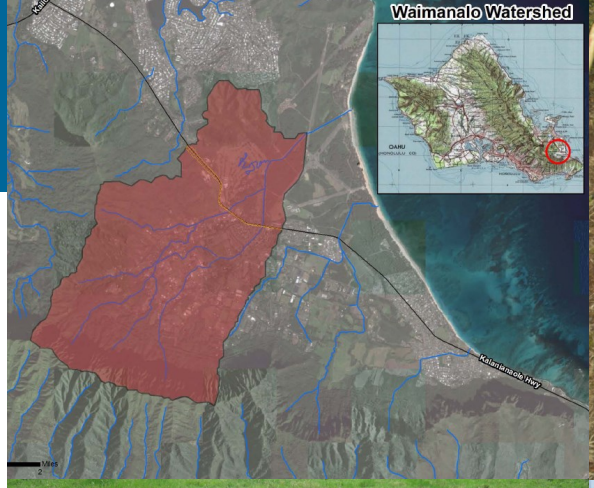

Implementation and Monitoring Plan
Waimanalo Stream Watershed

PROTECT
OUR WATER
MĀLAMA I KA WAI
STATE OF HAWAII DEPARTMENT OF TRANSPORTATION
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Hawaii State Department of Transportation
Highways Division, Oahu District
Storm Water Management Program
NPDES Permit No. HI S000001
April 2015

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Total Maximum Daily Load Implementation and Monitoring Plan Waimanalo Stream Watershed Waste Load Allocations

State of Hawaii Department of Transportation Highways Division, Oahu District

PROTECT OUR WATER

MĀLAMA I KA WAI

STATE OF HAWAII DEPARTMENT OF TRANSPORTATION

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April 2015
Version: Final

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Record of Revision

Revision No.	Revision Date	Description	Sections Affected
Original Document	October 2014	Original	N/A
1	February 2015	Formatting	All
2	April 2015	Draft Finalized. Date changed.	All

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ACRONYMS AND ABBREVIATIONS

BMP	Best Management Practice
CCH	City and County of Honolulu
CY	Cubic yard
DCA	Debris Cleaning Assessment
DOH	State of Hawaii Department of Health
DOT-HWYS	State of Hawaii Department of Transportation, Highways Division, Oahu District
EDOP	Effective date of permit
EPA	United States Environmental Protection Agency
GISB	Grated inlet skimmer box
HWY-OM	DOT-HWYS Oahu District Maintenance Section
I&M	Implementation & Monitoring
IC Program	Industrial and Commercial Activities Discharge Management Program
IDDE Program	Illicit Discharge Detection and Elimination Program
KG	Kilograms
MEP	Maximum Extent Practicable
MG	Milligram
MS4	DOT-HWYS' Municipal Separate Storm Sewer System
MS4 Permit	DOT-HWYS' NPDES Permit No. HI S000001
NPDES	National Pollutant Discharge Elimination System
PID	Point Identification Number
PBMPs	Permanent Best Management Practices
ROW	Right-of-way
SWMP	Storm Water Management Program
SWMPP	Storm Water Management Program Plan
TMDL	Total Maximum Daily Load
TMK	Tax map key
TN	Total nitrogen
TP	Total phosphorus
TSS	Total suspended solids
WLA	Waste load allocation
WQBEL	Water quality based effluent limits

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EXECUTIVE SUMMARY

On January 1, 2001, the United States Environmental Protection Agency (EPA) approved a total maximum daily load (TMDL) for Waimanalo Stream that contains wasteload allocations (WLAs) for the State of Hawaii Department of Transportation, Highways Division, Oahu District's (DOT-HWYS') municipal separate storm sewer system (hereinafter referred to as "the MS4"). Part F.3 of DOT-HWYS' National Pollutant Discharge Elimination System (NPDES) Permit No. HI S000001 (hereinafter referred to as "MS4 Permit") requires that DOT-HWYS submit an Implementation and Monitoring Plan (I&M Plan) within one year of the effective date of the MS4 Permit (by October 28, 2014) for the attainment of associated load reductions in Waimanalo Stream Watershed.

This I&M Plan documents the activity tracking necessary to demonstrate efforts to comply with the WLA reductions assigned to DOT-HWYS. To meet its WLA reduction goals, DOT-HWYS has taken a comprehensive approach by using established Best Management Practices (BMPs), including street sweeping, cleaning of MS4 structures, retrofitting permanent BMPs, erosional area repairs, construction site runoff management, illicit discharge detection and elimination, industrial and commercial discharge management, and public education and outreach to reduce total nitrogen (TN) and total phosphorus (TP) discharges to Waimanalo Stream.

The following is a brief summary of each section included in this I&M Plan:

- Section 1 - Provides a brief summary of the TMDL document for Waimanalo Stream and the WLA reductions assigned to DOT-HWYS.
- Section 2 - Broadly describes the BMPs currently implemented by DOT-HWYS.
- Section 3 - Presents a quantitative analysis, where appropriate, of how specific DOT-HWYS' programs reduce seasonal loads of TN and TP in Waimanalo Stream Watershed. Table 3-8 (reproduced below as Table ES-1) presents an overview of the seasonal pollutant load reductions calculated in Section 3.
- Section 4 - Documents how DOT-HWYS will monitor and report compliance with the WLA reductions assigned in the Waimanalo Stream TMDL.

Table ES-1. Anticipated Seasonal Pollutant Load Reduction for TMDL Compliance

Best Management Practice (BMP) Program	Anticipated Total Nitrogen (TN) Reduction (KG/season)		Anticipated Total Phosphorus (TP) Reduction (KG/season)	
	Dry Season	Wet Season	Dry Season	Wet Season
Street Sweeping (Existing)	3.87	3.36	2.91	2.53
Cleaning of MS4 Structure	0.22	0.059	0.067	0.02
Permanent BMPs	2.37	5.91	0.42	1.05
Erosion Control Program	--[a]	--[a]	--[a]	--[a]
Construction Site Runoff Control	--[a]	--[a]	--[a]	--[a]
Industrial and Commercial Activities Discharge Management and Illicit Discharge Detection and Elimination Programs	--[a]	--[a]	--[a]	--[a]
Public Education and Outreach	--[a]	--[a]	--[a]	--[a]
TOTAL ANTICIPATED REDUCTION:	6.46	9.329	3.397	3.6
REDUCTION REQUIRED:	**1.71**	**1.71**	0.06	0.06

Notes:

[a] These programs have resulted in pollutant load reductions in the Waimanalo Stream Watershed. These reductions have not been quantified at this time and are therefore considered qualitatively in this I&M Plan.

Wet Season = 181 days (November 1 – April 30); Dry Season = 184 days (May 1 – October 31)

1. SUMMARY OF TOTAL MAXIMUM DAILY LOAD AND WASTE LOAD ALLOCATION REDUCTIONS ASSIGNED

This Implementation and Monitoring Plan (I&M Plan) is submitted to satisfy Part F.3 of the State of Hawaii Department of Transportation, Highways Division, Oahu District's (DOT-HWYS') National Pollutant Discharge Elimination System (NPDES) Permit No. HI S000001, effective October 28, 2013 (hereinafter referred to as the "MS4 Permit"). Part F.3 requires that DOT-HWYS submit an I&M Plan for attainment of pollutant load reductions in Waimanalo Stream Watershed within one year of the effective date of the MS4 Permit (by October 28, 2014).

