UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

Total Maximum Daily Load (TMDL) Checklist

State:	**Hawaii**
Water Body:	**Waikele Watershed including Waikele Stream, Waikakalaua Stream and Kipapa Stream**
Pollutants:	**Turbidity, Total Nitrogen and Nitrite+Nitrate Nitrogen**
Date of Letter Requesting: EPA Approval:	**February 19, 2019**
Date EPA Received: Complete Submission	**April 17, 2019**
EPA Reviewer:	**Daniel R. Oros, PhD**

1. Submittal Letter

The Hawaii Department of Health (DOH) submittal letter, dated February 19, 2019 from Keith Kawaoka, Deputy Director for Environmental Health, to Tomás Torres, EPA Region 9 Water Division Director, requests EPA approval of the TMDLs for turbidity, total nitrogen and nitrite+nitrate nitrogen for the Waikele watershed on Oahu, Hawaii. The DOH adopted the TMDL on February 19, 2019. The submittal letter requests EPA to approve the TMDL under Clean Water Act (CWA) section 303(d). The TMDL submittal also contains a detailed plan for implementing the TMDL. Current federal regulations do not define TMDL as containing an implementation plan; therefore, EPA is not taking action on the implementation plan provided with this TMDL; however, EPA concurs with the State's proposed implementation approaches.

The DOH's submittal package includes: (1) Turbidity, Sediment, and Nutrient Total Maximum Daily Loads for the Waikele Watershed, Oahu, Hawaii (Staff Report, dated February 2019) and associated Appendices A, B, and C; and (2) records of Public Notification, Public Comments, and Responses to Public Comments.

EPA considers the submittal complete as of the date of receipt of the full submittal, April 17, 2019.

2. TMDLs Included

The Waikele watershed is in Hawaii on the island of Oahu and covers a 45 square-mile drainage area. The watershed includes Waikele Stream and its two main tributaries, Waikakalaua Stream and Kipapa

Stream (hereafter referred to as the Waikele watershed). The Waikele Stream was first listed under CWA section 303(d) as impaired by turbidity, total nitrogen and nitrite+nitrate nitrogen in 2002 (see Table 2 below, Staff Report, p.10). The TMDL addresses the water quality impairments in the Waikele watershed due to each of these pollutants during both wet (November through April months) and dry (May through October months) seasons. Turbidity is included on the section 303(d) list due to turbidity measurements exceeding only the wet season (November through April months) water quality criterion. The total nitrogen and nitrite+nitrate nitrogen listings are due to measurements of these nutrients exceeding both the Waikele Stream's associated wet and dry season (year-round) water quality criteria.

Table 2. Waikele Stream section 303(d) listing information from Hawaii's 2018 Integrated Report

Waterbody	Geocode ID	Pollutant	Basis for Listing	Season*	Cycles Listed
Waikele Stream	3-4-10	Total Nitrogen	numeric assessment	dry season; wet season	2002, 2004, 2006, 2010, 2014, 2016, 2018
Waikele Stream	3-4-10	Nitrite-nitrate	numeric assessment	dry season; wet season	2002, 2004, 2006, 2010, 2014, 2016, 2018
Waikele Stream	3-4-10	Turbidity	numeric assessment	wet season	2002, 2004, 2006, 2010, 2014, 2016, 2018

*Streams have wet and dry season standards (November to April and May to October, respectively) (see Table 3 for more detail).
Source: (DOH 2018)

EPA concurs with the State's finding of impairment and concludes that it is appropriate for the State to develop and adopt TMDLs for turbidity, total nitrogen and nitrite-nitrate nitrogen in the Waikele watershed to address the impairment listing.

3. Water Quality Standards Attainment

Applicable Water Quality Criteria

The Hawaii Administrative Rules (HAR) Title 11, Department of Health, Chapter 54, establish the applicable water quality standards for the waters of Hawaii[1]. These include both the beneficial uses to be protected and the water quality criteria necessary to protect the uses. State water quality criteria are defined for both inland and marine waterbodies. The inland water quality criteria apply to the Waikele watershed.

The season-specific water quality criteria for the Waikele watershed are shown below in Table 3 (TMDL Staff Report, p.14), where terms have the following meanings:

Geometric mean - The geometric mean of all time-averaged samples should not exceed this value. The geometric mean is calculated as the n^{th} root of the multiple of all samples, where *n* represents the total number of samples.

Not to exceed more than 10% of time - No more than 10% of all time-averaged samples exceed this value.

Not to exceed more than 2% of time - No more than 2% of all time-averaged samples exceed this value.

[1] DOH (Hawaii State Department of Health). 2014. *Hawaii Administrative Rules, Title 11, Department of Health, Chapter 54: Water Quality Standards*. Revised November 15, 2014.

