# Appendix I7: Implementation and Monitoring Plan for Waimanalo Stream, 2015

# IMPLEMENTATION AND MONITORING PLAN FOR WAIMANALO STREAM WASTELOAD ALLOCATION FOR THE CITY AND COUNTY OF HONOLULU MUNICIPAL SEPARATE STORM SEWER SYSTEM NPDES PERMIT NO. HI S000002

**June 2015**

**Prepared by**
**City and County of Honolulu**
**Department of Environmental Services**
**Kapolei, Hawaii**

E Mālama I Ka Wai Ola
Protect our waters...
FOR LIFE

# Transmittal Letter

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# Acronyms

| | |
|---|---|
| BMP | Best Management Practice |
| City/CCH | City and County of Honolulu |
| CWB | Clean Water Branch |
| CY | Calendar Year |
| DFM | City and County of Honolulu, Department of Facility Maintenance |
| DOH | State of Hawaii, Department of Health |
| ENV | City and County of Honolulu, Department of Environmental Services |
| EPA | United States Environmental Protection Agency |
| FY | Fiscal Year |
| GH | Good Housekeeping |
| GM | Geometric Mean |
| I&M Plan | Implementation and Monitoring Plan |
| MS4 | Municipal Separate Storm Sewer System |
| N+N | Nitrate plus Nitrite |
| NPDES | National Pollutant Discharge Elimination System |
| NTE | Not-to-Exceed |
| OM | Organic Matter |
| Permit | NPDES Permit No. HI S000002 |
| PM | Particulate Matter |
| PN | Particulate Nitrogen |
| PP | Particulate Phosphorus |
| TDN | Total Dissolved Nitrogen |
| TDP | Total Dissolved Phosphorus |
| TMDL | Total Maximum Daily Load |
| TN | Total Nitrogen |
| TP | Total Phosphorus |
| TSS | Total Suspended Solids |
| WLA | Wasteload Allocation |
| WQS | Water Quality Standards |

# Executive Summary

This implementation and monitoring plan was developed to comply with the terms of the National Pollutant Discharge Elimination System Permit No. HI S000002 (Permit) for the City's municipal separate storm sewer system (MS4).

The State of Hawaii, Department of Health (DOH) developed and established Total Maximum Daily Load (TMDL) fluxes for Waimanalo Stream. The DOH TMDL report did not define specific Wasteload Allocations (WLAs) for point dischargers such as the City and County of Honolulu (City or CCH). Therefore, the City derived its WLA based on its MS4 coverage as a percentage of the total area designated for urban land use (4.6% of Middle Kahawai sub-basin). The City also opted for a reductions-based approach, which required calculating the existing fluxes to determine the required load reductions.

Based on discussions with DOH representatives, it was determined that the City's load reduction goals should be based on the seasonal "high flow flux" interval (i.e., 2.5% NTE), as defined by the TMDL report. In addition, compliance will be based on the Middle Kahawai sub-basin (Ed Laws Station 16) since it contains urban land use coverage serviced by the City's MS4. Additionally, the DOH required that calculations for storm intervals (i.e., discrete events) be based on average concentrations and not geomean concentrations as originally calculated in the DOH TMDL report. Based on this methodology, the resulting load reduction goals for Total Nitrogen (TN) and Total Phosphorus (TP) are as follows:

**Table ES-1: Total Nitrogen and Total Phosphorus Load Reduction Summary (Sta. 16)**

| | TN | | TP | |
|---|---|---|---|---|
| | **Wet Season[1]** | **Dry Season[2]** | **Wet Season[1]** | **Dry Season[2]** |
| High Flow TMDL Flux (μg/s) | 365,855 | 25,020 | 68,592 | 3,336 |
| High Flow Existing Flux (μg/s) | 1,835,636 | 239,609 | 107,061 | 17,211 |
| Low Flow TMDL Flux (μg/s) | 15,500 | 4,140 | 3,100 | 690 |
| Low Flow (non-rain events) Existing Flux (μg/s) | 399,218 | 164,381 | 1,203 | 382 |
| Seasonal Flux Reduction Required (μg/s) | 1,070,596 | 50,208 | 37,266 | 13,493 |
| Seasonal Flux Reduction Required (%) | 58.3 | 21.0 | 34.8 | 78.4 |
| CCH MS4 Ownership (%) | 4.6 | 4.6 | 4.6 | 4.6 |
| Number of Days in season (2.5% NTE) (days) | 4.53 | 4.60 | 4.53 | 4.60 |
| CCH Seasonal Load Reduction (lb/season) | 43.3 | 2.0 | 1.5 | 0.5 |

[1] Wet Season – November 1st through April 30th
[2] Dry Season – May 1st through October 31st

Based on this analysis, the City will implement Best Management Practices (BMPs) targeted at removing 43.3 lbs and 2.0 lbs of TN in the wet and dry seasons, respectively, and 1.5 lbs and 0.5 lbs of TP in the wet and dry seasons, respectively. Reduction goals for total suspended solids are not applicable.

The City will implement a variety of BMPs to reduce pollutant loads in the watershed. These activities include:

- Public outreach efforts informing homeowners of how their actions affect water quality in the Waimanalo and Kahawai Streams;

- Public outreach efforts targeted to specific homeowners who could make improvements around their homes such as disconnecting roof drains;
- Routine street sweeping;
- Maintenance of the Kumuhau Street bioswale; and
- Inspection and cleaning of drainage structures and conveyances as necessary.

The combination of these efforts is expected to remove nutrients, namely TN and TP, from the waste stream and ultimately achieve the targeted City's WLA. Based on historical collections, it is anticipated that four street sweepings in the wet season, one street sweeping in the dry season, along with continued maintenance of the Kumuhau Street bioswale will collect and treat sediment and organic matter in sufficient quantity to meet the TN and TP reduction goals. If additional activities (ex. additional street sweeping cycles, drain cleaning, and/or permanent BMPs, etc.) are required to meet the target reductions, the City will implement them in increments as described in Section 5.0. The following table provides a summary of the estimated pollutant load reductions for each of the City's BMPs.

**Table ES-2: Summary of BMP Activities and Quantitative Reductions**

| Activity | TN Reduction (lbs/season) | | TP Reduction (lbs/season) | |
|---|---|---|---|---|
| | Wet Season | Dry Season | Wet Season | Dry Season |
| Downspout Disconnect | * | * | * | * |
| Homeowner Outreach/Volunteer Cleanup | * | * | * | * |
| Street Sweeping | 38 | 7 | 12.8 | 4.1 |
| Kumuhau Street Bioswale | 10.5 | 3.7 | 4.0 | 1.4 |
| Stream Cleaning | ** | ** | ** | ** |
| Storm Drain Maintenance | ** | ** | ** | ** |
| TOTAL | 48.5 | 10.7 | 16.8 | 5.5 |
| REDUCTIONS REQUIRED | 43.3 | 2.0 | 1.5 | 0.5 |

* The City will conduct a public education and outreach program to all homeowners within the watershed; however, due to difficulty in quantifying pollutant load reductions due to behavior changes, no homeowner contribution is assumed for accounting purposes at this time.

**Cleaning of streams, storm drains, and drainage structures will be implemented only if collections from other activities are less than anticipated and the City needs additional reductions to meet the load reduction goals for a particular season. Stream and/or Storm drain cleaning may also be done in lieu of additional street sweeping activities based on scheduling and equipment availability.

The final compliance deadline is December 31, 2018.

# 1.0 Introduction

The National Pollutant Discharge Elimination System (NPDES) Permit No. HI S000002 (Permit) issued by the State of Hawaii, Department of Health (DOH) to the City and County of Honolulu (City for CCH) for their municipal separate storm sewer system (MS4) became effective February 16, 2015. It stipulates that the City develop an updated Wasteload Allocation (WLA) implementation and monitoring plan (I&M Plan) for Waimanalo Stream by the end of Fiscal Year 2015 (FY15). For the purpose of complying with the foregoing requirement, the City is submitting this updated I&M Plan for Waimanalo Stream.