On January 1, 2001, the United States Environmental Protection Agency (EPA) approved a total maximum daily load (TMDL) for Waimanalo Stream that contains wasteload allocations (WLAs) for DOT-HWYS' municipal separate storm sewer system (hereinafter referred to as "the MS4"). A TMDL is a calculation of the maximum amount of pollutant that a water body can receive from point and non-point sources (including a margin of safety) and still meet applicable water quality standards. It also provides an allocation of that maximum amount divided among the water body's pollutant sources. The Clean Water Act Section 303 requires that States, territories, and tribes identify specific designated uses (e.g., drinking water, contact recreation, and aquatic life support) for each water body in their jurisdiction and identify the scientific water quality standards to support those uses. TMDLs are established for water bodies that fail to meet existing water quality standards for pollutants of concern and generally assign WLAs, which are the portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution (e.g., the MS4).

DOT-HWYS' prior MS4 Permit (effective from March 31, 2006 to September 8, 2009, and administratively extended thereafter until the issuance of the current permit) required DOT-HWYS to submit an I&M Plan for attainment of load reductions in Waimanalo Stream Watershed within one year of the effective date of the permit. DOT-HWYS submitted an I&M Plan for the Waimanalo Stream Watershed in March 2007 that outlined DOT-HWYS' proposed best management practices (BMPs) intended to meet the TMDL requirements. DOH provided written comments on this plan on April 16, 2008 and DOT-HWYS submitted a revised I&M Plan in conjunction with the City and County of Honolulu (CCH) in October 2008. DOT-HWYS has completed all projects and activities proposed in the October 2008 I&M Plan.

As described in the Fact Sheet accompanying DOT-HWYS' current MS4 Permit:

> *[The State of Hawaii Department of Health] is directly implementing the TMDL wasteload allocations (WLAs) applicable to the MS4 as water quality-based effluent limits (WQBELs). To demonstrate consistency with the assumptions and requirements of applicable WLAs, it is expected that DOT-HWYS will quantify pollutants removed from DOT-HWYS MS4. The quantity of a given pollutant removed on an annual or seasonal basis in a given watershed can then be compared to the WLA reductions required in that watershed. [As such, compliance with WLAs will be demonstrated] through meeting the WLA reductions on an annual or seasonal basis as specified in the permit.*

Table 1-1 presents where each of the minimum required elements of the I&M Plan is presented in this report.

Table 1-1. MS4 Permit Requirements and Corresponding Plan Sections

MS4 Permit Reference	Plan Section Where Requirement is Addressed
Part F.3.a.(1) *Detailed information on the activities proposed to be implemented.*	Section 2
Part F.3.a.(2) *Actual or literature documentation of the estimated effectiveness of the activities targeted to reduce the pollutants of concern such as total nitrogen, total phosphorus, total suspended solids, and turbidity in the watershed, as applicable, to demonstrate consistency with the annual or seasonal WLA reductions consistent with the assumption of the associated TMDL document.*	Section 3
Part F.3.a.(3) *A detailed and quantitative analysis which demonstrates that the proposed activities would ensure consistency with the annual or seasonal WLA reductions consistent with the assumption of the associated TMDL document.*	Section 3
Part F.3.a.(4) *Information from pre and post monitoring activities to quantitatively demonstrate consistency with the annual or seasonal WLA reductions consistent with the assumption of the associated TMDL document.*	Section 4
Part F.3.a.(5) *A monitoring plan which shall identify activities to demonstrate consistency with the annual or seasonal WLA reductions consistent with the assumption of the associated TMDL document.*	Section 4

The State of Hawaii Department of Health (DOH) determined that DOT-HWYS' existing discharge in Waimanalo Stream Watershed is not expected to comply with the new WLA reductions based on current activities. Therefore Part F.3.c.(5) also stipulates a schedule of compliance, presented as Table 1-2, to manage and effectively schedule and track DOT-HWYS' activities to comply with the WLA reductions.

Table 1-2. Schedule of Compliance for Waimanalo Stream Watershed

Due No Later Than:	Milestone/Deliverable
0.5 Years After Effective Date of Permit (EDOP)	Finalize Debris Cleaning Assessment (DCA) Plan
1 Year After EDOP	Finalize Implementation & Monitoring Plan Commence DCA Data Collection
2 Years After EDOP	Interim DCA Data Collection Report
3 Years After EDOP	Complete DCA Data Collection
4 Years After EDOP	Complete Analysis of DCA Data
5 Years After EDOP (Final Compliance Date)	Finalize WLA Completion Report

The schedule of compliance includes a Debris Cleaning Assessment (DCA) to better quantify removal rates for debris cleaning activities and better predict future pollutant removal rates needed to meet the required pollutant load reduction in TMDL watersheds. In order to normalize the DCA data for variations in rainfall quantity, intensity, and seasonality, studies of this type require multiple years to complete. However, the time constraints of the schedule of compliance and deadline for this I&M Plan require the DCA study activities to be condensed. The MS4 Permit and compliance schedule require that this I&M Plan be submitted before completing the DCA data collection. As a result, this I&M Plan includes certain assumptions that will be revisited and may be modified based on the results of the DCA.

The following sections provide a brief summary of the TMDL document for Waimanalo Stream and the WLA reductions assigned to DOT-HWYS.

1.1 TMDL for Waimanalo Stream

As described in the TMDL document, the Waimanalo Stream watershed (Figure 1-1), located on the windward side of the island of Oahu, covers 3,954 acres (6.1 square miles) and flows into Waimanalo Bay. Moist tradewinds blow across windward coastlines of Oahu ascend the eastern side of the Koolau mountains, generating orographic rainfall as the air cools at higher elevations and releases excess moisture in the form of trade wind showers, which may be intense at times. Primary land uses in the Waimanalo drainage basin include, from the mountains seaward, the upper forested conservation area, where development is prohibited because of the presence of steep slopes and potable water recharge areas; small agricultural operations, especially plant nurseries; residential neighborhoods; a golf course; and a military installation at Bellows Field. Waimanalo Stream is impaired primarily by sediments and nutrients, which enter the stream at a rate faster than they can be assimilated and recycled. As a result, Waimanalo Stream is not meeting the State of Hawaii water quality criteria and its beneficial uses are not being maintained.

DOT-HWYS owns and operates approximately 1.4 miles of highways in the Waimanalo Stream Watershed, including portions of State Route 72 (Kalanianaole Highway) (Figure 1-1). A portion of the runoff from DOT-HWYS' right-of-way (ROW) for these highway segments drains to the MS4.