Table 3. Stream water quality criteria (DOH 2014)

Parameter	Geometric mean		10% exceedance value		2% exceedance Value	
	Wet Season[a]	Dry Season[a]	Wet Season[a]	Dry Season[a]	Wet Season[a]	Dry Season[a]
Total Nitrogen (µg/L)	250	180	520	380	800	600
Nitrite + Nitrate Nitrogen (µg/L)	70	30	180	90	300	170
Turbidity (NTU)	5	2	15	5.5	25	10
Total Phosphorus[b] (µg/L)	50	30	100	60	150	80
Total Suspended Solids[b] (mg/L)	20	10	50	30	80	55

[a] Wet season = November 1 through April 30; Dry season = May 1 through October 31

[b] Waikele Stream was not listed for total phosphorus or total suspended solids (TSS); however, these WQC were used for analyses in this TMDL report.

As stated in Section 1, the Waikele Stream is listed for total nitrogen, nitrite+nitrate nitrogen and turbidity. Data analyses confirmed these impairments and identified total phosphorus and total suspended solids (TSS) as additional pollutants consistently exceeding the water quality criteria. The Waikele Stream was not listed for total phosphorus or TSS; however, TMDLs were established for these pollutants in addition to the pollutants on the 303(d) list.

Applicable Beneficial Uses

Beneficial uses in inland receiving waters include Class 1 or Class 2, depending upon underlying land use designations and regulations, as described below (TMDL Staff Report, p.12-13):

Class 1: It is the objective of Class 1 waters that these waters remain in their natural state as nearly as possible with an absolute minimum of pollution from any human-caused source. To the extent possible, the wilderness character of these areas shall be protected. Waste discharge into these waters is prohibited. Any conduct which results in a demonstrable increase in levels of point or nonpoint source contamination in Class 1 waters is prohibited.

Class 1.a: The uses to be protected in Class 1.a waters are scientific and educational purposes, protection of native breeding stock, baseline references from which human-caused changes can be measured, compatible recreation, aesthetic enjoyment, and other non-degrading uses which are compatible with the protection of the ecosystems associated with waters of this class.

Class 1.b: The uses to be protected in Class 1.b waters are domestic water supplies, food processing, protection of native breeding stock, the support and propagation of aquatic life, baseline references from which human-caused changes can be measured, scientific and educational purposes, compatible recreation, and aesthetic enjoyment. Public access to these waters may be restricted to protect drinking water supplies.

Class 2: The objective of Class 2 waters is to protect their use for recreational purposes, the support and propagation of aquatic life, agricultural and industrial water supplies, shipping, and navigation. The uses to be protected in this class of waters are all uses compatible with the protection and propagation of fish, shellfish, and wildlife, and with recreation in and on these waters. These waters shall not act as receiving waters for any discharge which has not received the best degree of treatment or control compatible with the criteria established for this class. No new treated sewage discharges shall be permitted within estuaries.

The Waikele Stream and its tributaries fall within the Class 1.a, 1.b, and Class 2 inland waters. The Class 1.b inland waters are in the eastern headwaters, while Class 1.a waters are in the eastern headwaters of the Oahu National Wildlife Refuge. The impaired segment of the Waikele Stream is a Class 2 waterbody. The applicable beneficial uses that will be protected by this TMDL include recreation, support and propagation of aquatic life, agricultural and industrial water supplies, shipping, navigation, and protection and propagation of fish, shellfish, and wildlife.

4. Numeric Targets

TMDLs were calculated for total nitrogen, nitrite+nitrate nitrogen, total phosphorous, and TSS (which represents turbidity) using the TMDL numeric targets presented below in Table 4 (TMDL Staff Report, p.15). The TMDL numeric targets are a direct translation of and set equal to the water quality criteria (shown above in Table 3, Section 3 Water Quality Standards Attainment). The geometric mean targets are the primary values used in TMDL calculations, while the 10 and 2 percent not-to-exceed targets were included to better understand required reductions.

Table 4. TMDL numeric targets

Parameter	Geometric mean		10% exceedance value		2% exceedance value	
	Wet Season[a]	Dry Season[a]	Wet Season[a]	Dry Season[a]	Wet Season[a]	Dry Season[a]
Total Nitrogen (µg/L)	250	180	520	380	800	600
Nitrite + Nitrate Nitrogen (µg/L)	70	30	180	90	300	170
Total Phosphorus (µg/L)	50	30	100	60	150	80
Total Suspended Solids (mg/L)[b]	20	10	50	30	80	55

[a] Wet season = November 1 through April 30; Dry season = May 1 through October 31
[b] Total suspended solids numeric targets were used as a surrogate for turbidity impairments

EPA concludes the State's use of these numeric water quality targets for the Waikele watershed TMDL is reasonable and appropriate and finds there is an adequate basis for these numeric targets.

