Efficiency and Level of Confidence

● High ◒ Medium ○ Low

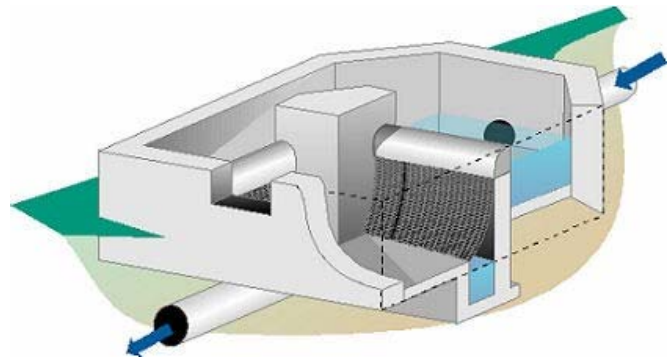
Notes:

Litter ratings are based on field studies (Caltrans 2003). Litter removal is the target constituent for the device. No long-term water quality monitoring studies have been conducted to evaluate treatment effectiveness of the GSRD IS on other water quality constituents.

Caltrans Evaluation Status

Approved

Schematic



Source: Caltrans

Key Design Elements

- Size the GSRD-IS to hold gross solids to be deposited during a 1-year period and pass the design flow (e.g., 25-year flow)
- Regulations may have a lower design storm than is associated with the drainage of the highway, and if upstream diversion is used the design event given in the regulation could be used
- Hydraulic head
- Caltrans designers should follow the Project Planning and Design Guide (Caltrans 2010)

Cost Effectiveness Relative to Detention Basins

Cost Effectiveness	Level of Confidence
◪	●

Rating Key for Cost Effectiveness Relative to Detention Basins

Benefit ↑ Cost ↓	Benefit ↑ Cost ↑
Benefit ↓ Cost ↓	Benefit ↓ Cost ↑

Rating Key for Cost Effectiveness Level of Confidence

● High ◒ Medium ○ Low

Notes:

BMP Fact Sheet

Litter and Debris Removal

GSRD–Inclined Screen

Maintenance Issues

Requirements:

- Periodic inspections required to ensure that the device is functional
- Sediment/debris removal

Special Training:

None identified

Project Development Issues

Right-of-Way Requirements:

Small footprint

Siting Constraints:

Must provide sufficient hydraulic head to operate by gravity (about 3 feet)

Construction:

None identified

Advantages

- Small footprint
- Based on pilot studies, the devices remove nearly all the gross solids from stormwater runoff with minimal maintenance requirements

Constraints

Hydraulic head requirement

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

Performance Demonstrations Literature Sources

Caltrans. 2003a. Phase I Gross Solids Removal Devices Pilot Study: 2000-2002. Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-03-072.31.22.

Caltrans. 2003b. Phase II Gross Solids Removal Devices Pilot Study: 2001-2003. Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-03-097.31.22.

Caltrans. 2003c. Phase III Gross Solids Removal Devices Pilot Study: 2002-2003. Interim Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-03-099.31.24.

Certifications, Verifications, or Designations

LA RWQCB: Full Capture certification for trash

BMP Fact Sheet

Litter and Debris Removal

GSRD–Linear Radial

Description

The Gross Removal Device (GSRD) Linear Radial (LR) is a non-proprietary device whose primary function is to remove gross solids (litter and vegetative material) from stormwater runoff. Currently, there is one GSRD LR configuration approved as a full capture treatment device. This GSRD LR utilizes a modular well casing with 5 mm x 64 mm louvers to serve as the screen. The GSRD LR is placed on a 2-percent slope.

Constituent Removal

Constituent Group	Removal Efficiency	Level of Confidence
Total Suspended Solids (TSS)	NA	
Total Nitrogen	NA	
Total Phosphorus	NA	
Pesticides	NA	
Total Metals	NA	
Dissolved Metals	NA	
Microbiological	NA	
Litter	●	●
Biochemical Oxygen Demand (BOD)	NA	
Total Dissolved Solids (TDS)	NA	

Rating Key for Constituent Removel Efficiency and Level of Confidence

● High ◒ Medium ○ Low

Notes:

Litter ratings are based on field studies (Caltrans 2003). Litter is the target constituent for the device. No long-term water quality monitoring studies have been conducted to evaluate treatment effectiveness of the GSRDs LR on other water quality constituents.