The DOH developed and established Total Maximum Daily Loads (TMDLs) for the Waimanalo Stream in its technical report *Total Maximum Daily Loads Estimated for Waimanalo Stream, Island of Oahu, Hawaii* (DOH, March 2001). This I&M Plan will address specific City activities targeted to reducing TN and TP discharges in the Waimanalo Stream watershed as necessary to comply with the TMDLs and the City's WLA. The monitoring plan specifies activity tracking necessary to demonstrate efforts by the City to comply with the urban source WLAs.

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## 2.0 Waimanalo Stream Watershed

The Waimanalo Stream watershed is about 5.9 square miles (3,790 acres) and is located in the Koolaupoko District on the windward side of Oahu. It receives up to 80 inches of rainfall annually near its headwaters in the Koolau Mountains. It is bordered by Kaelepulu watershed to the North; Kahawai watershed to the East; Kawainui watershed to the West; and the peak of the Koolau Mountain range to the south (see Figure 1). Waimanalo stream is a highly altered waterway, about 3.42 miles in length, and consists of two main tributaries – Waimanalo Stream and Kahawai Stream.

**Figure 1: Waimanalo Stream Watershed**

For the purposes of the TMDL report, only the perennial freshwater portion of the stream was analyzed by DOH because it was the only portion of the stream that was included on Hawaii's 1988 List of Impaired Waterbodies. This area, approximately 4.6 square miles (2,940 acres), is depicted by the hatched area in Figure 1 and is the focus of this I&M Plan.

The DOH further delineated the watershed into six sub-basins based on topography and water quality sampling station locations (see Figure 2). A seventh sub-basin, representing the lower watershed, was not included in the TMDL report since it extended beyond the freshwater extent of the stream.

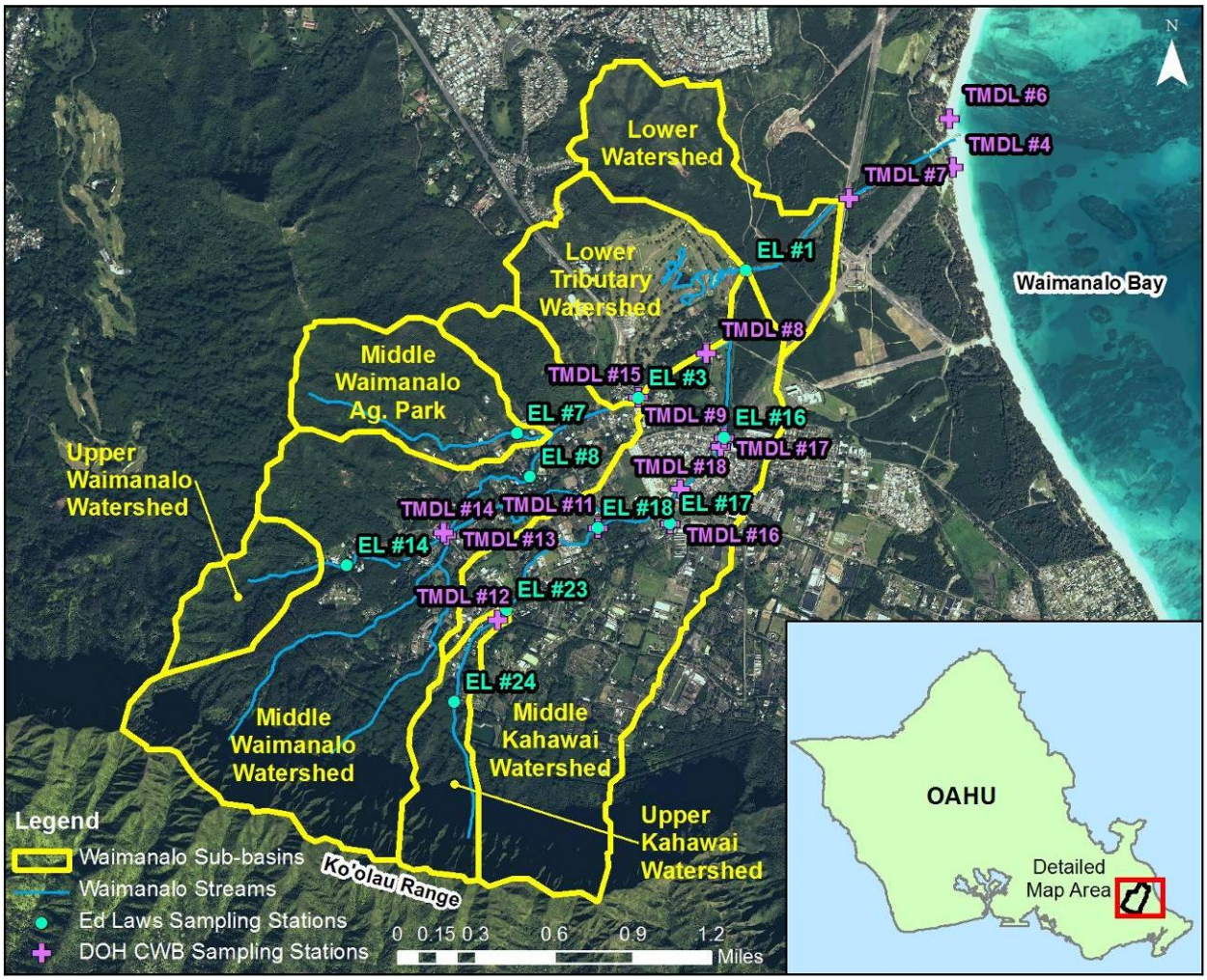


**Figure 2: Waimanalo Stream Sub-basins**

Stream water quality sampling stations used by DOH in the development of the TMDLs are also shown in Figure 2. Ed Laws sampling stations (shown in cyan) represent storm flow conditions collected between February 1999 and April 2000. DOH-CWB stream sampling stations (shown in magenta) were used to measure concentrations during non-storm events (low flow and zero flow) between November 1999 and April 2000.

Primary land uses in the Waimanalo watershed include forested conservation areas, small agricultural operations, residential neighborhoods, and a golf course. Bellows Air Force Station is located in the lower watershed area which was excluded from the TMDL study. Table 1 below summarizes the land use by sub-basin as determined by DOH.

**Table 1: Land Use within the Waimanalo Watershed**

| Sub-basin | Land Use | % of Sub-basin[1] |
|---|---|---|
| Lower Tributary Watershed | Agriculture | 63% |
| | Conservation | 35% |
| Middle Waimanalo Ag. Park | n/a | n/a |
| Upper Waimanalo Watershed | Conservation | 77% |
| | Steep Slope | 23% |
| Middle Waimanalo Watershed | Agriculture | 32% |
| | Conservation | 49% |
| | Steep Slope | 19% |
| Upper Kahawai Watershed | Agriculture | 21% |
| | Conservation | 25% |
| | Steep Slope | 53% |
| Middle Kahawai Watershed | Urban | 5% |
| | Agriculture | 75% |
| | Conservation | 7% |
| | Steep Slope | 13% |

[1]From the DOH Waimanalo TMDL Final Report, March 2001

Within the Middle Kahawai sub-basin (Ed Laws Station 16), the City regulates approximately 4.6% of the entire sub-basin (see Figure 3). This conservatively assumes that the entire urban land use (5% of sub-basin 16) is regulated by the City and DOT (note: DOT regulates 0.4% of sub-basin 16 per Permit No. HI S000001). The areas highlighted in yellow indicate City streets and/or properties that are serviced by the City's MS4.