5. Source Analysis

Point Sources

Point sources were primarily associated with construction activities and municipal separate storm sewer systems (MS4s). Point sources within the Waikele watershed that are regulated under NPDES permits, current as of February 2019, are listed below in Table 13 (TMDL Staff Report, p.47). The permit types include Construction Stormwater General Permit (regulated under HAR 11-15, Appendix C), three General Permits (900 Green Valley – permit No. HIR10E818; Castle & Cook Properties – permit No. HIR10D794; U.S. Army Corps of Engineers – permit No. HIR10D964), Industrial Stormwater General Permit (regulated under HAR 11-55, Appendix B), one Individual Permit (Aqua Engineers (Schofield Barracks WWTP) – permit No. HI0110141, expected permit renewal date is September 17, 2019), and three MS4 Permits (City & County of Honolulu – permit No. HIS000002; Hawaii DOT – permit No. HIS000001; U.S. Army Garrison Hawaii – permit No. HIS000090, expected permit renewal date is September 1, 2020).

Table 13. Recent NPDES permits in the Waikele watershed

Permit Type	Permittee	Permit Number	Issued	Expires
Construction Stormwater General Permit	Various	HAR 11-55 Appendix C	12/06/2013	12/05/2018 (Pending approval)
General Permit*	900 Green Valley	HIR10E818	11/24/2015	12/05/18 (Extended)
General Permit*	Castle & Cooke Properties, Inc.	HIR10D794	12/9/2013	12/05/2018 (Extended)
General Permit*	U.S. Army Corps of Engineers	HIR10D964	2/27/2015	12/05/2018 (Extended)
Industrial Stormwater General Permit	Various	HAR 11-55 Appendix B	12/06/2013	12/05/2017
Individual Permit	Aqua Engineers (Schofield Barracks Wastewater Treatment Plant)	HI0110141	Renewal in Process	---
MS4 Permit	CCH	HIS000002	1/16/2015	1/15/2020
MS4 Permit	DOT-Highways	HIS000001	Renewal in Process	9/26/2018
MS4 Permit	U.S. Army Garrison Hawaii	HIS000090	Renewal in Process	---

*NPDES General permit authorizing discharges of storm water associated with construction activities (DOH 2013a). Permits are current as of February 2019.

Nonpoint Sources

Nonpoint source inputs were first quantified using the Hydrologic Simulation Program – Fortran (HSPF) watershed model by land cover type since loadings are highly correlated with land-based activities. Wash-off of sediment and nutrients from various land cover types during wet weather/rainfall events was considered the primary mechanism for transport. After identifying all the sources, nonpoint sources were grouped into land use types including agriculture, conservation, rural, and urban.

Distribution of Simulated Existing Loads for Point and Nonpoint Sources

The HSPF model was used to assess the percentage of point source and nonpoint source-specific contributions to the total existing watershed load for each pollutant by Owner/Land Use category (see below Table C-1 columns 4 and 5; Staff Report, Appendix C). The HSPF model was then used to estimate the proportion of existing load during dry and wet seasons for each pollutant by Owner/Land Use category (see below Table C-1 columns 2 and 3). These loadings represent the simulated existing conditions, which were calibrated to observed data collected throughout the Waikele watershed (Staff Report, Appendices A and B).

Table C-1. Distribution of simulated existing loads by owner and source type

Owner/Land Use Category	Proportion of Existing Load		Owner-Specific Distribution by Source Type*	
	Dry Season	Wet Season	Point Source (WLA)	Nonpoint Source (LA)
Total Nitrogen				
City & County of Honolulu	15.9%	20.1%	60.5%	39.5%
Military	3.8%	7.6%	43.1%	56.9%
State of Hawaii	7.0%	6.6%	25.8%	74.2%
Hawaii State Department of Education	0.8%	1.0%	0%	100%
Agriculture	54.3%	48.7%	0%	100%
Conservation	18.2%	15.9%	0%	100%
Total	**100.0%**	**100.0%**	**16.4%**	**83.6%**
Nitrite + Nitrate				
City & County of Honolulu	21.2%	21.7%	60.5%	39.5%
Military	5.7%	7.4%	43.1%	56.9%
State of Hawaii	8.4%	7.9%	23.0%	77.0%
Hawaii State Department of Education	1.0%	1.0%	0%	100%
Agriculture	60.7%	54.0%	0%	100%
Conservation	3.0%	8.0%	0%	100%
Total	**100.0%**	**100.0%**	**16.3%**	**83.7%**
Total Phosphorous				
City & County of Honolulu	15.5%	3.9%	60.5%	39.5%
Military	3.8%	2.0%	43.1%	56.9%
State of Hawaii	5.0%	9.0%	8.8%	91.2%
Hawaii State Department of Education	0.6%	0.1%	0%	100%
Agriculture	40.5%	82.3%	0%	100%
Conservation	34.6%	2.6%	0%	100%
Total	**100.0%**	**100.0%**	**15.7%**	**84.3%**
Sediment				
City & County of Honolulu	6.8%	2.8%	60.5%	39.5%
Military	2.4%	2.0%	43.1%	56.9%
State of Hawaii	4.4%	9.8%	4.1%	95.9%
Hawaii State Department of Education	0.3%	0.1%	0%	100%
Agriculture	48.2%	74.5%	0%	100%
Conservation	37.8%	10.8%	0%	100%
Total	**100.0%**	**100.0%**	**15.5%**	**84.5%**