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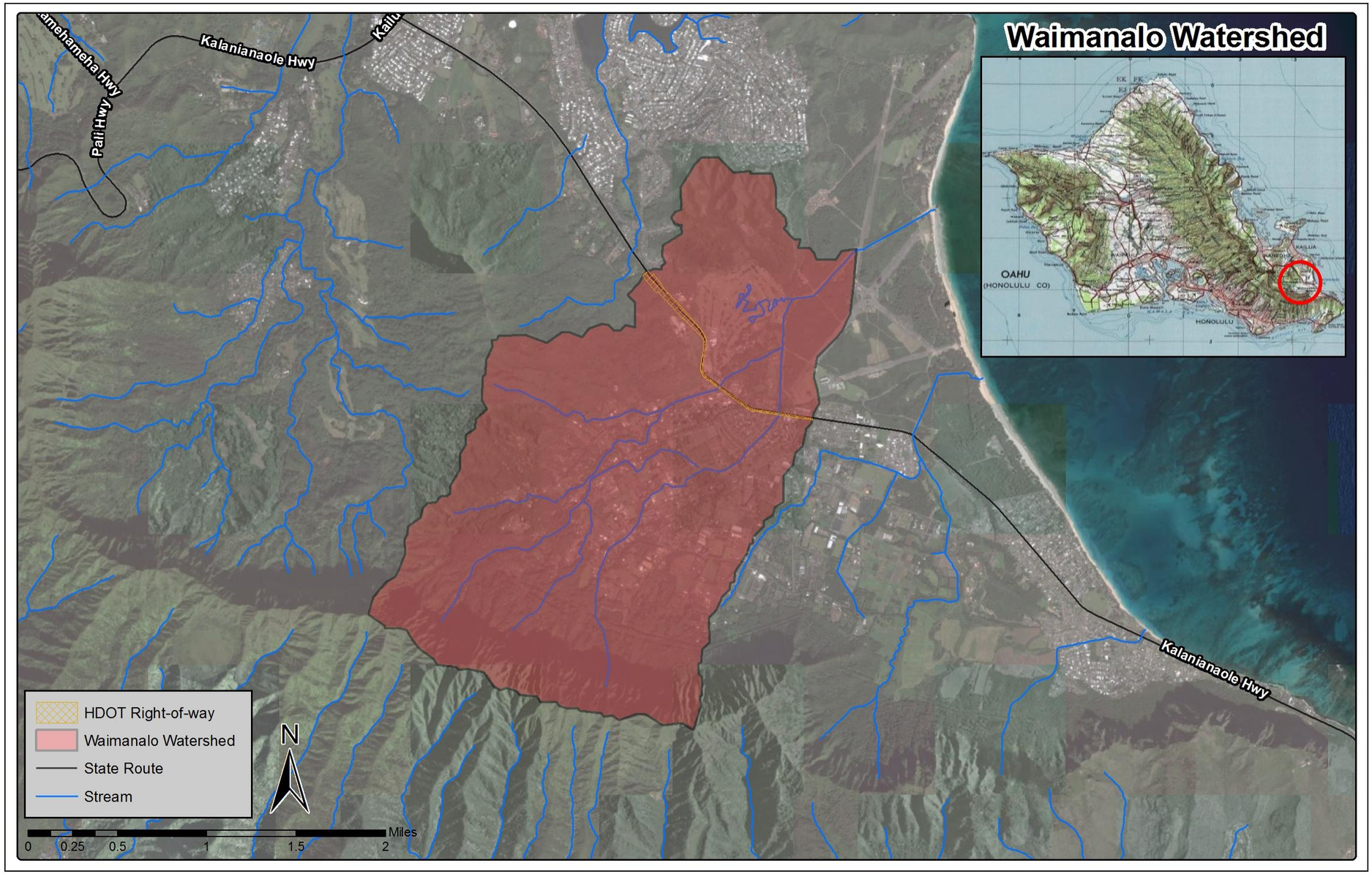

Figure 1-1. Waimanalo Stream Watershed Map

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1.2 DOT-HWYS' WLA Reductions for Waimanalo Stream

The approved TMDL for Waimanalo Stream did not establish WLAs; instead, the TMDL suggested specific BMPs that could be implemented. As described in the MS4 Permit, DOH calculated numeric load reduction requirements for DOT-HWYS in this watershed based on the original sample data utilized to prepare the TMDL. More information on this calculation is provided in Appendix A of the MS4 Permit Fact Sheet.

As presented in Part F.3.b.(5) of the MS4 Permit, consistent with the assumptions of the Waimanalo Stream Watershed TMDL, DOT-HWYS is required to comply with the seasonal WLA reductions presented in Table 1-3. DOH determined that no reduction is required for total suspended solids (TSS) for DOT-HWYS; accordingly this I&M Plan documents only reductions in loads of TN and TP.

Table 1-3. Waimanalo Stream Watershed WLA Reductions - Permit Part F.3.b.(5)

Season	TSS (KG per season)	TN (KG per season)	TP (KG per season)
Wet Season Reduction	0	1.71	0.06
Dry Season Reduction	0	1.71	0.06

Wet Season = 181 days (November 1 – April 30)
Dry Season = 184 days (May 1 – October 31)

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2. DOT-HWYS' STORM WATER MANAGEMENT PROGRAM ACTIVITIES

To meet its WLA reduction goals, DOT-HWYS intends to take a comprehensive approach by using established best management practices (BMPs). As used in this document, the term BMP refers to operational activities or physical controls applied to storm water and other runoff to reduce pollution. BMP programs currently implemented by DOT-HWYS include:

- Street sweeping;
- Cleaning of MS4 structures;
- PBMPs;
- Erosional area repairs;
- Construction site runoff management;
- Illicit discharge detection and elimination;
- Industrial and commercial activities discharge management; and
- Public education and outreach.

Each of these BMP programs continues to reduce TN and TP discharges from DOT-HWYS' ROW to the Waimanalo Stream Watershed. These BMP programs are discussed below and more detail about each program can be found in the comprehensive DOT-HWYS Storm Water Management Program Plan (SWMPP).

2.1 Street Sweeping (Debris Control Program)

Street sweeping has been identified as one of the most cost-effective methods of removing particulate debris from streets and roadways. Street sweeping removes particulate pollutants on roads before they are introduced to the MS4 by runoff events. The removal of fine particulate will also remove pollutants such as nutrients that are associated with particulates (Schueler and Holland 2000). Traditionally, street sweeping has focused on the removal of litter, leaves, and other large debris but effective street sweeping will remove/reduce pollutant loads associated with fine particulates.

DOT-HWYS' personnel and service contractors regularly sweep highways on the island of Oahu. DOT-HWYS Oahu District Maintenance Section (HWY-OM) and service contractors are responsible for removing any litter, debris, sediment, or other matter that accumulates within DOT-HWYS' ROW, including the MS4. Pollutants typically found on roadways that could enter the MS4 include:

- Material from illegal dumping;
- Runoff from construction activities within and adjacent to DOT-HWYS' ROW;
- Litter from motorists and pedestrians;
- Debris from vehicles;
- Loose paving materials and aggregate from cracked pavements and potholes;
- Vegetative debris; and
- Sediment accumulation.

Service contractors conduct much of the street sweeping on Oahu. Debris Control Program personnel conduct inspections of these activities. HWY-OM personnel conduct their own inspections and street sweeping on various routes.

2.2 Cleaning of MS4 Structures (Debris Control Program)

Catch basins typically include an inlet grate and/or drop structure that is connected to a drainage outfall. Manholes are structures where drainage pipes meet or change direction and often have a sump that accumulates solids and sediment. The cleaning of these structures has proven to be a cost-effective method to capture and remove gross pollutants in the MS4. Removing debris from storm drainage structures reduces the amount of pollutant material flushed into receiving waters by storm water runoff.

DOT-HWYS clears debris and other materials that accumulate in drainage structures through mechanical (e.g., vacuuming) or manual means. High priority inlets and their associated catch basins are inspected at least once every six months. Portions of selected State routes have been classified as low priority due to their relatively low traffic volume. These low priority drains are inspected once per year and cleaned if necessary. Similar to the sweeping schedule, the inspection schedule of drainage infrastructure is evaluated annually for possible changes. Large debris (e.g., wood or trash) accumulating on top of or blocking drainage structures is removed promptly. Cleaning activities are observed by an inspector who records the amount of material removed from the drainage structure, including the percentage of organic matter, trash, and sediment.