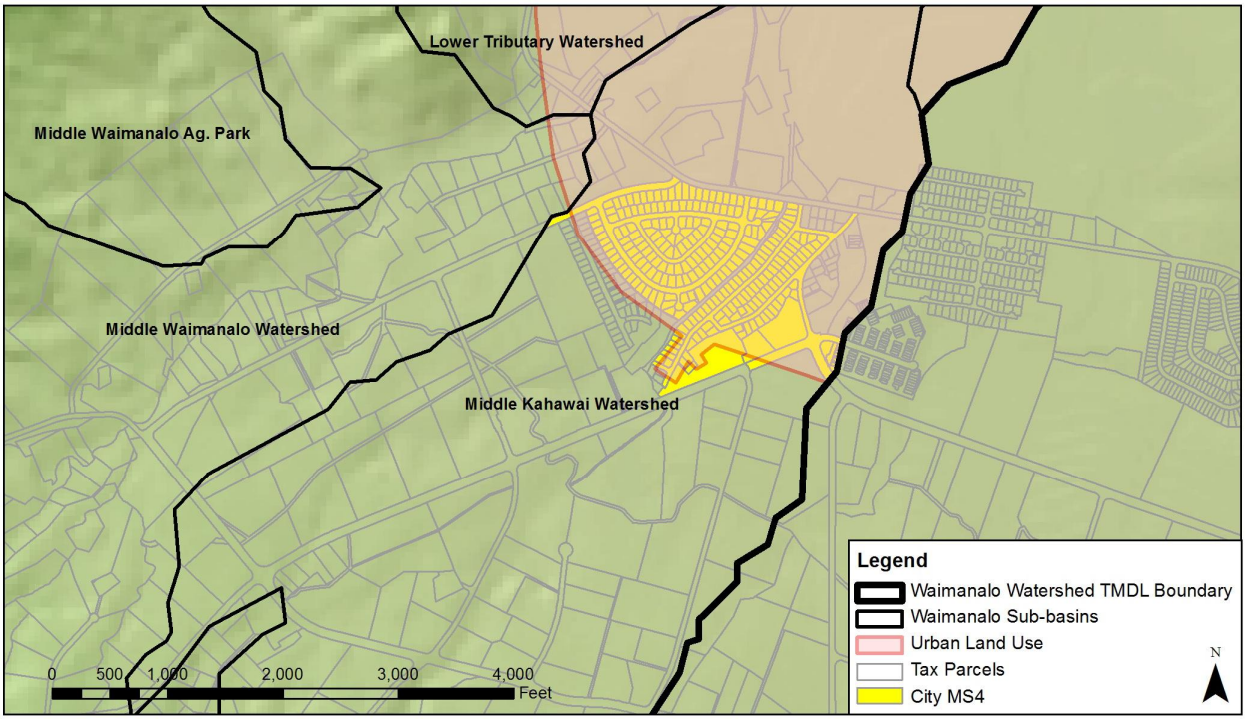


**Figure 3: Detail of City MS4 Coverage Area in Middle Kahawai Sub-basin**

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# 3.0 TMDLs and WLAs for Waimanalo Stream Watershed

TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards and is an allocation of that load among the various sources of that pollutant. In 2001, the DOH published and the United States Environmental Protection Agency (EPA) approved TMDL fluxes for Waimanalo Stream for Nitrate+Nitrite (N+N), Total Suspended Solids (TSS) and Total Dissolved Phosphorus (TDP). A "flux" is defined as the product of the pollutant concentration and the stream flow; the magnitude of the flux represents the weight of material passing a particular location per unit time (DOH, 2001). These TMDL fluxes were based on flow geometric means (GM) and the state water quality standards (WQS). They were allocated between the dry and wet seasons for three intervals: high flow, low flow, and zero flow. The TMDL report did not establish wasteload allocations (WLAs) for point source discharges so the City developed a methodology to determine its WLA and existing loads to calculate its reduction goals.

Furthermore, based on discussions with DOH, it was determined that only the Middle Kahawai sub-basin (Ed Laws' Station 16) is applicable for TMDL compliance since it contains CCH-owned MS4 facilities within the urban land use boundary.

## 3.1 TMDL Seasonal Fluxes

Several errors within the DOH TMDL calculations were identified during detailed evaluation of the data. For this reason, the City recalculated the TMDL fluxes using the original data tables (Ed Laws raw data, 1999-2000). The DOH also required that calculations for storm intervals (i.e., discrete events) be based on average concentrations and not geomean concentrations as originally calculated in the DOH TMDL report. Therefore, TMDL fluxes were calculated based on flow averages and state WQS, including adjustments for TSS 2% NTE and 10% NTE concentrations. In addition, TDP was converted to Total Phosphorus (TP) by adding the Particulate Phosphorus (PP) fraction to be consistent with the State WQS. The City also requested, and the DOH approved, the use of Total Nitrogen (TN) in lieu of N+N for TMDL compliance purposes. Per Laws, TN is the sum of Total Dissolved Nitrogen (TDN) and Particulate Nitrogen (PN) (2003). Based on an average of 21 sampling events, the N+N fraction of TN is approximately 84% of TN. Therefore, tracking TN for TMDL compliance is representative of the desired N+N load reduction.

The resulting wet season and dry season TMDL fluxes for the Middle Kahawai sub-basin of the Waimanalo watershed are presented in Table 2 (corrected and modified from Table 10 of the *Total Maximum Daily Loads Estimated for Waimanalo Stream, Island of Oahu, Hawaii* (DOH, March 2001)). The wet season is defined as the period between November 1st and April 30th for a total of 181 days. The dry season is defined as the period between May 1st and October 31st for a total of 184 days.

**Table 2: TMDL Fluxes – Middle Kahawai Sub-basin**

| | Wet Season | | | Dry Season | | |
|---|---|---|---|---|---|---|
| | TN (μg/s) | TSS (mg/s) | TP (μg/s) | TN (μg/s) | TSS (mg/s) | TP (μg/s) |
| High Flow TMDL Flux | 365,822 | 31,461 | 68,592 | 25,020 | 1,972 | 3,336 |
| Low Flow TMDL Flux | 15,500 | 1,240 | 3,100 | 4,140 | 230 | 690 |

Underlined values are revised or modified from DOH Table 10; all other values are consistent with Table 10

## 3.2 Existing Seasonal Fluxes

The DOH TMDL report did not provide calculations for the existing fluxes, so the City derived those values based on the original data tables for observed storm flows and observed concentrations (Ed Laws

raw data, 1999-2000) and followed a similar methodology used by DOH to derive the TMDL fluxes (flow averages and concentration averages). The low flow existing flux was calculated in a similar manner (flow averages and concentration averages) from the non-rain event samples collected by DOH-CWB (1998-2000). The resulting wet season and dry season existing fluxes for the Middle Kahawai sub-basin are provided in Table 3.

**Table 3: Existing Fluxes – Middle Kahawai Sub-basin**

| | Wet Season | | | Dry Season | | |
|---|---|---|---|---|---|---|
| | TN (μg/s) | TSS (mg/s) | TP (μg/s) | TN (μg/s) | TSS (mg/s) | TP (μg/s) |
| High Flow Existing Flux[1] | 1,835,636 | 23,752 | 107,061 | 239,609 | 1,160 | 17,211 |
| Low Flow Existing Flux[2] | 399,218 | 843 | 1,203 | 164,381 | 435 | 382 |

[1]Average of the product of the observed flow and observed concentration (Ed Laws raw data, 1999-2000)
TN Flux Ave (μg/s) = observed flow (L/s) * TN (μM/L) * molar mass of N (14 g/M)
TSS Flux Ave (mg/s) = observed flow (L/s) * TSS (mg/L)
TP Flux Ave (μg/s) = observed flow (L/s) * TP (μM/L) * molar mass of P (31 g/M)
[2]Average of the observed concentration (DOH-CWB data, 1998-2000)

## 3.3 Seasonal Load Reduction Goals

The load reduction goals for the entire Middle Kahawai sub-basin (Ed Laws Station 16) were computed based on the "High Flow Existing Flux" minus the "High Flow TMDL Flux" minus the "Low Flow Existing Flux". The low flow flux occurs during non-rain events, and therefore represents non-runoff conditions. MS4 Permittees are not regulated for non-storm water runoff, and therefore, the existing baseload is subtracted from the storm flow loads. In cases where the existing low flow flux is less than the low flow TMDL flux, the low flow flux was assumed to be the existing load. This approach is in accordance with the anti-degradation of water quality policy stated in HAR 11-54-1.1. If the result of the above equation is negative for a particular pollutant, no reductions are required.

