HEE NERR Nutrient Metadata
January-December 2020
Latest Update: June 14, 2021

Note: This is a provisional metadata document; it has not been authenticated as of its download date. Contents of this document are subject to change throughout the QAQC process and it should not be considered a final record of data documentation until that process is complete. Contact the CDMO (cdmosupport@baruch.sc.edu) or reserve with any additional questions.

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons –

Shimi Rii, Research Coordinator, P.O. Box 1346, Kāneʻohe, HI 96744, 808-783-9621, shimi@hawaii.edu
Gus Robertson, SWMP Technician, P.O. Box 1346, Kāneʻohe, HI 96744, 801-673-3747, jar32@hawaii.edu

2) Research objectives –

a) Monthly grab sampling program

Our long term monitoring program currently consists of 3 official SWMP sites (1 pending) in our watershed. The overall goal is to track the physical and biogeochemical parameters of the Heʻeia Stream water that originates in our upper watershed, then move through invasive wetland vegetation, areas undergoing invasive mangrove removal, and restored taro fields, and flow out towards a coastal ancient Hawaiian fishpond and out into Kāneʻohe Bay. The SWMP sites are intended to measure various parameters in real-time representing the emerging wetland/tidal marsh, estuary, coastal/ocean interface, and patch reef in the Bay. This indicates a gradient in salinity, temperature, and land-use change. We designed these SWMP sites to be able to track short- and long-term changes in our watershed through active restoration of habitat using a combination of conventional and Indigenous Native Hawaiian management strategies. As a measure of success, we hope to be able to capture the return to conditions ideal for many of our native species (fish, waterbirds, invertebrates, etc.) that have not been seen in the watershed for decades. We also envision the SWMP stations to serve as data hubs for researchers with various expertise to conduct question-specific research based around our consistent SWMP water quality measurements. Specifically, the SWMP nutrient dataset is designed to illustrate the nutrient consumption in the wetland and the fate of nutrients in the coastal fishpond and nearshore reef environments.

Our monthly grab sampling program consists of sampling for nutrients (nitrate + nitrite, orthophosphate, silicic acid, ammonium, total nitrogen and total phosphorus), total suspended solids, particulate carbon and nitrogen, chlorophyll *a*, and quarterly sampling of environmental DNA (eDNA) for fish.

For this 2020 submission, we report nutrient (nitrate + nitrite, orthophosphate, silicic acid, ammonia) and chlorophyll *a* data from three permanent SWMP stations (Wai 2, Reef 9, and Kahoʻokele).

b) Diel sampling program

We started our diel sampling program in November 2020 and conducted sampling at Wai 2 for November and December.

3) Research methods –

a) Monthly grab sampling program

Sample collection and collection intervals: Before sampling, all nutrient bottles are rinsed 3 times with 10% hydrochloric acid and rinsed 3 times with DI water. Samples are collected on a monthly basis during the full moon phase on an outgoing tide (within 3 hours before slack low tide). Physical water parameters are

documented using a YSI ProDSS immediately before the sample collection. Sampling is conducted using a horizontal Van Dorn water sampler (2.2 L capacity), and collected near the depth of the YSI sensor faces, within 2 m of the instrument. Small amounts of water (~10 mL) collected in the Van Dorn bottle are used to rinse two amber LDPE 500 ml bottles three times, and then ~250 mL of water are collected into each bottle.

Sample processing: Each amber 500 mL bottle is then processed for both nutrients and chlorophyll *a*. Using a syringe and a 25 mm GF/F filter in a filter holder, 5 mL of the filtrate is used to rinse the 60 mL LDPE pre-acid washed bottles twice prior to collecting 40 mL of the filtrate into the bottle for subsequent nutrient analyses. Then, another 50 mL is filtered through the GF/F filter for a total of 100 ml. The GF/F filter is then folded in half and stored in an aluminum foil packet. Both nutrients and chlorophyll samples, post collection, are then kept on ice in a cooler and delivered within 3 hours of field sampling to the University of Hawai'i SOEST Laboratory for Analytical Biogeochemistry (S-LAB), where they are frozen in a laboratory-grade walk-in -20°C freezer for subsequent laboratory processing.

Equipment and analyzers: Nutrients are processed on a Seal Analytical AA3 HR Nutrient Autoanalyzer following these established protocols. Chlorophyll *a* was analyzed on a Turner 10-AU fluorometer using the methods shown here and by Welschmeyer (1994). The 2019 TNI Evaluation Report using standards was conducted February-March 2019 is found here. The Method Detection Limits reported in this submission was analyzed using these EPA protocols. The Method Detection Limits used for each nutrient and chlorophyll *a* were calculated June 2020 and the results are reported here.