2.3 PBMPs

DOT-HWYS has developed an Action Plan for retrofitting PBMPs into its existing MS4 system. The purpose of the Action Plan is to reduce storm water pollution by designing and constructing/installing appropriate and cost-effective BMPs (retrofits) in strategic locations and structures within the DOT-HWYS' existing MS4. Potential retrofit sites were selected from a review of previous studies that identified potential sites and a review of data collected during routine MS4 monitoring and maintenance activities.

The Post-Construction Storm Water Management in New Development and Redevelopment Program (Post-Construction Program) institutes procedures to incorporate the installation of appropriate PBMPs for certain new development and significant redevelopment projects that DOT-HWYS undertakes (e.g., contract projects), as well as certain types of encroachment projects. PBMPs are designed to be installed and remain in place as part of a project to provide

for long-term storm water quality or quantity control. New development and significant redevelopment projects include, but are not limited to, new roadways and roadway and intersection improvements or modifications, such as widening.

Specific elements of the Post-Construction Program include:

- Revising DOT-HWYS' standards for addressing post-construction PBMPs to include Low Impact Development requirements;
- Instituting PBMP considerations throughout the life-cycles of both DOT-HWYS' and encroachment projects; and
- Implementing an Asset Management System to track the frequency of inspections and maintenance of PBMPs; and

supporting a training program and providing outreach materials so that people involved in DOT-HWYS-related new developments or significant redevelopments (e.g., DOT-HWYS' and utility company personnel, design consultants, contractors, etc.) are familiar with PBMP criteria, methods, specifications, and permitting requirements.

2.4 Erosion Control Program

The function of the Erosion Control BMPs Program (Erosion Control Program) is to implement permanent erosion control improvements, ensuring that erosional areas with the potential for significant water quality impact, but with limited public safety concerns, are also addressed.

The Erosion Control Program is responsible for implementing the following BMPs:

- Identify erosional areas with the potential for significant water quality impact for the purpose of implementing erosion control improvements.
- Submit to DOH a list of projects with an implementation schedule for permanent erosion control improvements.
- Implement temporary erosion control measures on erosional areas (i.e., highway-adjacent eroded slopes) within DOT-HWYS' ROW with the potential for significant water quality impact, if a permanent solution is not immediately possible.
- Provide DOH with an Action Plan to address erosion at DOT-HWYS' storm drain system outlets with significant potential for water quality impacts.
- Develop a maintenance plan for vegetated portions of the drainage system used for erosion and sediment control.

2.5 Construction Site Runoff Control Program

The objective of the Construction Site Runoff Control Program (Construction Program) is to reduce, to the Maximum Extent Practicable (MEP), the discharge of pollutants from both private and public construction projects. The program includes the following components:

- Plan review and approval process, which includes reviewing site-specific BMP plans and storm water pollution prevention plans;
- An inspection program to ensure that construction BMPs are properly installed for contract, in-house, maintenance, and encroachment permit projects; and
- A program to provide annual training on elements of the Construction Program to DOT-HWYS' staff with construction storm water responsibilities.

2.6 Industrial and Commercial Activities Discharge Management (IC Program) & Illicit Discharge Detection and Elimination (IDDE Program)

Storm water flowing from industrial and commercial areas may be a significant source of pollutants that enter the MS4. Therefore, the Industrial and Commercial Activities Discharge Management Program (IC Program) is designed to reduce, to the MEP, the discharge of pollutants from industrial and commercial facilities and activities that initially discharge into the MS4. While listed as separate programs in the SWMPP, in practice, this program is related to the Illicit Discharge Detection and Elimination Program (IDDE Program), because industrial and commercial facilities activities are susceptible to causing illicit discharges. DOT-HWYS takes a proactive approach in reducing illicit discharges by identifying industrial and commercial areas that drain into the MS4 for priority inspections.

The IC Program consists of:

- Developing a comprehensive database to track industrial and commercial facilities and activities whose storm water runoff initially discharges into the MS4;
- Developing prioritized areas for inspection of industrial and commercial facilities and activities;
- Ranking the commercial facilities and activities according to relative risk of discharge of contaminated runoff to the MS4;
- Conducting inspections or investigations of industrial and highly ranked commercial facilities and parcels within the designated prioritized areas; and
- Supporting a training program so that those involved in this program have the necessary knowledge and skills to conduct investigations.

DOT-HWYS requires a connection permit for all properties initially discharging storm water into the MS4. Owners of properties adjacent to DOT-HWYS' ROW were required to self-report connections to the MS4 in a mail survey. If unpermitted connections are discovered during routine field investigations, these property owners are required to obtain a connection permit. Additionally, any new construction that involves private connections to the MS4 requires a connection permit. To obtain a connection permit, property owners are required to describe the size of connection, type of discharge and flow rate, as well as other characteristics of the property (e.g., industrial land uses) which may require further review by DOT-HWYS.

DOT-HWYS has developed a Prioritized Area Plan that designates priority areas for industrial and commercial facility and activity inspections according to the relative risk that any discharge

may be contaminated with pollutants. The Prioritized Area Plan includes an inspection schedule that establishes inspection frequencies for industrial and commercial facilities and activities. All highly ranked commercial facilities are inspected at least once every five years. If an industrial facility or activity on the prioritized list does not have NPDES permit coverage, this facility or activity would be subject to inspection at least twice every five years. If an industrial facility has NPDES permit coverage, this facility or activity would be subject to inspection at least once every five years.

The IDDE Program screens for and addresses any illicit discharge that drains into the MS4 within the watershed, including discharges sourced from industrial, commercial, and residential land uses. In addition to administering a connection and discharge permitting program, the IDDE Program conducts investigations of parcels suspected of illicit discharges or illegal connections identified through:

- Routine inspections of parcels designated by the industrial and commercial database and inventory list;
- Field screening of major and minor outfalls;
- Public complaints; and
- Complaints from DOH.

2.7 Public Education and Outreach Program

The Public Education and Outreach Program (Public Education Program) addresses the need to inform the general public about how their daily activities may affect the quality of receiving waters. The Public Education Program is a community involvement program that focuses on informing the public about MS4 pollution issues and provides citizens with the tools and ideas to help eliminate the causes of pollution. The purpose of the Public Education Program is to motivate the community to control pollution at the source by increasing public awareness of storm water pollution issues. By educating the public on methods to reduce the generation of pollutants, public participation can reduce the quantity of pollutants introduced into the MS4.

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3. QUANTITATIVE ANALYSIS OF PROPOSED ACTIVITIES IN WAIMANALO STREAM WATERSHED

This section describes the quantitative analysis of specific DOT-HWYS' programs to document compliance with the required WLA reductions. The anticipated seasonal pollutant reductions for specific programs have been quantitatively analyzed and aggregated to provide the total anticipated seasonal pollutant reduction for each pollutant. This total anticipated seasonal mass reduction was then compared to the seasonal reductions required in Table 1-3 to assess consistency with the WLA reductions assigned to DOT-HWYS.

The TMDL document did not specifically assess DOT-HWYS' existing pollutant loads. To be consistent with the assumptions and data used in other TMDLs and I&M Plans, DOT-HWYS has set 1980 as the baseline condition for DOT-HWYS' pollution reduction program, and the quantitative analyses presented here measure pollution reduction efforts from the 1980 baseline.