Per discussions with DOH, the City's load reduction goals and compliance with the WLAs should be based on the seasonal "high flow" interval, as defined by the DOH TMDL report, and the modified TMDL fluxes noted in Table 2. The rationale to comply with only the high flow interval criteria is based on the premise that discharges from the MS4 occurred approximately 2.5% of the time during TMDL development. Therefore, the City will demonstrate compliance with the WLA by removing the defined amount of pollutants as described in Table 4 below.

**Table 4: CCH MS4 Load Reductions for Middle Kahawai Sub-basin**

| | Unit | Wet Season | | | Dry Season | | |
|---|---|---|---|---|---|---|---|
| | | TN (µg/s) | TSS (mg/s) | TP (µg/s) | TN (µg/s) | TSS (mg/s) | TP (µg/s) |
| High Flow Existing Flux | µg/s or mg/s (see above) | 1,835,636 | 23,752 | 107,061 | 239,609 | 1,160 | 17,211 |
| High Flow TMDL Flux | µg/s or mg/s (see above) | 365,822 | 31,461 | 68,592 | 25,020 | 1,972 | 3,336 |
| Low Flow Flux (subtract)[1] | µg/s or mg/s (see above) | 399,218 | 843 | 1,203 | 164,381 | 435 | 382 |
| Reduction Goal | µg/s or mg/s (see above) | 1,070,596 | - | 37,266 | 50,208 | - | 13,493 |
| Reduction Goal | % | 58.3 | - | 34.8 | 21.0 | - | 78.4 |
| Conversion to lbs/day[2] | lb/day | 203.9 | - | 7.1 | 9.6 | - | 2.6 |
| CCH MS4 Ownership[3] | % | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 |
| # of Days in Season[4] | days | 4.53 | 4.53 | 4.53 | 4.60 | 4.60 | 4.60 |
| CCH Reduction Goal | lbs/season | 43.3[5] | - | 1.5 | 2.0 | - | 0.5 |

[1]Value is equal to the "Low Flow Existing Flux", even if it is lower than the "Low Flow TMDL Flux" in accordance with Water Quality Anti-degradation Policy (HAR 11-54-1.1)
[2]1 mg/s = 0.1905 lb/day; 1 µg/s = 0.0001905 lb/day
[3]CCH MS4 urban coverage is 4.6% of the Middle Kahawai sub-basin
[4]Wet Season = 2.5% * 181 days; Dry Season = 2.5% * 184 days
[5]ENV's independent calculations resulted in TN wet season reductions of 42.4 lb. 43.3 lbs was selected to be consisted with Permit No. HI S000002 (19.63 kg)

Based on the above computations, the City's implementation plan will target reductions in TN loadings by 43.3 lbs during the wet season and 2.0 lbs during the dry season and TP loadings by 1.5 lbs in the wet season and 0.5 lbs in the dry season. TSS reductions are not applicable.

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# 4.0 Proposed Best Management Practice Implementation and Monitoring Plan

The City will implement various Best Management Practices (BMPs) to reduce pollutants, particularly TN and TP, from entering Waimanalo Stream and its tributaries. The aggregate effect of these individual activities is expected to reduce the pollutants in the City's storm water discharge to below the target WLA. This TMDL Implementation Plan identifies specific activities with the goal of reducing pollutants, improving water quality, and increasing the stream's ability to support aquatic habitat. While ultimately the attainment of the Waimanalo Stream TMDL requires all stakeholders, including major landowners and land operators, to participate in pollution reduction efforts, the City proposes to implement the following BMPs to reduce point source loads from the City's streets and facilities.

- Community Involvement and Outreach/Education
- Pollution Prevention and Good Housekeeping
- Water Quality Improvement Projects

## 4.1 Community Involvement and Outreach/Education

Outreach efforts which educate the general public to effect changes in their behavior can result in significant reductions of pollutants that would otherwise enter the storm drain system and receiving waters.

### *4.1.1 Downspout Disconnection*

Building rooftops are impervious surfaces, similar to paved streets and parking lots that accumulate debris, chemicals, fine sediment, nutrients or other pollutants that could adversely affect water quality if the runoff is discharged untreated. Connected downspouts discharge rooftop runoff either directly to the storm drain system or to impervious surfaces. In both cases, there is little to no treatment of storm water runoff before it reaches the stream system. Most of the nitrogen contained in storm water is in the form of dissolved nitrate. Since the nitrogen is not in solid form, removal through plant uptake has been shown to be much more effective than filtration methods.

Downspout disconnection can help reduce runoff volume, rate, and accumulated rooftop pollutants introduced to local streams by allowing runoff water to pass through the initial plant uptake process as well as the secondary infiltration process rather than discharging directly to the storm drainage system. Disconnected downspouts typically drain to pervious areas such as yards and lawns, rain barrels, or rain gardens, all of which allow rooftop runoff to enter treatment prior to discharge.

A survey of the 245 residential properties in Waimanalo to assess the potential for downspout disconnection was performed on May 30, 2013. The results of the survey are provided in Table 5.

**Table 5: Survey of Properties for Potential Downspout Disconnection**

| Roof / Gutter / Downspout Condition | Number |
|---|---|
| Roofs with no gutters | 96 |
| Roofs with gutters with direct connection to storm drainage system | 11 |
| Disconnected roof gutters that drain to impervious surfaces | 48 |
| Disconnected roof gutters that drain to pervious surfaces or rain barrels | 93 |
| TOTAL PROPERTIES SURVEYED | 248 |

Based on the results, there is a potential for 59 houses to implement downspout disconnection or redirection as there is a direct or indirect connection to the storm drainage system. These properties have been identified in Appendix A. In addition, these lots were identified to have at least 10 feet of pervious area available for infiltration down gradient of the disconnected downspout or sufficient room to accommodate a rain barrel installation.

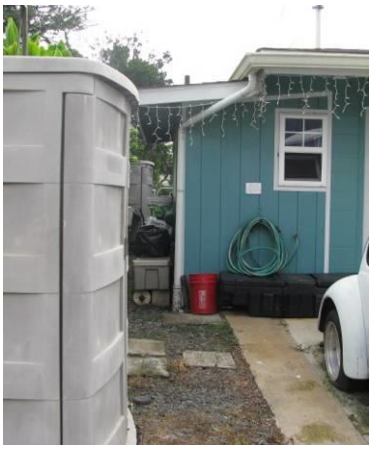

**Figure 4: Typical Example of Connected Downspout**

**Figure 5: Typical Example of Disconnected Downspout Draining to Impervious Surfaces**

The City will prepare an informational mailer to targeted homeowners educating them on the benefits of downspout disconnection. The mailer will specify the benefits of such activity and provide homeowners with resources for additional information.