Caltrans Evaluation Status

Approved

Schematic

Source: Caltrans

Key Design Elements

- Annual estimated gross solids loading rate size to hold gross solids to be deposited during a 1-year period and pass the design flow (e.g., 25-year flow)
- Regulations may have a lower design storm than is associated with the drainage of the highway, and if upstream diversion is used the design event given in the regulation could be used
- Caltrans designers should follow the Project Planning and Design Guide (Caltrans 2010)

Cost Effectiveness Relative to Detention Basins

Cost Effectiveness	Level of Confidence
◪	●

Rating Key for Cost Effectiveness Relative to Detention Basins

Benefit ↑ Cost ↓	Benefit ↑ Cost ↑
Benefit ↓ Cost ↓	Benefit ↓ Cost ↑

Rating Key for Cost Effectiveness Level of Confidence

● High ◒ Medium ○ Low

Notes:

BMP Fact Sheet

Litter and Debris Removal

GSRD–Linear Radial

Maintenance Issues

Requirements:

- Periodic inspections required to ensure that the device is functional
- Sediment/debris removal

Special Training:

None identified

Project Development Issues

Right-of-Way Requirements:

Small footprint

Siting Constraints:

- Must provide sufficient area to accommodate the length of linear radial GSRD required
- Low head requirement

Construction:

None identified

Advantages

- Small footprint
- Based on pilot studies, the device removes nearly all the gross solids from stormwater runoff with minimal maintenance requirements

Constraints

Length requirement

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

Performance Demonstrations Literature Sources

Caltrans. 2003. Phase I Gross Solids Removal Devices Pilot Study: 2000-2002. Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-03-072.31.22.

Certifications, Verifications, or Designations

LA RWQCB: Full Capture certification for trash

BMP Fact Sheet

Multi-Chambered Treatment

Description

Multi-chambered treatment trains (MCTTs) use three treatment mechanisms. The first chamber is a catch basin used to remove large, grit-sized material. The second chamber is a settling chamber that removes settleable solids with tube separators, and oil and grease with sorbent pads. The third chamber is a sand/peat filter. The filtration chamber consists of a 450-mm filter media layer with a 50/50 mixture of sand and peat moss. This layer is separated from a gravel-packed underdrain by a layer of filter fabric. The filter area is determined from the recommended solids loading rate of a peat/sand mixture (5000 g TSS/m2/year). Gravity draining can be used to return the filtered runoff to the drainage system. These devices were originally designed to reduce toxicity in the runoff from critical stormwater source areas and to be implemented where toxicity in runoff is an identified problem.

Constituent Removal

Constituent Group	Removal Efficiency	Level of Confidence
Total Suspended Solids (TSS)	●	●
Total Nitrogen	○	○
Total Phosphorus	○	○
Pesticides	NA	
Total Metals	◒	●
Dissolved Metals	○	◒
Microbiological	○	○
Litter	●	◒
Biochemical Oxygen Demand (BOD)	NA	
Total Dissolved Solids (TDS)	NA	

Rating Key for Constituent Removel Efficiency and Level of Confidence

● High ◒ Medium ○ Low

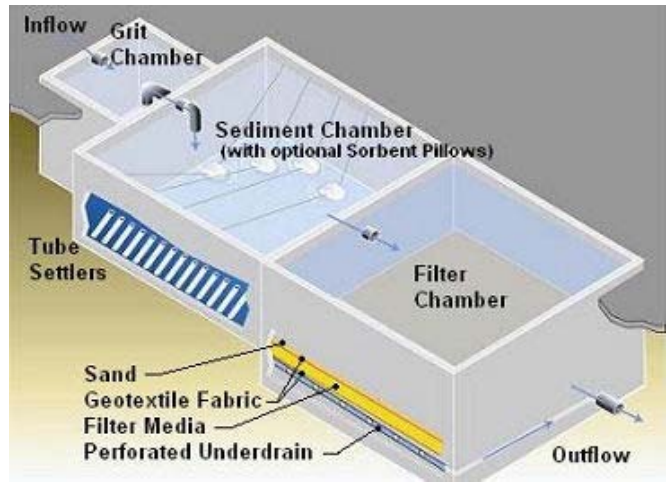
Notes:

Two MCTTs were sited, constructed, and monitored as part of the Caltrans BMP Retrofit Pilot Program (2004). The high TSS removal efficiency rating is based on Pitt et al. (1996). Caltrans data showed 75% TSS removal, but average influent was only 41 mg/L, nitrate concentrations increased by 62%, and dissolved zinc removal efficiency rating was high (Caltrans 2004). The litter removal efficiency rating is based on best professional judgment. Level of confidence based on the Caltrans study.

Caltrans Evaluation Status

Approved

Schematic



Source: Caltrans

Key Design Elements

- Capture volume
- Mosquito proofing
- Settling chamber area
- Filter area
- Caltrans designers should follow the Project Planning and Design Guide (Caltrans 2010)

Cost Effectiveness Relative to Detention Basins

Cost Effectiveness	Level of Confidence
◪	●

Rating Key for Cost Effectiveness Relative to Detention Basins

Benefit ↑ Cost ↓	Benefit ↑ Cost ↑
Benefit ↓ Cost ↓	Benefit ↓ Cost ↑

Rating Key for Cost Effectiveness Level of Confidence

● High ◒ Medium ○ Low

Notes:

Multi-Chambered Treatment

Maintenance Issues

Requirements:

- Periodic cleaning and replacement of media
- Inspection of mosquito proofing
- Vector control or abatement

Special Training:

Training required for media replacement

Project Development Issues

Right-of-Way Requirements:

Space requirements are relatively high

Siting Constraints:

- Site where there is a small, impervious contributing watershed
- Do not site MCTTs where runoff from bare soil or construction activities will be allowed to enter the filter
- MCTTs should be sited where enough vertical clearance (head) is provided, about 6.5 feet

Construction:

- Material availability for the filter, excavation for the device/unknown field conditions, and interface with existing activities at the site are the primary issues to be addressed in the construction of MCTTs
- The tube settler system is a special-order item with a significant lead-time

Advantages

- Constituent removal for suspended solids, metals, and bacteria similar to that for an Austin Sand Filter
- The MCTTs can provide consistent pollutant removal when properly maintained
- The target area for use of MCTTs are vehicle service facilities, parking areas, paved storage areas, and fueling stations with drainage areas up to 1 hectare

Constraints

- More expensive to construct than gravity-drained Austin Sand Filters, which provide comparable performance
- The presence of tube settlers in the sedimentation basin impedes maintenance activities
- A permanent pool of water is maintained in the MCTT, which increases vector concerns

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

Performance Demonstrations Literature Sources

Caltrans. 2004. BMP Retrofit Pilot Program Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-050.

Pitt, R., B. Robertson, P. Barron, A. Ayyoubi, and S. Clark. 1999. Stormwater Treatment at Critical Areas Vol. 1: The Multi-Chambered Treatment Train. Birmingham: University of Alabama at Birmingham, Department of Civil and Environmental Engineering.

Certifications, Verifications, or Designations

None identified

BMP Fact Sheet

Traction Sand Trap

Double Barrel

Description

Double Barrel Traction Sand Traps are inverted pipe sections that capture traction sand that was previously applied to snowy or icy roads.