The following sub-sections present a quantitative analysis, where appropriate, of how specific DOT-HWYS' programs reduce seasonal loads of TN and TP in Waimanalo Stream Watershed. Section 3.8 summarizes the average anticipated seasonal reductions of TN and TP in kilograms (KG). While some of the programs and activities lend themselves to direct measurement and estimation of pollutant reduction, pollutant reductions from several of the programs and activities have instead been considered qualitatively in this I&M Plan.

3.1 Street Sweeping in Waimanalo Stream Watershed

Anticipated seasonal reductions in TN and TP loads due to street sweeping were calculated by assessing data from DOT-HWYS' 2009-2013 street sweeping operations in Waimanalo Stream Watershed in conjunction with literature data on concentrations of nutrients per KG of debris collected. This data will serve as a basis for projecting future seasonal reductions.

3.1.1 Data on Street Sweeping Operations

DOT-HWYS tracks debris removed through street sweeping operations for all DOT-HWYS' routes intersecting the Waimanalo Stream Watershed. At the end of each street sweeping event, inspectors record the total cubic yards (CY) of debris removed and estimate a rough percentage of sediment, organic matter, and trash found in the street sweeping hopper. DOT-HWYS chose to average data from 2009-2013 (with the highest value for sediment and organic matter excluded from each seasonal average to generate a conservative estimate) to provide a representative estimate of debris removal to use on an seasonal basis for Waimanalo Stream Watershed. A summary of the data is provided in Figures 3-1 and 3-2. Averaging data from these years yields an average anticipated dry season removal of 3.57 CY of sediment and 2.57 CY of organic matter and an average anticipated wet season removal of 3.15 CY of sediment and 2.14 CY of organic matter.

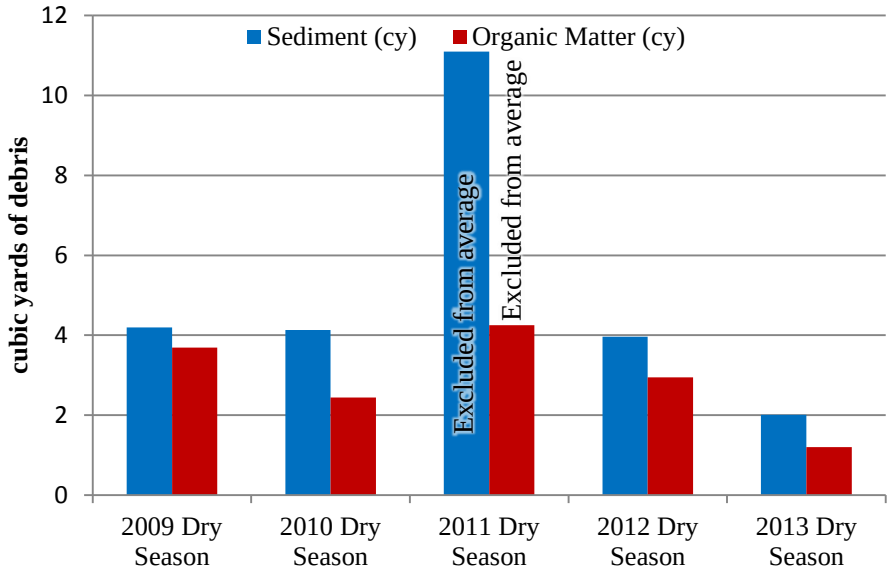

Figure 3-1. Cubic yards of street sweeping debris collected in Waimanalo Stream Watershed, 2009-2013 Dry Seasons

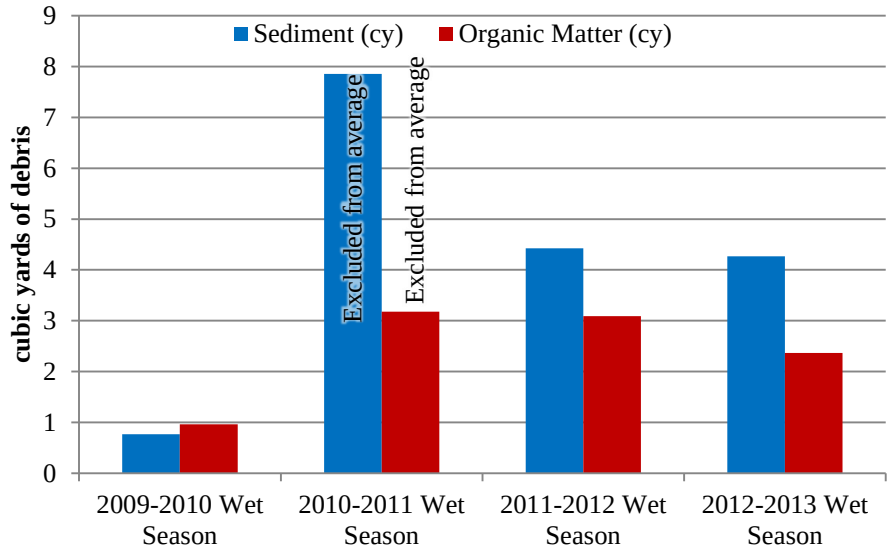

Figure 3-2. Cubic yards of street sweeping debris collected in Waimanalo Stream Watershed, 2009-2013 Wet Seasons

3.1.2 Literature Data on Concentrations of Nutrients per Kg of Debris Collected

DOT-HWYS reviewed existing literature on the concentration of nutrients in debris removed through street sweeping and MS4 structure cleaning. A 2011 study in Florida summarized results from 14 MS4s and 459 individual samples to establish concentrations of nutrients per KG of debris recovered in street sweeping and catch basin cleaning (Berretta et al. 2011). These data were specific to highway land use and unique concentrations were presented for street sweeping and catch basin cleaning, respectively.

In the absence of highway-specific data in Hawaii, these literature values were used to convert dry-equivalent debris into KG of TP or TN recovered. DOT-HWYS is carrying out a sampling effort during the DCA study to confirm that results from the Berretta et al. (2011) study are applicable to conditions in Hawaii. As part of the WLA Completion Report, these literature values will be re-evaluated and adjusted as necessary to reflect the results of the DCA data collected. Final compliance calculations will also be revised as necessary.

Tables 3-1 and 3-2 present the conversion from an average anticipated seasonal wet-weight volume of debris removed to a dry mass of TN and TP removed from Waimanalo Stream Watershed through street sweeping on a seasonal basis. In these tables, the wet-weight volume of debris is multiplied by three constants (bulk density, moisture content, and nutrient content) to calculate the dry mass of TN and TP.