Pollutant reductions for downspout disconnection are calculated based on the pollutant load received from the total rooftop drainage area ($A_{IMP}$) suitable for disconnection and the anticipated removal efficiency of the selected BMP. The equation used to estimate TN and TP load reductions for downspout disconnection is expressed as follows:

Load Reduction [lb/yr] = LR * $A_{IMP}$ * P * PP * RE * C, where:

LR = Loading rate for urban land use (NY State Stormwater Management Design Manual) (1.5 mg/L for TN; 0.11 mg/L for TP)

$A_{IMP}$ = impervious rooftop drainage area recommended for disconnection (estimated from Google Earth images) (4.15 Acres)

P = Average precipitation totals for calendar years 1990-2012 (11.8 in/yr during the dry season, 29.2 in/yr during the wet season)

PP = Percent of Residents who Participate (%)

RE = Removal Efficiency for Specific BMP Type (open channel removal rate of 56% for TN and 24% for TP per National Pollutant Removal Performance Database, Center of Watershed Protection [CWP], 2007)

C = Conversion Factor, 0.2266

Table 6 provides a summary of the estimated load reductions in TN and TP from this activity based on varying participation rates.

**Table 6: Downspout Disconnection Anticipated Load Reduction**

| Percent Participation | # of Houses | Wet Season Load Reduction | | Dry Season Load Reduction | |
|---|---|---|---|---|---|
| | | TN (lb/season) | TP (lb/season) | TN (lb/season) | TP (lb/season) |
| 10% | 6 | 2.3 | 0.07 | 0.9 | 0.03 |
| 20% | 12 | 4.6 | 0.14 | 1.9 | 0.06 |
| 30% | 18 | 6.9 | 0.22 | 2.8 | 0.09 |
| 40% | 24 | 9.2 | 0.29 | 3.7 | 0.12 |
| 50% | 30 | 11.5 | 0.36 | 4.7 | 0.15 |
| 60% | 35 | 13.8 | 0.43 | 5.6 | 0.18 |
| 70% | 41 | 16.1 | 0.51 | 6.5 | 0.21 |

While downspout disconnection is a meaningful and tangible homeowner contribution to reducing pollutants in the waste stream, this activity has not been included in the accounting of TN or TP load reductions from the City's MS4 due to uncertainty in the participation rate. If, however, it is determined, based on photographic evidence, that a significant number of homeowners have taken action, reduction contributions from this activity will be used to offset other activities such as street sweeping.

### *4.1.2 Homeowner Outreach/Volunteer Cleanup*

Raising awareness among homeowners about some of the common activities around their homes that can negatively affect water quality can invoke a behavior change. This shift in behavior is a primary citizen-based strategy that can yield significant positive results and water quality improvements.

Currently, Waimanalo Stream next to Weinberg Village has been adopted by Job Corp Hawaii and Weinberg Village through the City and County's Adopt-a-stream program. They maintain the native plants placed along the upper banks during approximately two community involvement events each year. The work involves mainly weeding around the planted natives and collecting plant material (approximately 25 bags of plant material are collected during each event by an average of 10-20 volunteers).

Since the effects of public participation on storm water discharges is often unreliable and difficult to quantify, the anticipated removal rates from this activity have not been included in the calculations to

quantify TN or TP load reductions. However, if a methodology is developed to quantify the homeowner/volunteer group contribution in removal of TN and TP (i.e., volume of material removed and debris composition), it will be applied in a manner identical to that of street sweeping described below.

## 4.2 Pollution Prevention and Good Housekeeping

The City currently implements a host of pollution prevention and good housekeeping (GH) practices across the island. Collectively, these programs are a key element in the diversion of trash, sediment, and nutrients from entering the storm drain system and discharging to receiving waters. The City will implement the following plan to expand its maintenance operations in the Waimanalo Stream watershed for the upcoming 2016 fiscal year (FY16).

### *4.2.1 Street Sweeping*

The Kailua Corporation Yard of the City Department of Facility Maintenance (DFM) currently maintains the City's streets and facilities within the Waimanalo Stream watershed area. The current street sweeping schedule is irregular and conducted based on the availability of staff and operability of the equipment. The baseyard currently uses a regenerative air street sweeper (Tymco model 600) for its street sweeping operations.

A street sweeping pilot study was initiated in June 2013 to determine baseline conditions in the wet and dry seasons. During the baseline study, the total volume of debris removed from the roadside area was estimated by spreading the collected material into a rectangle of uniform thickness and measuring the dimensions to calculate the volume. In addition, the percent composition of the debris collected (gravel + sand + sediment, green waste, and trash) was visually estimated. The raw data summarizing the estimated removal quantity and debris composition are presented in Table 7 below.

**Table 7: Summary of Street Sweeping Baseline Data Collection**

| Date | Season | Quantity Collected (CY) [1] | Debris Composition (%)[2] | | |
|---|---|---|---|---|---|
| | | | Trash | Gravel/Sand/ Sediment | Green Waste |
| 6/26/13 | Dry | 2.70 | 0 | 85 | 15 |
| 11/8/13 | Wet | 3.70 | 1 | 49 | 50 |
| 1/21/14 | Wet | 2.22 | 0 | 60 | 40 |
| 3/25/14 | Wet | 0.97 | 0 | 30 | 70 |
| 5/29/14 | Dry | 2.77 | 0 | 50 | 50 |
| 7/28/14 | Dry | 3.56 | 0 | 30 | 70 |
| 10/3/14 | Dry | 0.62 | 1 | 60 | 39 |
| 11/14/14 | Wet | 0.78 | 1 | 40 | 59 |
| 1/30/15 | Wet | 2.22 | 1 | 74 | 25 |
| 3/6/15 | Wet | 0.65 | 0 | 70 | 30 |

[1]Quantity estimated by spreading out the material collected into a uniform thickness and measuring length x width x depth
[2]Debris composition percentages estimated based on visual assessment

Particulate matter (PM) consisting of road sediment/sand/gravel were randomly sampled from the material collected and taken to the University of Hawaii at Manoa Agricultural Diagnostic Service Center

for nitrogen and phosphorus analysis. The nitrogen content of the samples varied from 0.002% to 1.41% of total weight with an average concentration of 0.0034 lb-N/lb-PM. The phosphorus content of the samples varied from 0.05% to 0.17% with an average concentration of 0.0012 lb-P/lb-PM, respectively.

Organic matter (OM) was also extracted from the material collected and taken to the University of Hawaii at Manoa Agricultural Diagnostic Service Center for nitrogen and phosphorus analysis. The nitrogen content of the samples varied from 0.64% to 1.63% of the total weight. The average nitrogen content of all OM collected was 0.0124 lb-N/lb-OM. The phosphorus content of the samples varied from 0.05% to 0.15% of the total weight. The average phosphorus content of all OM collected was 0.0010 lb-P/lb-OM.

EPA bulk density conversion factors were used for "gravel" + "sand", "soil" (for sediment), and "compost" (for green waste) (www.epa.gov/osw/conserve/smm/wastewise/pubs/conversions.pdf). The measured concentrations along with the bulk density conversion factors were used to compute the estimated removal quantity of TN, and TP according to the following equations:

TN Load Reduction [lb/sweep] = $(V_{TOTAL} * F_{G+S+S} * W_{G+S+S} * N_{PM}) + (V_{TOTAL} * F_{GREEN\ WASTE} * W_{COMPOST} * N_{OM})$, where:

$V_{TOTAL}$ = Total volume of material collected (CY)

$F_{G+S+S}$ = Estimated fraction of gravel + sand + sediment by volume based on visual assessment (%)

$F_{GREEN\ WASTE}$ = Estimated fraction of green waste by volume based on visual assessment (%)

$W_{G+S+S}$ = Average bulk density conversion factor for gravel, sand, and sediment (2,466 lbs/CY)

$W_{COMPOST}$ = Bulk density conversion factor for green waste (360 lbs/CY)

$N_{PM}$ = Nitrogen content of particulate matter (gravel, sand, and sediment) (lb-N/lb-PM)

$N_{OM}$ = Nitrogen content of organic matter (green waste) (lb-N/lb-OM)

TP Load Reduction [lb/sweep] = $(V_{TOTAL} * F_{G+S+S} * W_{G+S+S} * P_{PM}) + (V_{TOTAL} * F_{GREEN\ WASTE} * W_{COMPOST} * P_{OM})$, where:

$V_{TOTAL}$ = Total volume of material collected (CY)

$F_{G+S+S}$ = Estimated fraction of gravel + sand + sediment by volume based on visual assessment (%)

$F_{GREEN\ WASTE}$ = Estimated fraction of green waste by volume based on visual assessment (%)

$W_{G+S+S}$ = Average bulk density conversion factor for gravel, sand, and sediment (2,466 lbs/CY)

$W_{COMPOST}$ = Bulk density conversion factor for green waste (360 lbs/CY)

$P_{PM}$ = Phosphorus content of particulate matter (gravel, sand, and sediment) (lb-P/lb-PM)

$P_{OM}$ = Phosphorus content of organic matter (green waste) (lb-P/lb-OM)

A summary of the computations is provided in Table 8.