4) Site location and character –

He'eia (11.5 km^2), O'ahu, Hawai'i, extends from the summit of the Ko'olau mountain range to the fourth largest wetland in the islands containing historically productive flooded taro agroecosystems (*lo'i*), a coastal *loko i'a*, and into Kāne'ohe Bay highly valued for marine biodiversity. Ha'ikū and 'Ioleka'a basins contribute ~2.0 cfs perennial flow as He'eia Stream. State-wide, He'eia remains one of the few watersheds actively managed from ridge to reef. The He'eia NERR comprises a 1,385-acre region within the He'eia watershed, spanning the wetland and flooded-field agroecosystems managed by Kāko'o 'Ōiwi, the 800-year-old He'eia Fishpond managed by Paepae o He'eia, the surrounding streams and Kāne'ohe Bay under the jurisdiction of the state of Hawai'i Department of Land and Natural Resources, and Moku o Lo'e, the island on which Hawai'i Institute of Marine Biology, University of Hawai'i at Mānoa resides.

Wai 2 (W2): 21.43831° N, 157.81093° W

W2, installed on September 18, 2019, is a site in He'eia Stream as the water flows out of the wetland area that has recently undergone large-scale mangrove removal. At W2, water either diverts and flows into the He'eia Fishpond, or goes straight towards the stream mouth into Kāne'ohe Bay. There is slight tidal influence, with intrusions of saline water at the peak of high tide when tide is greater than typical values. As a result, the typical salinity is 0.11 psu, but have observed salinity as high as 33.2 psu, very occasionally. Typical water depth is 0.52 m, increasing slightly only when heavy rains coincide with high tide. The bottom habitat is soft, silty, dark (anoxic) sediment. Pollutants in the area may include fecal contaminants from invasive cats, pigs, and mongoose, and potential cesspool contamination from the upper watershed. At W2, we now have an active data logger, and we are collecting monthly grab samples of nutrients, total suspended solids, chlorophyll *a*, and bimonthly samples of eDNA.

Reef 9 (R9): 21.44628° N, 157.80183° W

R9, installed on February 13, 2020, is a site on a patch reef located in Kāne'ohe Bay, a subtropical embayment on the windward coast of O'ahu. The salinity range is 33.7 psu to 35.0 psu, and depth changes ~1 m throughout tidal changes. This is a perpetual ocean site and presumed to have no input of freshwater except precipitation or during extreme low tide events. The bottom habitat is sandy, coral rubble, the average depth is ~3 m. Pollutants may include motorboat oil and human contaminants from nearby motorboat operators and proximity to He'eia Kea Small Boat Harbor.

Kahoʻokele (KK): 21.43582° N, 157.80524W

Kahoʻokele, installed on September 29, 2020, is positioned on the ocean side (*makai*) of a ~800 year old Native Hawaiian fishpond. It is within close proximity to one of the fishpond sluice gates (*mākāhā*), also named Kahoʻokele, which serves as a point of water exchange between Heʻeia Stream and Kāneʻohe Bay. These traditional sluice gates are essential for regulating the physical-chemical parameters of the fishpond as well as maintenance of traditional husbandry of resource fish, and Kahoʻokele has been shown to exchange ~25% of the water exchanged through all the gates at the fishpond. The salinity range is 27.2 psu to 35.2 psu, and depth changes ~1 m throughout tidal changes. The bottom habitat is sandy, coral rubble, and pollutants may include pathogens related to domestic animal (i.e. cat, pig, mongoose) and other land-based pollutants coming from Heʻeia Stream and nearby Heʻeia State Park. Additionally, this site may be heavily influenced by groundwater sources of nutrients.