Constituent Removal

Constituent Group	Removal Efficiency	Level of Confidence
Total Suspended Solids (TSS)	○	●
Total Nitrogen	○	○
Total Phosphorus	○	○
Pesticides	NA	
Total Metals	○	●
Dissolved Metals	○	○
Microbiological	NA	
Litter	NA	
Biochemical Oxygen Demand (BOD)	NA	
Total Dissolved Solids (TDS)	NA	

Rating Key for Constituent Removel Efficiency and Level of Confidence

● High ◒ Medium ○ Low

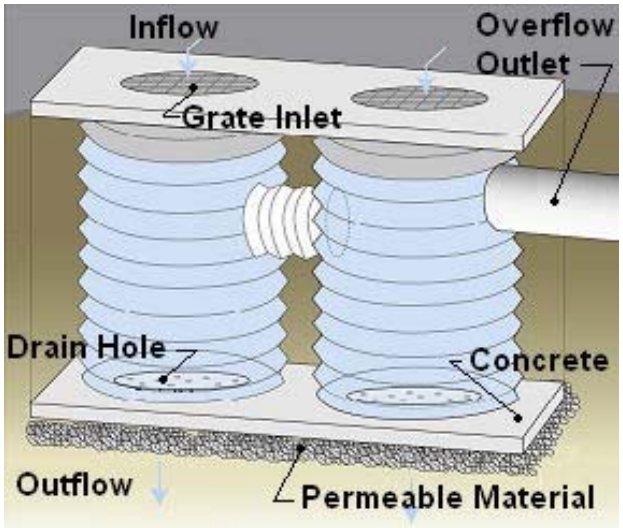
Notes:

Removal ratings and levels of confidence are based on the evaluations of two sand traps that were part of the Tahoe Sand Trap Effectiveness Study (2003).

Caltrans Evaluation Status

Approved

Schematic



Source: Caltrans

Key Design Elements

- Sand storage capacity
- Invert 3 to 6 ft above groundwater if drainage is allowed through base (CMP riser type)
- Caltrans designers should follow the Project Planning and Design Guide (Caltrans 2010)

Cost Effectiveness Relative to Detention Basins

Cost Effectiveness	Level of Confidence
◪	●

Rating Key for Cost Effectiveness Relative to Detention Basins

Benefit ↑ Cost ↓	Benefit ↑ Cost ↑
Benefit ↓ Cost ↓	Benefit ↓ Cost ↑

Rating Key for Cost Effectiveness Level of Confidence

● High ◒ Medium ○ Low

Notes:

BMP Fact Sheet

Traction Sand Trap

Double Barrel

Maintenance Issues

Requirements:

- Annual vactoring out of the traction sand traps
- Vector control or abatement

Special Training:

None identified

Project Development Issues

Right-of-Way Requirements:

Small footprint

Siting Constraints:

Low head requirement

Construction:

None identified

Advantages

- Sand traps require very little land space
- Requires very little or no hydraulic head to operate

Constraints

Treatment for most constituents is marginal

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

Performance Demonstrations Literature Sources

Caltrans. 2003. Caltrans Tahoe Highway Runoff Characterization and Sand Trap Effectiveness Studies. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-03-054.36.02.

Certifications, Verifications, or Designations

None identified

BMP Fact Sheet

Wet Basin/Pond

Description

A Wet Basin holds a permanent pool of water designed to detain and treat a runoff water quality volume. The basin supports plant species that provide constituent removal by biological processes. In addition, the vegetation may help reduce erosion of the side slopes and trap sediments. Sedimentation processes also occur in the basin. Wet basins are usually deep enough to prevent resuspension of particles, and should be sited where a permanent pool of water can be maintained from a dry weather flow source. In some references, this BMP is referred to as a "wet pond."

Constituent Removal

Constituent Group	Removal Efficiency	Level of Confidence
Total Suspended Solids (TSS)	●	●
Total Nitrogen	◒	◒
Total Phosphorus	○	○
Pesticides	NA	
Total Metals	●	●
Dissolved Metals	◒	●
Microbiological	●	○
Litter	●	◒
Biochemical Oxygen Demand (BOD)	NA	
Total Dissolved Solids (TDS)	NA	

Rating Key for Constituent Removel Efficiency and Level of Confidence

● High ◒ Medium ○ Low

Notes:

Removal ratings and levels of confidence were based on an evaluation of a wet basin as part of the Caltrans BMP Retrofit Pilot Program Study (2004). Average nitrate concentration from discharges after storm events was 132% greater than stormwater influent, however dry weather flow reductions caused a net annual removal of total nitrogen. The litter removal efficiency rating is based on best professional judgment.