* Proportions are based on the percent of total area compared to the MS4 area for each owner, with the exception of the State of Hawaii. The nonpoint source load (non-DOT areas) for the State of Hawaii was determined by tabulating the loads from model subbasins 14, 22, 24, 28, 29, and 43, which contain agricultural land uses that fall under state ownership. This proportion of the total State of Hawaii load was used to represent the LA.

The submittal considers all the point and nonpoint sources that contribute total nitrogen, nitrite+nitrate nitrogen and sediment to the Waikele watershed. EPA concludes that the State's source analysis is reasonable and appropriate.

6. Linkage Analysis

The linkage analysis establishes the relationship between nutrient and sediment loading and numeric targets and defines the TMDL or loading capacity of receiving waters to determine the reductions required to attain the water quality criteria (as expressed by the numeric targets).

To support the TMDL objectives using available data, the development of a comprehensive watershed model was used to represent the Waikele watershed. A watershed model is essentially a series of algorithms applied to watershed characteristics and meteorological data to simulate naturally occurring land-based processes over an extended period, including hydrology and pollutant

transport. The HSPF watershed model was used in this TMDL to best simulate watershed processes, including hydrology and pollutant accumulation and wash-off, and to represent flow and water quality in the streams that drain to the mouth of the Waikele watershed. The HSPF model was calibrated for a fourteen-year period (1998 to 2011), with water years covering a range of hydrologic conditions, including wet, dry and average years. The HSPF model was then used to calculate both existing conditions and the TMDLs (or loading capacities) for total nitrogen, nitrite+nitrate nitrogen and sediment in the Waikele Stream using watershed simulation model output. The modeling approach and results were described in detail in the TMDL Staff Report (Appendices A, B and C). Appendix A contains the details on model configuration, hydrology and sediment calibration, Appendix B describes the nutrient simulations, and Appendix C shows the loading calculations for the Waikele watershed.

In addition, the average daily simulated flow at the mouth of the Waikele watershed (model sub-basin 10) was multiplied by the applicable dry or wet season geometric mean numeric targets (TMDL Staff Report, p.30) and a conversion factor to determine the allowable daily load (i.e., loading capacity) for each pollutant. Dry and wet season geometric means were then calculated for both the modeled existing load and loading capacity.

The percent reduction from the total existing load needed to attain water quality criteria was also calculated for total nitrogen, nitrite+nitrate nitrogen and sediment. Necessary reductions in existing pollutant loads were calculated for the Waikele watershed to identify the reductions needed from existing loads to meet the loading capacity and corresponding numeric targets. Reductions were calculated based on the modeled existing loads of pollutants relative to their respective loading capacity (based on the applicable sediment and nutrient numeric targets):

$$\text{Percent Reduction} = \frac{(\text{Modeled Existing Load} - \text{Loading Capacity})}{(\text{Modeled Existing Load})} \times 100$$

The submittal considers all the major sources that contribute pollutants to the water column. EPA concludes the State's linkage analysis is reasonable and appropriate.

7. TMDL and Allocations

The TMDL was determined as the sum of individual waste load allocations (WLAs) for point sources, load allocations (LAs) for both nonpoint sources and natural background loads, and a margin of safety (MOS), which accounts for any uncertainty in the data and computational methodology. Allocations were determined by subtracting the MOS from the allowable load and then apportioning the remaining allowable load to the identified sources using the proportion that each source contributed to the existing load.

An example showing TMDL allocation calculations for total nitrogen loads during dry season is provided below in Table C-2 (Staff Report, Appendix C). Table C-1 cited earlier in section 5 above, provides the values for the proportional source contribution to existing load (as %) and the source-specific fraction of the point source load (as %), which when multiplied by the total nitrogen loading capacity yields the dry season load (kg/d).