**Table 8: Summary of Street Sweeping Load Reduction Computations**

| Season | Qty (CY) | Material Collected | Debris Composition (%) | Bulk Density (lb/CY) | Concentration (lb/lb) | | Qty Removed (lb/sweep) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | TN | TP | TN | TP |
| Dry (6/26/13) | 2.70 | Gravel+Sand+Sediment | 85 | 2,466 | 0.0016 | 0.0011 | 10.5 | 6.1 |
| | | Green Waste | 15 | 360 | 0.0102 | 0.0009 | | |
| Wet (11/8/13) | 3.70 | Gravel+Sand+Sediment | 49 | 2,466 | 0.0006 | 0.0011 | 8.5 | 5.5 |
| | | Green Waste | 50 | 360 | 0.0087 | 0.0009 | | |
| Wet (1/21/14) | 2.22 | Gravel+Sand+Sediment | 60 | 2,466 | 0.0052 | 0.0014 | 21.5 | 4.8 |
| | | Green Waste | 40 | 360 | 0.0136 | 0.0005 | | |
| Wet (3/25/14) | 0.97 | Gravel+Sand+Sediment | 30 | 2,466 | 0.0044 | 0.0013 | 6.6 | 1.2 |
| | | Green Waste | 70 | 360 | 0.0142 | 0.0009 | | |
| Dry (5/29/14) | 2.77 | Gravel+Sand+Sediment | 50 | 2,466 | 0.0009 | 0.0012 | 9.5 | 4.6 |
| | | Green Waste | 50 | 360 | 0.0130 | 0.0011 | | |
| Dry (7/28/14) | 3.56 | Gravel+Sand+Sediment | 30 | 2,466 | 0.0141 | 0.0132 | 48.9 | 5.5 |
| | | Green Waste | 70 | 360 | 0.0017 | 0.0011 | | |
| Dry (10/3/14) | 0.62 | Gravel+Sand+Sediment | 60 | 2,466 | 0.00002 | 0.0005 | 1.17 | 0.52 |
| | | Green Waste | 39 | 360 | 0.0133 | 0.0007 | | |
| Wet (11/14/14) | 0.78 | Gravel+Sand+Sediment | 40 | 2,466 | 0.0024 | 0.0014 | 4.30 | 1.32 |
| | | Green Waste | 59 | 360 | 0.0149 | 0.0015 | | |
| Wet (1/30/15) | 2.22 | Gravel+Sand+Sediment | 74 | 2,466 | 0.0014 | 0.0008 | 6.96 | 3.40 |
| | | Green Waste | 25 | 360 | 0.0064 | 0.0008 | | |
| 3/6/15 (Wet) | 0.65 | Gravel+Sand+Sediment | 70 | 2,466 | 0.0003 | 0.0013 | 4.50 | 1.56 |
| | | Green Waste | 30 | 360 | 0.0163 | 0.0015 | | |

The street sweeping pilot study will continue through the end of calendar year (CY16). Throughout this period, the total volume of material collected and the estimated debris composition will be tracked for each street sweeping cycle. In addition, laboratory analysis for the nutrient content of the particulate fraction and organic fraction of the material collected from street sweeping will be conducted.

Based on the data collected thus far, it is estimated that each street sweeping cycle is anticipated to reduce TN and TP loading by approximately 7-10 lbs and 3-5 lbs, respectively. On average, 4.4 lbs of TN and 1.7 lbs of TP are removed per cubic yard of street sweeping debris collected.

This activity will occur approximately four times during the wet season and once during the dry season. In the event the street sweeping equipment is out of commission for an extended period of time, the baseyard will borrow equipment from another baseyard to ensure the removal from this activity is sufficient to meet the City's WLA.

The seasonal removal quantity will be measured based on the City's fiscal year which begins on July 1st of each year. Data collected from each street sweeping cycle will be tallied and the running total will be

measured against seasonal metrics to determine if collections are on target to meet the TN and TP reduction goals for the season. If, at any time, the actual collections fall short of the estimates and it appears that routine street sweeping operations scheduled for the remainder of the season are not sufficient to meet the reduction goals, additional activities including drain cleaning will be conducted.

#### *4.2.2 Stream Cleaning*

The Kailua Corporation Yard also maintains portions of Waimanalo Stream, including the approximately 1,600 linear feet of concrete lined channel near the Kalanianaole Highway/Kahawai Stream crossing. The stream is cleaned on a bi-annual basis and more frequently if required, such as prior to or following a large rain event. Maintenance records detailing the specific composition of the debris removed from the stream were not available, and therefore estimations regarding pollutant removal cannot be made at this time.

#### *4.2.3 Kahawai Stream Pump Station*

The Kahawai Stream Pump Station, located along Kahawai Stream and Kalanianaole Highway, is operated and maintained by the Collection System Maintenance Division (CSM) of the ENV. The site is unmanned and closed at all times except during routine inspection which occurs daily, seven days a week. Routine maintenance operations occur once a week. The facility consists of approximately 1.72 acres and includes an asphalt concrete driveway as well as the gated paved parking area and a pump station building.

The pump station is located in a manicured area adjacent to Kahawai Stream, separated by a 130-foot buffer area of lush vegetation and mature trees. If unmaintained, the decaying leaves could present a potential source of nitrogen loading to the surrounding area. As such, the City currently has a landscape maintenance contractor perform regular maintenance on the property grounds. Maintenance records detailing the specific composition of the debris removed from the site were not available, and therefore estimations regarding pollutant removal cannot be made at this time.

#### *4.2.4 Maintenance of Storm Drainage System*

Within the Waimanalo Stream watershed, the City currently maintains approximately 90 inlets (catch basins and grated inlets), 25 manholes, and nearly 12,000 linear feet of ditches, drainage pipes, and box culverts. The City routinely inspects its drainage facilities once every five years (once per permit term) and cleans all structures that are at least 50% full. Cleaning is performed more frequently if complaints are received. The City will continue this routine maintenance through the end of the permit term (2020).

### 4.3 Water Quality Improvement Projects

#### *4.3.1 NPDES Erosional Area Improvements at Kumuhau Street (Job No. ENV-SWQ 12-01)*

An existing roadside swale along Kumuhau Street was highly eroded due to frequent storm water runoff scouring the bare slope (see Figure 6). In 2012, DFM constructed approximately 400 linear feet of bioswale which consisted of grass and turf reinforcement matting underlain by a filtration layer and drainage layer (see Figure 7). The purpose of the bioswale is to provide pretreatment of storm water runoff prior to entering the storm drainage system. The City also installed a Geoweb cellular confinement system filled with crushed aggregate along the roadway shoulders at the intersection of Kumuhau Street and Mahailua Street to stabilize bare and eroded areas. The total cost of the project was approximately $400,000. Had the project not been implemented, the bare roadside slopes and shoulders would have continued to erode.