Caltrans Evaluation Status

Approved

Schematic

Source: Caltrans

Key Design Elements

- Drawdown time
- Length width ratio
- Depth (deeper reduces maintenance of emerged vegetation)
- Permanent pool to capture volume ratio
- Basin side slopes
- Sedimentation forebay
- Vegetation selection
- Liner requirements
- Caltrans designers should follow the Project Planning and Design Guide (Caltrans 2010)

Cost Effectiveness Relative to Detention Basins

Cost Effectiveness	Level of Confidence
◪	●

Rating Key for Cost Effectiveness Relative to Detention Basins

Benefit ↑ Cost ↓	Benefit ↑ Cost ↑
Benefit ↓ Cost ↓	Benefit ↓ Cost ↑

Rating Key for Cost Effectiveness Level of Confidence

● High ◒ Medium ○ Low

Notes:

Wet Basin/Pond

Maintenance Issues

Requirements:

- Sensitive species inspections
- Vegetation removal to maintain efficacy of mosquito fish
- Sediment removal (hand removal with machetes was found to be more cost-effective than mechanical removal)
- Vector control or abatement

Special Training:

None identified

Project Development Issues

Right-of-Way Requirements:

Space requirements are high for wet basins

Siting Constraints:

- A wet basin usually has an area of 1 to 3 percent of the contributing drainage area
- Soil should have a low infiltration rate or be lined with a clay or geotextile liner so that water level is maintained in the basin
- Wet basins should be sited where a permanent pool of water can be maintained from a dry weather flow source

Construction:

- Excavated soil surface should be suitable to support plant life
- If a pond liner is used, it must be carefully constructed to avoid punctures

Advantages

- High removal efficiencies for many constituents
- Recreational and aesthetic benefits

Constraints

- There are potential problems associated with mosquitoes and the device may become a regulated wetland if not consistently maintained per an established schedule
- A permanent pool of water must be maintained and therefore may have limitations on siting
- Wet basins are larger than extended detention basins

Design, Construction, Maintenance, and Cost Sources

Caltrans. 2010. Stormwater Quality Handbook: Project Planning and Design Guide. Sacramento: Caltrans, Office of Storm Water Management, Division of Design. CTSW-RT-10-254.03.

King County. 2005. Surface Water Design Manual, King County Surface Water Management Division, Washington. Retrieved January 17, 2009, from Dnr.metrokc.gov/wlr/dss/2005SWDM/2005Manualwith Errata.pdf

US EPA. Storm Water Technology Fact Sheet, Wet Detention Ponds. EPA 832-F-99-048.

Performance Demonstrations Literature Sources

Caltrans. 2004. BMP Retrofit Pilot Program Final Report. Sacramento: Caltrans, Division of Environmental Analysis. CTSW-RT-01-050.

Schueler, T. R. 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Department of Environmental Programs, Metropolitan Washington Council of Governments, Washington, DC.

Urbonas, B. R., J. T. Doerfer, J. Sorenson, J. T. Wulliman, and T. Fairley. 1992. Urban Storm Drainage Criteria Manual, Volume 3 - Best Management Practices, Stormwater Quality, Urban Drainage and Flood Control District, Denver, CO.

Weber, S. L. 2007. Evaluation of Two Washington State Department of Transportation Stormwater Facilities Along State Route 18 Highway. Report prepared for MBA requirement from University of New Mexico.

Young, G. K., S. Stein, P. Cole, T. Kammer, F. Graziano, and F. Bank. 1996. Evaluation and Management of Highway Runoff Water Quality. U.S. Department of Transportation.

Certifications, Verifications, or Designations

None identified