Table C- 2. Example of TMDL allocation calculations

TMDL Component	Methodology	Dry Season Load (kgd)
Loading Capacity	Geometric mean of all daily dry weather allowable loads; daily allowable loads calculated as: simulated flow (in cfs) x dry weather WQC (0.180 mg/L) x 2.44657 (conversion factor to result in kilograms per day)	7.0
Wasteload Allocations		
City & County of Honolulu MS4	Proportional source contribution to existing load multiplied by the source-specific fraction of point source loading (Table C-1) applied to the available loading capacity: (7.0 x 15.9% x 60.5%) - Reserve WLA	0.4
U.S. Army Garrison Hawaii MS4	Proportional source contribution to existing load multiplied by the source-specific fraction of point source loading (Table C-1) applied to the available loading capacity: (7.0 x 3.8% x 43.1%) - Reserve WLA	0.1
State of Hawaii DOT MS4	Proportional source contribution to existing load multiplied by the source-specific fraction of point source loading (Table C-1) applied to the available loading capacity: (7.0 x 7.0% x 25.8%) - Reserve WLA	0.1
Construction Stormwater Permits	WLA = 0	0.0
Industrial Stormwater Permits	WLA = 0	0.0
Reserve WLA for Future Growth (5%)	5% of Loading Capacity: (7.0 x 0.05)	0.35
Load Allocations		
City & County of Honolulu	Proportional source contribution to existing load multiplied by the source-specific fraction of nonpoint source loading (Table C-1) applied to the available loading capacity: (7.0 x 15.9% x 39.5%) – Reserve WLA	0.7
U.S. Army Garrison Hawaii	Proportional source contribution to existing load multiplied by the source-specific fraction of nonpoint source loading (Table C-1) applied to the available loading capacity: (7.0 x 3.8% x 56.9%) – Reserve WLA	0.2
State of Hawaii	Proportional source contribution to existing load multiplied by the source-specific fraction of nonpoint source loading (Table C-1) applied to the loading capacity: (7.0 x 7.0% x 74.2%) _Reserve WLA	0.4
Hawaii State Department of Education MS4	Proportional source contribution to existing load multiplied by the source-specific fraction of point source loading (Table C-1) applied to the loading capacity: (7.0 x 0.8% x 100%)- Reserve WLA	0.05
Agriculture	Proportional source contribution to existing load multiplied by the source-specific fraction of nonpoint source loading (Table C-1) applied to the loading capacity: (7.0 x 54.3% x 100%) – Reserve WLA	3.6
Conservation Land	Proportional source contribution to existing load multiplied by the source-specific fraction of nonpoint source loading (Table C-1) applied to the loading capacity: (7.0 x 18.2% x 100%)	1.2
Existing Load	Geometric mean of all simulated daily dry weather existing loads	64.5
Load Reduction	(Existing Load - Loading Capacity)	57.5
Percent Reduction	(Existing Load - Loading Capacity)/(Existing Load) x 100	89%

* Remaining allocable load = loading capacity – MOS – construction stormwater WLA – industrial stormwater WLA – future growth WLA; 5.66 kilograms per day in this example

Determination of Allocations for Point and Nonpoint Sources

The HSPF model was calibrated for a fourteen-year period (water years 1998 to 2011) (Staff Report, Appendices A and B). This period covered a range of hydrologic conditions, including wet, dry and average years. In addition to calculating existing loads based on current conditions, output from the HSPF model was used to determine the loading capacity, LAs and WLAs for total nitrogen,

nitrite+nitrate nitrogen and sediment in the Waikele watershed. Because turbidity is not a mass-based constituent and loads cannot be calculated, the sediment TMDLs (represented by TSS) were used as a surrogate for turbidity TMDLs.

Waste Load Allocations

The WLA is the portion of the loading capacity allocated to point source discharges to the waterbody. Point sources in the Waikele watershed include NPDES permits for construction, industrial and MS4 stormwater. The MS4 permittees include CCH permit HIS000002, Hawaii DOT permit HIS000001 and U.S. Army Garrison Hawaii permit HIS000090 (Staff Report, Table 13, p.47). The construction and industrial permits were each assigned a WLA of zero because the discharge originating from these facilities is incorporated in the WLA for the MS4s. The Schofield Barracks WWTP is designed not to discharge treated wastewater during normal operations; instead, treated wastewater is normally used for irrigation purposes. The facility has an NPDES permit because it occasionally needs to discharge during periods when the irrigation system is undergoing maintenance and effluent storage capacity is reached. However, discharges are very infrequent (twice in the past 19 years), short in duration (5 days each), and low in magnitude (estimated as less than 0.01% of stormwater nutrient loads from the U.S. Army Garrison facility). The TMDL accounts for these very sporadic discharges from the Schofield Barracks WWTP as part of the U.S. Army Garrison's overall WLA. The Hawaii Department of Health's decision not to set a separate WLA for Schofield Barracks WWTP is reasonable due to the very infrequent recurrence, short duration and small scale of actual discharges from the facility to the Waikele watershed.

A separate WLA was also included as a reserve capacity for future permittees and was assigned a WLA of five percent (5%) of the allowable load. The WLAs are shown below in Tables C-3 through C-6 for total nitrogen, nitrite+nitrate nitrogen and sediment (Staff Report, Appendix C).[2]

Load Allocations

The LA is the portion of the loading capacity allocated to nonpoint source discharges to the waterbody. Nonpoint sources receiving load allocations in the Waikele watershed include agriculture, forested areas owned by the CCH and U.S. Army Garrison Hawaii, natural background (conservation land), the Department of Education[3], and agricultural and lands owned by either the state or private entities that are not subject to a NPDES permit. These allocations were calculated using the proportion that each source contributed to the pollutant-specific existing load. The nonpoint source fraction of the existing load was applied for each source after subtracting the future growth WLA from the loading capacity. The TMDL LAs are shown below in Tables C-3 through C-6 for total nitrogen, nitrite/nitrate nitrogen and sediment (Staff Report, Appendix C).