**Figure 6: Before Condition – Bare Slope along Kumuhau Street**

**Figure 7: After Condition – Bioswale along Kumuhau Street**

Water quality data of before and after conditions were not sampled at the bioswale location. Therefore, the estimated pollutant load reduction from this project is based solely on the soil loss potential that was reduced and does not take into account the water quality benefit provided by the nutrient update occurring in the bioswale. The reduction in soil loss potential is estimated by the Universal Soil Loss Equation (USLE)(DPP, 1999) as follows:

Long-term average annual soil loss, A [lbs/acre/season] = R * % cum * K * LS * C * P * 2000, where:

R = Rainfall Erosivity Factor (450)

% cum = Percent of Erosive Rainfall Accumulation for Windward Oahu (0.261 for dry season, 0.739 for wet season)

K = Soil Erodibility Factor (0.17)

LS = Slope-Length/Slope-Gradient Factor (varies per site)

C = Cover and Management Factor (before condition – 0.07; after condition – 0.01)

P = Erosion Control Practice Factor (before condition – 1.0; after condition – 0.8)

TN Load Reduction [lb] = A * $A_{TOTAL}$ * $N_{SEDIMENT}$, where:

A = Long-term Average Annual Soil Loss (lbs/acre/season)

$A_{TOTAL}$ = Project Area (0.195 acre)

$N_{SEDIMENT}$ = Nitrogen content of gravel and sediment (0.00312 lb-N/lb-PM based on grab sample collected on 5/30/13 in project vicinity)

TP Load Reduction [lb] = A * $A_{TOTAL}$ * $P_{SEDIMENT}$, where:

A = Long-term Average Annual Soil Loss (lbs/acre/season)

$A_{TOTAL}$ = Project Area (0.195 acre)

$P_{SEDIMENT}$ = Phosphorus content of gravel and sediment (0.00119 lb-N/lb-PM based on grab sample collected on 5/30/13 in project vicinity)

A summary of the computations is provided in Tables 9 and 10.

**Table 9: Summary of Kumuhau Street Soil Loss and Pollutant Load Calculations**

| Condition | Location | Annual Soil Loss, A (lbs/ac/yr) | Area (acre) | Sediment Concentration | | Annual Pollutant Load | |
|---|---|---|---|---|---|---|---|
| | | | | (lb-N/lb-PM) | (lb-P/lb-PM) | TN (lb/yr) | TP (lb/yr) |
| Before | Bioswale Segment 1 | 11,995 | 0.0695 | 0.00312 | 0.00119 | 16.06 | 6.10 |
| | Bioswale Segment 2 | 40,805 | 0.1045 | | | | |
| | Mahailua Intersection | 2,088 | 0.0212 | | | | |
| After | Bioswale Segment 1 | 1,371 | 0.0695 | 0.00312 | 0.00119 | 1.84 | 0.70 |
| | Bioswale Segment 2 | 4,663 | 0.1045 | | | | |
| | Mahailua Intersection | 239 | 0.0212 | | | | |

**Table 10: Summary of Kumuhau Street Seasonal Pollutant Load Reductions**

| Condition | Pollutant Load | |
|---|---|---|
| | TN | TP |
| Before Project (lb/yr) | 16.06 | 6.10 |
| After Project (lb/yr) | 1.84 | 0.70 |
| Annual Pollutant Reduction (lb/yr) | 14.22 | 5.40 |
| Wet Season Reduction (lb/season)[1] | 10.51 | 3.99 |
| Dry Season Reduction (lb/season)[2] | 3.71 | 1.41 |

[1]Wet Season cumulative rainfall total = 73.9% of annual rainfall
[2]Dry Season cumulative rainfall total = 26.1% of annual rainfall

## 4.4 Permanent BMP

It is not anticipated that permanent BMPs will be required to meet the nutrient load reductions; however, if it becomes necessary to further reduce pollutant loads, the City will consider permanent BMP options which include retrofitting outfalls with sediment capture devices and/or installing catch basin inserts in strategic locations. The decision to implement permanent BMPs will be made after the results of FY17 debris collection data is compiled and analyzed. If required, a revised I&M Plan will be submitted to the DOH by the end of FY18. Additional details on the implementation timeline are provided in Section 5.0.

## 4.5 Summary of BMP Activities

The following table summarizes the estimated effectiveness of the various BMP activities to be implemented by the City.

**Table 11: Summary of BMP Activities and Quantitative Reductions**

| Activity | TN Reduction (lbs/season) | | TP Reduction (lbs/season) | |
|---|---|---|---|---|
| | Wet Season | Dry Season | Wet Season | Dry Season |
| Downspout Disconnect | * | * | * | * |
| Homeowner Outreach/Volunteer Cleanup | * | * | * | * |
| Street Sweeping | 38 | 7 | 12.8 | 4.1 |
| Kumuhau Street Bioswale | 10.5 | 3.7 | 4.0 | 1.4 |
| Stream Cleaning | ** | ** | ** | ** |
| Storm Drain Maintenance | ** | ** | ** | ** |
| TOTAL | 48.5 | 10.7 | 16.8 | 5.5 |
| REDUCTIONS REQUIRED | 43.3 | 2.0 | 1.5 | 0.5 |

* The City will conduct a public education and outreach program to all homeowners within the watershed; however, due to difficulty in quantifying pollutant load reductions due to behavior changes, no homeowner contribution is assumed for accounting purposes at this time.

**Cleaning of storm drains and drainage structures will be implemented only if collections from other activities are less than anticipated and the City needs additional reductions to meet the load reduction goals for a particular season. Storm drain cleaning may also be done in lieu of additional street sweeping activities based on scheduling and equipment availability.

## 4.6 Summary of Activities to be Tracked

The City will meet the specified TN and TP load reduction goals during the wet and dry seasons by employing a combination of street sweeping and continued maintenance of the Kumuhau Street bioswale.

The City intends to continue routine street sweeping within the residential areas of the Waimanalo Stream watershed indefinitely. The quantity of material collected, the debris composition, and the laboratory analysis of the particulate and organic matter will continue through the end of the street sweeping pilot study (December 2016). At the conclusion of the pilot study, laboratory analysis for the nutrient content of the collected material will cease and the three years of data will be averaged to determine estimated removal rates going forward. The quantification of the material removed and estimation of debris composition will continue until the end of FY17. After that date, the City will utilize the historical data to determine the basic level of street sweeping activities necessary to meet the pollutant load reduction goal and ultimately the City's WLA.

The City will also continue to maintain the recently constructed bioswale along Kumuhau Street. Maintenance activities will include periodic inspections to verify healthy plant growth, remove built up sediment and trash, remove invasive plants and weeds, clear the inlet/outlet, and prune vegetation. The swale will also be inspected for signs of erosion and standing water following periods of heavy rainfall. If repairs are required, they will be conducted at that time.

If the combination of all of the proposed activities results in less reduction than required, the City will reevaluate the program. Depending on the findings, this may result in implementing additional program elements, including identifying opportunities for permanent BMP development.

# 5.0 Compliance Schedule

The achievement of the City's WLA for the Waimanalo Stream Watershed will occur over a period of three and a half years with a final compliance deadline of December 31, 2018. Based on historical collections to date, it is anticipated that a combination of street sweeping (four times in the wet season and once in the dry season) and continued maintenance of the Kumuhau Street bioswale will collect or treat sediment and organic matter in sufficient quantity to meet the seasonal TN and TP reduction goals.

If it is determined that significantly more activities are required to meet the target reductions and the City is unable to meet the WLA by the compliance deadline, the City will work with the appropriate agency to reevaluate the program. Depending on the findings, this may result in implementing additional program elements or reevaluating the current conditions to determine if the characteristics of the MS4 discharges have changed. In accordance with these modifications, the City will submit a revised I&M Plan in FY18 and request a modification to the final compliance deadline. The revised plan will outline the additional activities the City plans to implement to achieve the WLA and include a timeline for implementation. The proposed implementation schedule is shown in the following table.