Table 3-1. Conversion Calculations for TN Removal through Street Sweeping Operations

	DRY SEASON			WET SEASON		
	Sediment	Organic matter	TOTAL	Sediment	Organic matter	TOTAL
Average anticipated seasonal debris removed (CY)	3.57	2.57		3.15	2.14	
Bulk density (KG/CY)	1039 [a]	497 [b]		1039 [a]	497 [b]	
Moisture content conversion factor for street sweeping debris (%)	94 [a]	94 [a]		94 [a]	94 [a]	
TN conversion factor for street sweeping debris (KG TN/KG dry mass)	0.0008266 [a]	0.0008266 [a]		0.0008266 [a]	0.0008266 [a]	
Average anticipated seasonal TN removed through street sweeping (KG)	2.88	0.99	3.87	2.54	0.82	3.36

[a] Source: Berretta et al. (2011)
[b] Source: Government of Saskatchewan Ministry of Agriculture (2008) presented as wet bulk density of compost

Table 3-2. Conversion Calculations for TP Removal through Street Sweeping Operations

	DRY SEASON			WET SEASON		
	Sediment	Organic matter	TOTAL	Sediment	Organic matter	TOTAL
Average anticipated seasonal debris removed (CY)	3.57	2.57		3.15	2.14	
Bulk density (KG/CY)	1039 [a]	497 [b]		1039 [a]	497 [b]	
Moisture content conversion factor for street sweeping debris (%)	94 [a]	94 [a]		94 [a]	94 [a]	
TP conversion factor for street sweeping debris (KG TP/KG dry mass)	0.000622 [a]	0.000622 [a]		0.000622 [a]	0.000622 [a]	
Average seasonal TP removed through street sweeping (KG)	2.17	0.74	2.91	1.91	0.62	2.53

[a] Source: Berretta et al. (2011)
[b] Source: Government of Saskatchewan Ministry of Agriculture (2008) presented as wet bulk density of compost

3.2 Cleaning of MS4 Structures in Waimanalo Stream Watershed

DOT-HWYS tracks debris removed through the cleaning of MS4 structures for all routes intersecting Waimanalo Stream Watershed. At the end of each cleaning event, inspectors record the total CY of debris removed and estimate a rough percentage of sediment, organic matter, and trash removed. DOT-HWYS averaged data from 2009-2013 to provide a representative estimate of anticipated debris removal to use on a seasonal basis. This data will serve as a basis for projecting future seasonal reductions.

A summary of the data is provided in Figures 3-3 and 3-4. Averaging data from these years yields an average anticipated dry season removal of 0.128 CY of sediment and 0.032 CY of organic matter and an average anticipated wet season removal of 0.0375 CY of sediment and 0.0125 CY of organic matter.

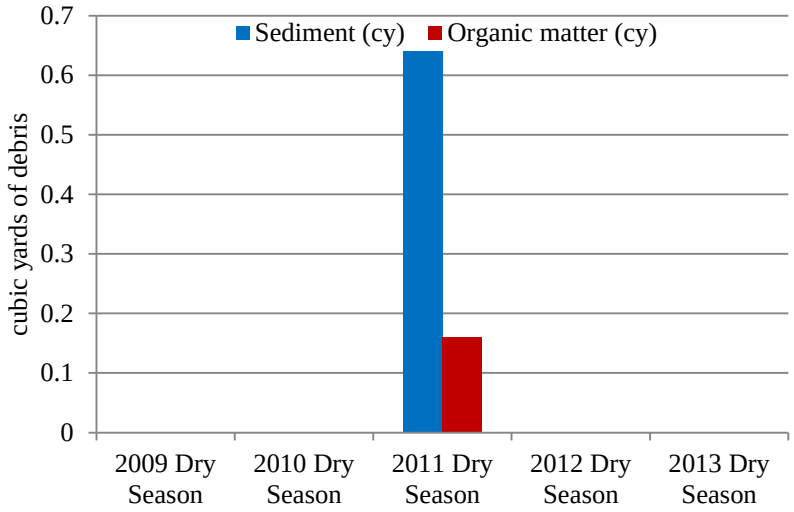

Figure 3-3. Cubic yards of debris removed from inlets and manholes in Waimanalo Stream Watershed, 2009-2013 Dry Seasons

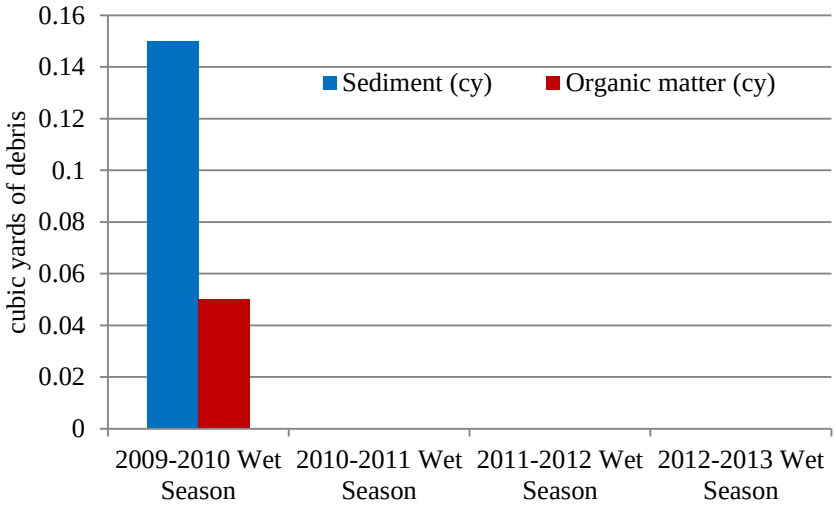

Figure 3-4. Cubic yards of debris removed from inlets and manholes in Waimanalo Stream Watershed, 2009-2013 Wet Seasons

Tables 3-3 and 3-4 present the conversion from an average anticipated seasonal wet-weight volume of debris removed to a dry mass of TN and TP removed from Waimanalo Stream Watershed through cleaning of MS4 structures.

Table 3-3. Conversion Calculations for TN Removal through Cleaning of Inlets and Manholes

	DRY SEASON			WET SEASON		
	Sediment	Organic matter	TOTAL	Sediment	Organic matter	TOTAL
Average anticipated seasonal debris removed (CY)	0.128	0.032		0.0375	0.0125	
Bulk density (KG/CY)	1039 [a]	497 [b]		1039 [a]	497 [b]	
Moisture content conversion factor for catch basin debris (%)	79 [a]	79 [a]		79 [a]	79 [a]	
TN conversion factor for catch basin debris (KG TN/KG dry mass)	0.0019263 [a]	0.0019263 [a]		0.0019263 [a]	0.0019263 [a]	
Average anticipated seasonal TN removed through MS4 cleaning (KG)	0.2	0.02	0.22	0.05	0.009	0.059

[a] Source: Berretta et al. (2011)
[b] Source: Government of Saskatchewan Ministry of Agriculture (2008) presented as wet bulk density of compost

Table 3-4. Conversion Calculations for TP Removal through Cleaning of Inlets and Manholes

	DRY SEASON			WET SEASON		
	Sediment	Organic matter	TOTAL	Sediment	Organic matter	TOTAL
Average anticipated seasonal debris removed (CY)	0.128	0.032		0.0375	0.0125	
Bulk density (KG/CY)	1039 [a]	497 [b]		1039 [a]	497 [b]	
Moisture content conversion factor for catch basin debris (%)	79 [a]	79 [a]		79 [a]	79 [a]	
TP conversion factor for catch basin debris (KG TP/KG dry mass)	0.0005666 a	0.0005666 [a]		0.0005666 [a]	0.0005666 [a]	
Average anticipated seasonal TP removed through MS4 cleaning (KG)	0.06	0.007	0.067	0.017	0.003	0.02

[a] Source: Berretta et al. (2011)
[b] Source: Government of Saskatchewan Ministry of Agriculture (2008) presented as wet bulk density of compost

3.3 PBMPs in Waimanalo Stream Watershed

No new development or significant redevelopment projects have occurred in Waimanalo Stream Watershed that would necessitate the construction of PBMPs. Should any such development or redevelopment take place along DOT-HWYS' ROW within Waimanalo Stream Watershed, DOT-HWYS will follow their MS4 Permit requirements to implement appropriate PBMPs.