[2] The WLAs are presented as daily loads. There was no intent regarding how they would be expressed in NPDES permits, but the way WLAs are currently presented in the TMDL allows for flexibility to implement WLAs on a monthly or annual basis.
[3] The DOE MS4 allocation is listed as a LA because DOH is proposing a rule change which would exempt DOE from MS4 requirements. Once the rule revision is completed, the allocation assigned to the DOE MS4 will be treated as a LA.

Table C-3. Total nitrogen allocations and load reductions required to achieve geometric mean TMDLs

TMDL Component	Geometric Mean TMDL		Modeled Existing Load	
	Dry Season* Load (kgd)	Wet Season* Load (kgd)	Dry Season* Load (kgd)	Wet Season* Load (kgd)
Loading Capacity	7.01	16.24	N/A	N/A
Wasteload Allocations				
City County of Honolulu MS4	0.38	1.13	3.72	6.96
U.S. Army Garrison Hawaii MS4	0.09	0.42	0.87	2.60
State of Hawaii DOT MS4	0.07	0.16	0.69	0.96
Construction Stormwater General and Individual Permits	0	0	0	0
Industrial Stormwater General and Individual Permits	0	0	0	0
Reserve WLA for Future Growth (5%)	0.35	0.81	—	—
Load Allocations				
City County of Honolulu	0.68	1.98	6.54	12.23
U.S. Army Garrison Hawaii	0.16	0.75	1.56	4.66
State of Hawaii DOT (and other)	0.39	0.87	3.82	5.36
State of Hawaii DOE MS4	0.05	0.15	0.53	0.94
Agriculture	3.62	7.52	35.04	46.40
Conservation Land	1.21	2.45	11.73	15.09
Total Existing Load			64.48	95.22
Load Reduction			57.47	78.98
Percent Reduction			89%	83%

Note: Loads rounded to the nearest 0.1 kilogram or number (unless this would result in an allocation of zero); thus, totals may be different than the sum of their parts.
* Wet season is defined at November 1 through April 30 and dry season is May 1 through October 31.
Acronyms: kgd = kilograms per day, N/A = not applicable; "—" = not explicitly modeled

Table C-4. Nitrite + nitrate allocations and load reductions required to achieve geometric mean TMDLs

TMDL Component	Geometric Mean TMDL		Modeled Existing Load	
	Dry Season* Load (kgd)	Wet Season* Load (kgd)	Dry Season* Load (kgd)	Wet Season* Load (kgd)
Loading Capacity	1.17	4.55	N/A	N/A
Wasteload Allocations				
City County of Honolulu MS4	0.09	0.34	3.31	5.08
U.S. Army Garrison Hawaii MS4	0.02	0.12	0.88	1.72
State of Hawaii DOT MS4	0.01	0.05	0.55	0.78
Construction Stormwater General and Individual Permits	0	0	0	0
Industrial Stormwater General and Individual Permits	0	0	0	0
Reserve WLA for Future Growth (5%)	0.06	0.23	—	—
Load Allocations				
City County of Honolulu	0.15	0.60	5.82	8.92
U.S. Army Garrison Hawaii	0.04	0.21	1.58	3.07
State of Hawaii DOT (and other)	0.08	0.29	3.08	4.34
State of Hawaii DOE MS4	0.01	0.04	0.42	0.62
Agriculture	0.67	2.33	26.17	34.82
Conservation Land	0.03	0.35	1.28	5.16
Total Existing Load			43.09	64.52
Load Reduction			41.92	59.98
Percent Reduction			97%	93%

Note: Loads rounded to the nearest 0.1 kilogram or number (unless this would result in an allocation of zero); thus, totals may be different than the sum of their parts.
* Wet season is defined at November 1 through April 30 and dry season is May 1 through October 31.
Acronyms: kgd = kilograms per day, N/A = not applicable; "—" = not explicitly modeled

Table C-5. Sediment allocations and load reductions required to achieve geometric mean TMDLs