**Table 12: Schedule of Compliance**

| Due No Later Than: | Milestone / Deliverable |
|---|---|
| June 30, 2015 | • Submit updated I&M Plan per Part F.3.a.<br>• Continue 3-yr street sweeping pilot study (quantity of material collected, debris composition, and TN/TP analysis) |
| June 30, 2016 | • Continue 3-yr street sweeping pilot study (quantity of material collected, debris composition, and TN/TP analysis) |
| December 31, 2016 | • Complete street sweeping pilot study (TN/TP analysis)<br>• Continue numerical tracking of GH activities (quantity of material collected and debris composition) |
| June 30, 2017 | • Complete numerical tracking of GH activities (quantity of material collected and debris composition) |
| December 31, 2017 | • Submit street sweeping pilot study report and provide summary of street sweeping material analyzed during pilot study |
| June 30, 2018 | • Complete analysis of GH numerical tracking data to determine basic level of activities necessary, and<br>• If additional activities are required, submit revised I&M Plan which outlines additional activities to be implemented[1] |
| December 31, 2018 | FINAL COMPLIANCE DEADLINE<br>• Submit final report detailing how compliance with WLA reductions was achieved and will be maintained |

[1]Other activities are defined as other municipal and public participation maintenance activities such as drain cleaning, volunteer cleanups, regulatory compliance and enforcement policies, homeowner involvement, downspout disconnections, structural retrofits and other structural BMP measures

After the final compliance deadline, the City's compliance will be based on fulfilling the basic level of activities determined to be necessary to meet the pollutant load reduction.

Ultimately, it is the City's goal to contribute to good stewardship of the land and ensure that water quality in and around the island of Oahu is safe and useable for all intended purposes. These activities are proposed to aid in achieving this goal.

# 6.0 References

Center for Watershed Protection, "National Pollutant Removal Performance Database," Version 3, September 2007.

Center for Watershed Protection, "New York State Stormwater Management Design Manual," Appendix A, August 2010.

City and County of Honolulu, Department of Environmental Services.

City and County of Honolulu, Department of Environmental Services, "National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit No. HI S000002," February 16, 2015.

City and County of Honolulu, Department of Facility Maintenance.

City and County of Honolulu, Department of Planning and Permitting, "Rules Relating to Soil Erosion Standards and Guidelines", April 1999.

http://water.epa.gov

Laws, Edward A. and Lisa Ferentinos, "Human Impacts on Fluxes of Nutrients and Sediment in Waimanalo Stream Oahu, Hawaiian Islands", April 2003.

Renard, K.G., G. R. Foster, et. al., "Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE)", U.S. Department of Agriculture, Agriculture Handbook 703, January 1997.

State of Hawaii, Department of Health, "Hawaii Administrative Rules, Title 11, Chapter 55," May 27, 2009.

State of Hawaii, Department of Health, Environmental Planning Office, "Total Maximum Daily Loads Estimated for Waimanalo Stream, Island of Oahu, Hawaii," March 2001.

United States Department of Agriculture, Agriculture Research Service, "Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss

www.epa.gov/osw/conserve/smm/wastewise/pubs/conversions.pdf

www.prh.noaa.gov/

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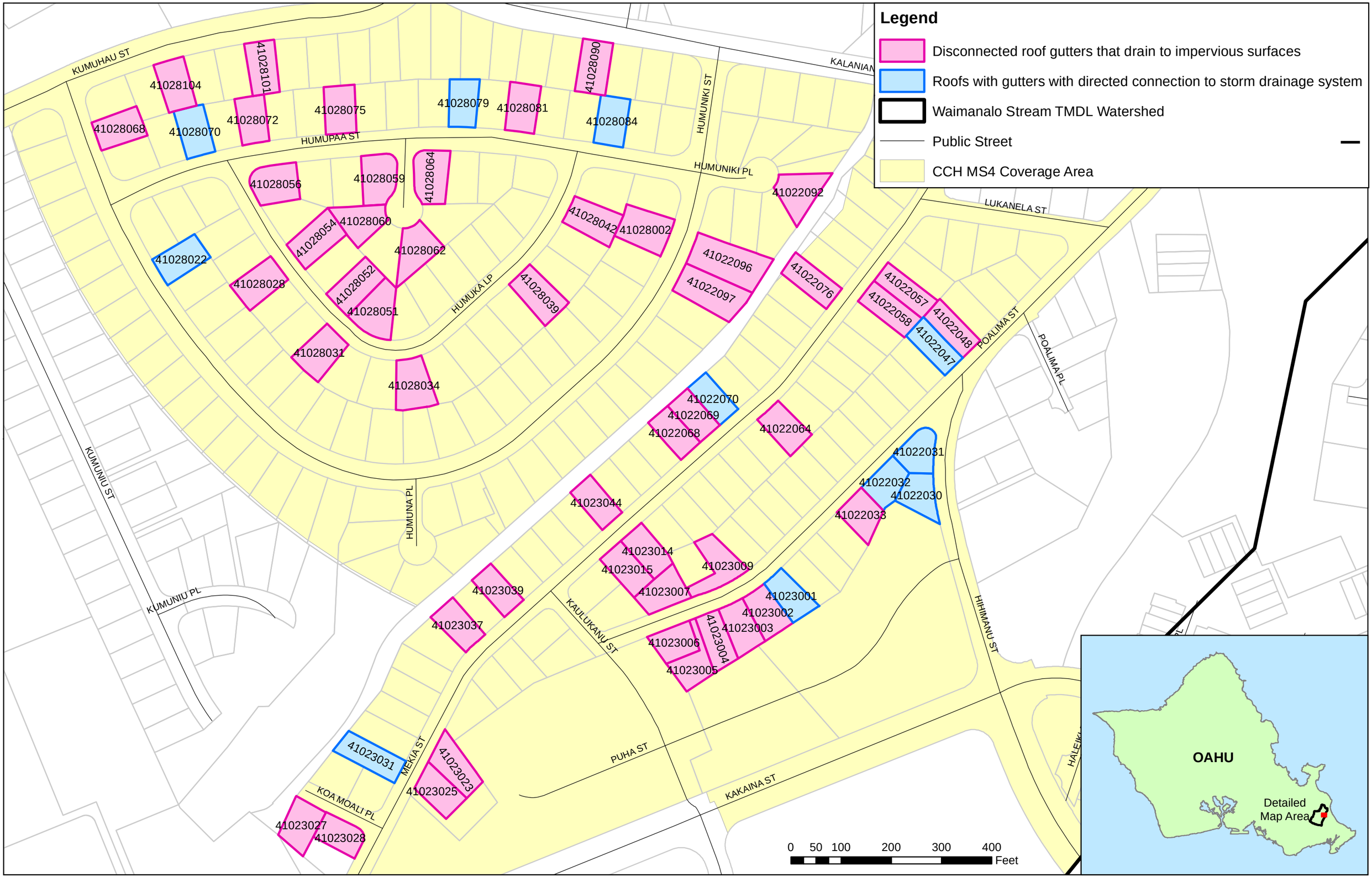
# APPENDIX A:

# CITY AND COUNTY OF HONOLULU
# DEPARTMENT OF ENVIRONMENTAL SERVICES
# DOWNSPOUT DISCONNECTION FIELD SURVEY
# (MAY 2013)


Legend
Disconnected roof gutters that drain to impervious surfaces
Roofs with gutters with directed connection to storm drainage system
Waimanalo Stream TMDL Watershed
Public Street
CCH MS4 Coverage Area
KUMUHAU ST
KALANIAN
HUMUPAA ST
HUMUNIKI ST
HUMUNIKI PL
LUKANELA ST
HUMUKA LP
HUMUNA PL
KUMUNIU ST
KUMUNIU PL
POALIMA ST
POALIMA PL
KAULUKANU ST
HIHIMANU ST
MEKIA ST
PUHA ST
KAKAINA ST
KOA MOALI PL
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41023006
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Feet
OAHU
Detailed
Map Area

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