DOT-HWYS has retrofitted two PBMPs (one bioswale and one grated inlet skimmer box [GISB]) in Waimanalo Stream Watershed (Figure 3-5).

3.3.1 Reduction Calculations

The Simple Method (Schueler 1987) was used to estimate the pollutant removal achieved by installing the PBMPs described in Table 3-6. Concentrations of TN and TP in DOT-HWYS' runoff were calculated as geometric mean values of all available sampling data from Waimanalo Watershed (164 grab and automatic samples from 2008-2010).

3.3.2 Literature Data on Pollutant Removal Efficiencies for Selected PBMPs

DOT-HWYS reviewed existing literature to determine characteristic pollutant removal efficiencies for various PBMPs. Results of this review are presented in Table 3-5. Where appropriate, the lowest and highest removal efficiencies were averaged to provide an average value.

Table 3-5. Literature Data on Pollutant Removal Efficiencies for Selected PBMPs

PBMP Type	TN (% removal)			TP (% removal)			Source
	Lowest	Highest	Average	Lowest	Highest	Average	
Bioswale	39	89	**64**	29	80	**54.5**	[1]
Grate Inlet Skimmer Box (GISB)	--	--	**56**	--	--	**57**	[2]

Sources:
[1] State of Oregon Department of Environmental Quality (2003)
[2] BioClean Environmental (2000)

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Table 3-6. PBMP Projects in Waimanalo Stream Watershed

Site #	Associated PID	Proposed BMP	**A** area (acres)	**Ia** impervious fraction (%)	**Rv** Runoff coefficient	**P_W** Wet season rainfall (inches)	**P_D** Dry season rainfall (inches)	**R_W** Wet season runoff (inches)	**R_D** Dry season runoff (inches)	**TNRed%** TN removal efficiency (%)	**TPRed%** TP removal efficiency (%)	**TN_W** Wet season TN load reduction (KG)	**TN_D** Dry season TN load reduction (KG)	**TP_W** Wet season TP load reduction (KG)	**TP_D** Dry season TP load reduction (KG)
1	800012	Bioswale	4.84	33	0.35	30	12	9.48	3.79	64.0	54.5	5.54	2.22	0.97	0.39
2	800010	GISB	0.157	87	0.84	30	12	22.55	9.02	56.0	57.0	0.37	0.15	0.08	0.03
											Total	**5.91**	**2.37**	**1.05**	**0.42**

Notes:

PID = Unique Point Identification Number for MS4 structure
A = Contributing drainage area (acres)
Ia = Impervious fraction (%)
Pj = Fraction of annual rainfall events that produce runoff = 0.9

Rv = Runoff coefficient = 0.05 + 0.9(Ia)

P_W = Wet season rainfall (inches) from Giambelluca et al. (2012)
P_D = Dry season rainfall (inches) from Giambelluca et al. (2012)

R_W = Wet season runoff (inches) = P_W * Pj * Rv
R_D = Dry season runoff (inches) = P_D * Pj * Rv

TNRed% = TN removal efficiency (%)
TPRed% = TP removal efficiency (%)

TNConc = Characteristic TN concentration in DOT-HWYS runoff in Waimanalo Stream Watershed = 1.84 MG/L
TPConc = Characteristic TP concentration in DOT-HWYS runoff in Waimanalo Stream Watershed = 0.38 MG/L
CF = Unit conversion factor = 6272640 in^2/acre * 0.0163871 L/in^3 * 0.000001 KG/MG = 0.1

TN_W = Wet season TN load reduction (KG) = A * R_W * TNConc * TNRed% * CF
TN_D = Dry season TN load reduction (KG) = A * R_D * TNConc * TNRed% * CF

TP_W = Wet season TP load reduction (KG) = A * R_W * TPConc * TPRed% * CF
TP_D = Dry season TP load reduction (KG) = A * R_D * TPConc * TPRed% * CF

Note: totals may be different from the multiplication of their parts due to rounding.