TMDL Component	Geometric Mean TMDL		Modeled Existing Load	
	Dry Season Load (kgd)	Wet Season Load (kgd)	Dry Season Load (kgd)	Wet Season Load (kgd)
Loading Capacity	389.5	1,299.0	N/A	N/A
Wasteload Allocations				
City County of Honolulu MS4	9.2	12.7	1.7	2.2
U.S. Army Garrison Hawaii MS4	3.2	8.8	0.6	1.5
State of Hawaii DOT MS4	2.5	18.4	0.5	3.2
Construction Stormwater General and Individual Permits	0	0	0	0
Industrial Stormwater General and Individual Permits	0	0	0	0
Reserve WLA for Future Growth (5%)	19.5	65.0	—	—
Load Allocations				
City County of Honolulu	16.2	22.3	3.1	3.9
U.S. Army Garrison Hawaii	5.7	15.8	1.1	2.7
State of Hawaii DOT (and other)	14.0	102.7	2.6	17.8
State of Hawaii DOE MS4	1.06	1.3	0.2	0.2
Agriculture	178.4	919.1	33.7	159.6
Conservation Land	139.7	132.9	26.4	23.1
Total Existing Load			69.9	214.3
Load Reduction			N/A	N/A
Percent Reduction			N/A	N/A

Note: Loads rounded to the nearest 0.1 kilogram or number (unless this would result in an allocation of zero); thus, totals may be different than the sum of their parts.
* Wet season is defined at November 1 through April 30 and dry season is May 1 through October 31.
Acronyms: kgd = kilograms per day, N/A = not applicable; "—" = not explicitly modeled
Shaded values are for reference only

Table C-6. Sediment allocations and load reductions required to achieve 10% exceedance value TMDLs

TMDL Component	Geometric Mean TMDL		Modeled Existing Load	
	Dry Season Load (kgd)	Wet Season Load (kgd)	Dry Season Load (kgd)	Wet Season Load (kgd)
Loading Capacity	4,991.0	18,997.2	N/A	N/A
Wasteload Allocations				
City County of Honolulu MS4	117.8	185.8	2,349.1	3,686.8
U.S. Army Garrison Hawaii MS4	41.1	129.0	819.8	2,559.1
State of Hawaii DOT MS4	32.1	269.8	640.2	5,353.4
Construction Stormwater General and Individual Permits	0	0	0	0
Industrial Stormwater General and Individual Permits	0	0	0	0
Reserve WLA for Future Growth (5%)	249.6	949.9	—	—
Load Allocations				
City County of Honolulu	207.0	326.4	4,127.6	6,478.1
U.S. Army Garrison Hawaii	73.5	230.6	1,466.2	4,576.9
State of Hawaii DOT (and other)	178.8	1,502.5	3,565.5	29,815.2
State of Hawaii DOE MS4	13.6	19.4	272.0	385.8
Agriculture	2,286.7	13,440.9	45,600.7	266,723.2
Conservation Land	1,790.7	1,942.9	35,709.7	38,555.7
Total Existing Load			94,550.8	358,134.2
Load Reduction			89,559.8	339,137.0
Percent Reduction			95%	95%

Note: Loads rounded to the nearest 0.1 kilogram or number (unless this would result in an allocation of zero); thus, totals may be different than the sum of their parts.
* Wet season is defined at November 1 through April 30 and dry season is May 1 through October 31.
Acronyms: kgd = kilograms per day, N/A = not applicable; "—" = not explicitly modeled
Shaded values are for reference only

Load-based allocations are presented for all the individual sources. The dry and wet weather loading capacities for total nitrogen, nitrite-nitrate nitrogen and sediment are presented in Tables C3-C6 above. These tables show the reductions necessary to meet the TMDLs (presented as percent reduction from the existing loading).

The TMDL allocations were calculated using the most stringent of the three criteria (geometric mean, 10% and 2% NTE) that were in exceedance. TMDL compliance will be based on the geometric mean

criteria for total nitrogen, and the 10 percent wet season criteria for TSS[4]. Due to the high variability in modeled nitrite+nitrate nitrogen loadings (Appendix B), the allocations for nitrite+nitrate nitrogen will be assumed to be met, provided that the total nitrogen allocations are met. The nitrite+nitrate nitrogen loading table is included in this document to provide additional information to assist with meeting the total nitrogen TMDL targets, and the State is not requiring WLAs and LAs for this pollutant.

Total nitrogen reductions required to achieve the geometric mean water quality standard numeric criteria are 89 percent and 83 percent for the dry and wet seasons, respectively. These reductions decrease to 70 percent and 51 percent, respectively, to meet the dry and wet season 2 percent exceedance value TMDLs. Nitrite+nitrate nitrogen existing concentrations are estimated to need dry and wet season reductions of 97 percent and 93 percent, respectively, to achieve the geometric mean loading targets. Model results indicated that for sediment, the existing conditions are currently meeting the geometric mean numeric target; however, reductions of over 95 percent were required to meet the 10 percent exceedance value TMDLs. These analyses suggest that sediment loads tend to achieve the numeric targets during baseline conditions and exceed during storm events.

EPA concurs with the State's analysis and concludes the allocations are set at levels necessary to attain applicable water quality objectives. EPA concludes the State's submittal includes WLAs and LAs that are consistent with the provisions of the CWA and federal regulations.

8. Margin of Safety

The MOS can be implicit (incorporated into the TMDL analysis through conservative assumptions) or explicit (expressed in the TMDL as a portion of the loadings) or a combination of both. The TMDLs for the Waikele watershed includes an implicit MOS based on the following conservative assumptions:

1. The TMDL numeric targets are a direct translation of the water quality criteria and are applied at all locations within the watershed using the modeled flow at the mouth of the watershed. Therefore, the application of the numeric water quality criteria throughout the watershed does not account for the waterbody's ability to assimilate pollutants (specifically nutrients) prior to reaching the station used to calculate the loading capacities.

2. The model was calibrated using a time series rainfall/streamflow dataset that includes an extreme wet weather event (December 2008) beyond a 100-year storm, resulting in uncertainty regarding the modeled loadings. The uncertainty is incorporated into the TMDL load calculations by assuming a 100-year return flow on the affected days. Nevertheless, because the data collected during the large storm event remains a source of uncertainty, it is still considered an implicit MOS.

3. The TMDL for sediment was calculated based on the TSS numeric target, while the existing loads were calculated as SSC loads. In paired samples, SSC loads are expected to be higher than TSS loads, sometimes by as much as 35%. This was considered when calculating TSS load reductions; however, the discrepancy remains a source of uncertainty.

[4] The Waikele Stream is listed as impaired for exceeding turbidity criteria during the wet season (Staff Report, Table 2, p.10) and TSS is used as a surrogate for the turbidity criteria. Since the geometric mean TSS criteria is being met (Staff Report, Table 20, Fig. 43, p.73), reductions to achieve the geometric mean sediment criteria are not required. However, reductions to meet the 10% criteria are required, but only during the wet season to maintain consistency with the wet season turbidity impairment (Staff Report, p.69-70).

EPA finds the State's margin of safety analysis to be reasonable.

9. Seasonal Variations and Critical Conditions

The TMDL notes that in the Waikele watershed, the critical conditions for impairments coincide with storm events. The data analysis shows that such events can occur throughout the year. Model simulations of multiple years (1998 to 2011) accounted for seasonal variations in rainfall, evaporation and associated impacts on runoff and transport of sediment and nutrient loads to receiving waters.

EPA finds the State's seasonal variations and critical conditions analysis to be reasonable.

10. Public Participation

The DOH published a public notice and opportunity for public comment on the proposed TMDL analysis and implementation plan on July 29, 2018 and took public comment through October 1, 2018. DOH addressed the questions and comments received on the proposed TMDL analysis and implementation plan in a Response to Comments document posted at its website prior to DOH's adoption hearing on December 28, 2018. The DOH approved the TMDL package on February 19, 2019.

EPA finds the State provided sufficient opportunities for public comment and adequately responded to public comments.

11. Technical Analysis

The technical analyses to support the Basin Plan amendment for the TMDL package are contained in the Staff Report: *Turbidity, Sediment, and Nutrient Total Maximum Daily Loads for the Waikele Watershed, Oahu, Hawaii*, dated February 2019. This document (and its supporting documents and appendices) provide a detailed and appropriate level of technical analysis to support all TMDL elements including: a source determination; target development; linkage analysis and loading capacity; load and waste load allocations; the TMDL; and a margin of safety and critical conditions discussion.

The TMDL submittal provides an appropriate level of technical analysis supporting all TMDL elements.

12. Reasonable Assurances

WLAs will be enforced through the applicable NPDES permit conditions. For LAs, DOH may pursue implementation of the approved LAs through Hawaii's Nonpoint Source Management Plan (DOH 2015), Hawaii's Coastal Nonpoint Pollution Control Program Management Plan (State of Hawaii Department of Business, Economic Development, and Tourism) (State of Hawaii 1996), and the Clean Water State Revolving Fund Intended Use Plan, all of which serve the State Water Quality Standards (HAR 11-54). In addition, the development of watershed-based plans and TMDL Implementation Plans would provide specific measures for reducing loads in the Waikele watershed. If such plans address the nine elements required by EPA guidance and incorporate the LA objectives, they will assist in the application for additional CWA § 319(h) incremental funds for water quality improvement projects.

The DOH is also aware of potential interest in applying water quality trading approaches to assist future TMDL implementation actions. To help facilitate development and implementation of water quality trading-based implementation approaches, DOH stated its intention to exercise flexible interpretation of

the TMDL and its supporting terms, conditions and assumptions. To implement trading that affects point source discharges addressed by this TMDL, DOH will ensure that clearly articulated and enforceable trading provisions are incorporated in existing and/or future NPDES permits with numeric effluent limitations consistent with the terms, conditions and assumptions with the approved TMDL. DOH intends to work with partners taking part in trading arrangements to ensure that the legal framework for trading is consistent with applicable federal, State and local regulations and policies.