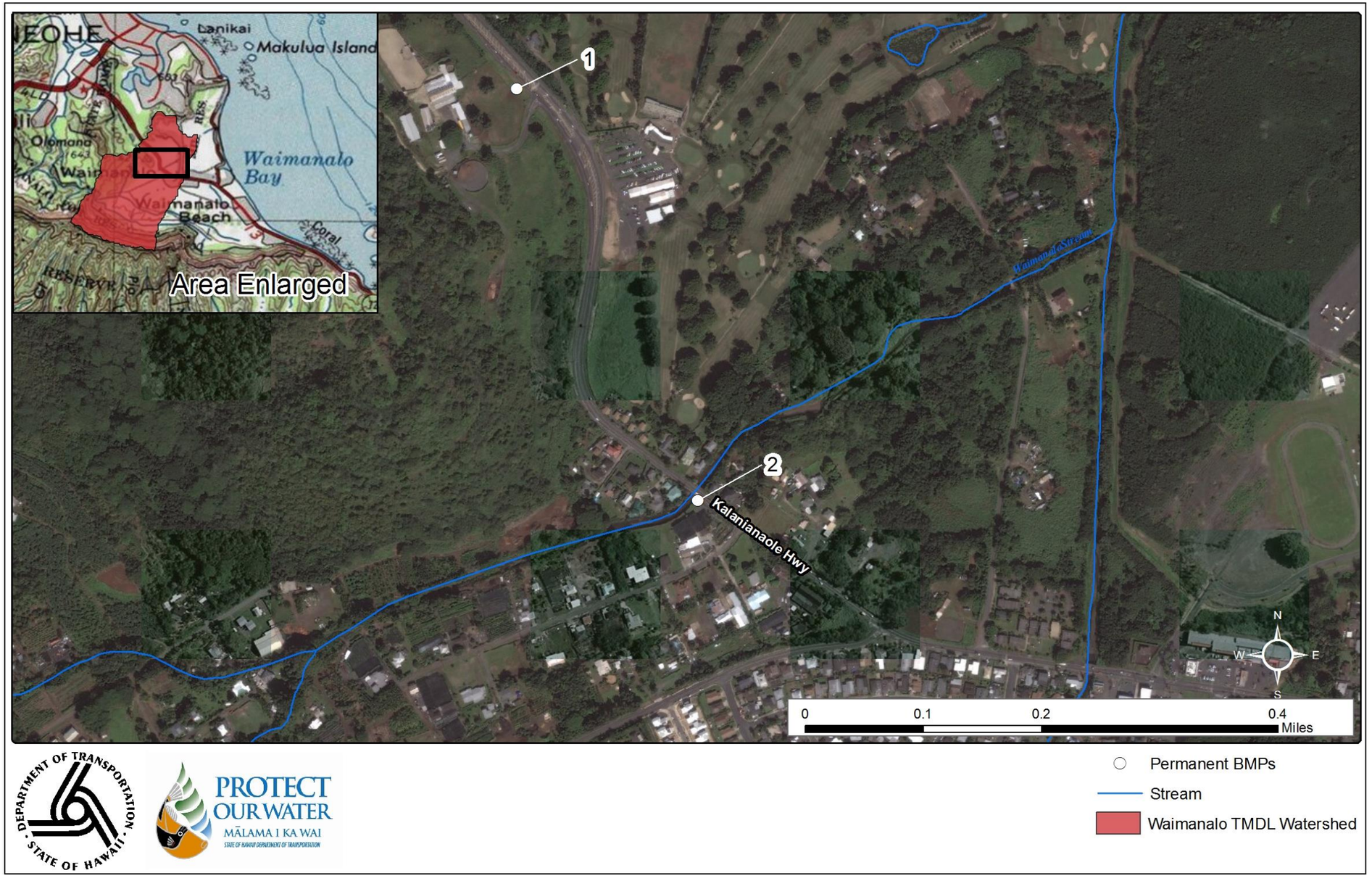

Figure 3-5. Identified PBMP Sites in Waimanalo Stream Watershed

3.4 Erosion Control Program in Waimanalo Stream Watershed

The 2007 *Islandwide Assessment of Erosional Areas on the Island of Oahu* identified two erosional areas of concern in Waimanalo Stream Watershed. Table 3-7 identifies the status of each site. Implementing these projects has resulted in reductions in loadings of TN and TP within Waimanalo Stream Watershed. Substantial pollutant reductions in discharges from the MS4 are attributed to the repair of these erosional areas, but these reductions have not been quantified at this time and are therefore considered qualitatively in this I&M Plan.

Table 3-7. Status of Identified Erosion Sites in Waimanalo Stream Watershed

PID	Route	Temporary Projects Completed	Permanent Projects Under Design/ Construction	Permanent Projects Completed
901	72	--	--	X
952	72	--	--	X

3.5 Construction Site Runoff Control Program Activities in Waimanalo Stream Watershed

DOT-HWYS will continue to verify that site-specific BMPs have been installed in accordance with their approved site-specific BMP plans prior to the commencement of any ground disturbing activities. Additionally, independent inspections will continue to be conducted as required in the MS4 permit to ensure BMPs are installed and maintained per the approved plan. DOT-HWYS has developed checklists, inspection forms, and corrective action and reporting procedures for construction projects and has conducted numerous annual construction activities BMP trainings for its staff and contractors. Should any new construction take place along DOT-HWYS' ROW within Waimanalo Stream Watershed, DOT-HWYS will follow their MS4 Permit requirements to implement appropriate construction site runoff control BMPs.

Substantial pollutant reductions in discharges from the MS4 are attributed to the Construction Program, but these reductions have not been quantified at this time and are therefore considered qualitatively in this I&M Plan.

3.6 Industrial and Commercial Activities Discharge Management (IC Program) and Illicit Discharge Detection and Elimination (IDDE Program) in Waimanalo Stream Watershed

As of October 2014, ten industrial and commercial facilities were located adjacent to DOT-HWYS' ROW within Waimanalo Stream Watershed. One of these facilities holds a permit to connect to the MS4. Since the tracking of deficiencies began in 2000, there have been no deficiencies recorded in Waimanalo Stream Watershed. During routine inspections, owners of the sites or facilities have been provided educational material to encourage best practices at their facilities. Substantial pollutant reductions in discharges from the MS4 are attributed to the IC and IDDE Programs, but these reductions have not been quantified at this time and are therefore considered qualitatively in this I&M Plan.

3.7 Public Education and Outreach in Waimanalo Stream Watershed

DOT-HWYS will continue to evaluate potential partnerships with agencies and other stakeholders to more effectively promote storm water awareness and affect behavioral change within the watershed.

In addition, DOT-HWYS sponsors an Adopt-A-Highway program that allows volunteers from any organization to pick up litter along Hawaii's State highways. Adopt-A-Highway groups agree to adopt a portion of State highway for a minimum of two years, pick up litter on that highway at least four times a year, and provide safety training for their volunteers before each cleanup. DOT-HWYS provides all safety materials and trash bags, schedules trash pick-ups and erects highway signs to recognize the sponsoring groups' cleaning efforts. One Adopt-A-Highway group is responsible for over 1.3 miles of highway within Waimanalo Stream Watershed.

Substantial pollutant reductions in discharges from the DOT-HWYS MS4 are attributed to the Public Education and Outreach Program, but these reductions have not been quantified at this time and are therefore considered qualitatively in this I&M Plan.

3.8 Summary of Anticipated Seasonal Load Reductions in Waimanalo Stream Watershed

Table 3-8 presents a summary of the anticipated seasonal pollutant load reductions calculated in Sections 3.1 to 3.7, where appropriate.

Table 3-8. Anticipated Seasonal Pollutant Load Reduction for TMDL Compliance

Best Management Practice (BMP) Program	Anticipated Total Nitrogen (TN) Reduction (KG/season)		Anticipated Total Phosphorus (TP) Reduction (KG/season)	
	Dry Season	Wet Season	Dry Season	Wet Season
Street Sweeping (Existing)	3.87	3.36	2.91	2.53
Cleaning of MS4 Structure	0.22	0.059	0.067	0.02
Permanent BMPs	2.37	5.91	0.42	1.05
Erosion Control Program	--[a]	--[a]	--[a]	--[a]
Construction Site Runoff Control	--[a]	--[a]	--[a]	--[a]
Industrial and Commercial Activities Discharge Management and Illicit Discharge Detection and Elimination Programs	--[a]	--[a]	--[a]	--[a]
Public Education and Outreach	--[a]	--[a]	--[a]	--[a]
TOTAL ANTICIPATED REDUCTION:	6.46	9.329	3.397	3.6
REDUCTION REQUIRED:	**1.71**	**1.71**	0.06	0.06

Notes:

[a] These programs have resulted in pollutant load reductions in the Waimanalo Stream Watershed. These reductions have not been quantified at this time and are therefore considered qualitatively in this I&M Plan.

Wet Season = 181 days (November 1 – April 30); Dry Season = 184 days (May 1 – October 31)

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4. MONITORING PLAN

The following sub-sections document how DOT-HWYS will monitor and report compliance with assigned WLA reductions in the Waimanalo Stream Watershed.

DOT-HWYS is currently reviewing methods to optimize TN and TP removals wherever practicable, such as increasing the frequency of sweeping in TMDL watersheds. Nonetheless, there are natural variables such as the timing, intensity, and duration of precipitation, which influence these removals and are fully outside the control of DOT-HWYS. For example, there is strong evidence that rainfall in Hawaii is affected on a year-to-year time scale by the occurrence of El Niño and La Niña events in the tropical Pacific, which give rise to large year-to-year variability in rainfall in Hawaii (Giambelluca et al. 2012). Corresponding variability in pollutant removals can be seen in Figures 3-1 to 3-4 of this report. As such, DOT-HWYS intends to demonstrate compliance with WLA reductions based on a three-year running average of TN and TP reductions.

4.1 Street Sweeping and MS4 Cleaning

DOT-HWYS will continue to track removals from street sweeping and MS4 structure cleaning, as described in Section 3.1 and 3.2, respectively.

4.2 PBMPs

Monitoring of seasonal reductions resulting from PBMPs may involve modeling similar to the Simple Method presented in Section 3.3 (for non-structural PBMPs such as bioswales) or by measuring the amount of debris removed (for structural PBMPs such as continuous deflection separator units).

4.3 Other BMP Programs

Other BMP programs whose associated reductions have not been quantified in this report will continue to be documented in the Annual Report.

4.4 Overall Compliance Reporting

Following the WLA Completion Report (no later than five years after the effective date of the MS4 Permit), the results of this monitoring will be reported annually in the SWMP Annual Report.