SWMP Station Timeline

Station Code	SWMP Status	Station Name	Location	Active Dates	Reason Decommissioned	Notes
W2	P	Wai 2	21.43831° N, 157.81093° W	9/18/2019 - present	NA	NA
R9	P	Reef 9	21.44628° N, 157.80183° W	2/13/2020 - present	NA	NA
KK	P	Kahoʻokele	21.43582° N, 157.80524° W	9/29/2020- present	NA	NA

5) Coded variable definitions –

heew2nut = Heʻeia Wai 2 Nutrients
heer9nut = Heʻeia Reef 9 Nutrients
heekknut = Heʻeia Kahookele Nutrients

monthly grab sample program = 1
diel grab sample program = 2

6) Data collection period –

Wai 2:

1/9/2020 09:09
2/10/2020 09:33
3/6/2020 07:26
4/7/2020 08:30
5/7/2020 07:32, 07:33
6/5/2020 07:30, 07:31
7/7/2020 08:32, 08:37
8/4/2020 08:10, 08:11
9/2/2020 08:12, 08:12
10/2/2020 07:39, 07:40
10/30/2020 07:44, 07:47
12/1/2020 08:30, 08:34
12/29/2020 08:17, 08:18

11/12/2020 06:30, 08:45, 11:00, 13:15, 15:30, 17:45, 20:00, 22:15
11/13/2020 00:30, 02:45, 05:00, 07:15
12/14/2020 11:45, 14:00, 16:15, 18:30, 20:45, 23:00
12/15/2020 01:15, 03:30, 05:45, 08:00, 10:15

Reef 9:

2/13/2020 14:45
9/2/2020 06:58, 06:59

3/5/2020 07:52
5/6/2020 07:17, 07:18
6/22/2020 07:30, 07:31
7/6/2020 07:25, 07:26
8/3/2020 07:27, 07:28
10/1/2020 06:42, 06:44
10/29/2020 06:46, 06:49
11/30/2020 07:42, 07:46
12/28/2020 07:40, 07:46

Kaho'okele (KK):

10/2/2020 07:07, 07:08
10/30/2020 06:50, 06:50
12/1/2020, 07:35, 07:39
12/29/2020, 07:42, 07:43

7) Associated researchers and projects–

As part of the SWMP long-term monitoring program, He'eia NERR also monitors 15-minute meteorological and water quality data which may be correlated with this nutrient/pigment dataset. These data are available at www.nerrsdata.org.

We have also started collecting nutrients and pigments at 1 other future SWMP station, but we will be reporting those measurements at a later time when the respective SWMP station is established officially.

In addition to the 4 SWMP stations, we also collect nutrients and pigments from 6 other stations in the He'eia watershed, designed to fill knowledge gaps on the fate of nutrients through the watershed. Many of these stations may be added as secondary SWMP stations in the future.

8) Distribution –

NOAA retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The NERRS retains the right to be fully credited for having collected and process the data. Following academic courtesy standards, the NERR site where the data were collected should be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

Requested citation format:
NOAA National Estuarine Research Reserve System (NERRS). System-wide Monitoring Program. Data accessed from the NOAA NERRS Centralized Data Management Office website: www.nerrsdata.org; *accessed* 12 October 2019.

NERR nutrient data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Principal investigators and contact persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under the general information link on the CDMO home page) and online at the CDMO home page www.nerrsdata.org. Data are available in comma separated version format.

II. Physical Structure Descriptors

9) Entry verification –

Nutrient data is received by the Research Coordinator from the S-LAB Laboratory Specialist in a Microsoft Excel format. The original nutrient data is then archived in a shared Google Drive folder and an external hard drive. The S-LAB calculates and reports results in µg/L. For purposes of consistency in the NERR System, He'eia NERR converts the concentrations into mg/L by dividing all values by 1000. The SWMP Technician then enters the data from each month into the Microsoft Excel worksheet that will be subsequently processed for QAQC. Prior to running NutrientQAQC, the worksheet is sent to the Research Coordinator for verification.

After verification, nutrient data are entered into a Microsoft Excel worksheet and processed using the NutrientQAQC Excel macro. The NutrientQAQC macro sets up the data worksheet, metadata worksheets, and MDL worksheet; adds chosen parameters and facilitates data entry; allows the user to set the number of significant figures to be reported for each parameter and rounds using banker's rounding rules; allows the user to input MDL values and then automatically flags/codes measured values below MDL and inserts the MDL; calculates parameters chosen by the user and automatically flags/codes for component values below MDL, negative calculated values, and missing data; allows the user to apply QAQC flags and codes to the data; produces summary statistics; graphs selected parameters for review; and exports the resulting data file to the CDMO for tertiary QAQC and assimilation into the CDMO's authoritative online database.

10) Parameter titles and variable names by category –

Required NOAA NERRS System-wide Monitoring Program nutrient parameters are denoted by an asterisk "*".

Data Category	Parameter	Variable Name	Units of Measure
Phosphorus and Nitrogen:			
	*Orthophosphate, Filtered	PO4F	mg/L as P
	*Ammonium, Filtered	NH4F	mg/L as N
	*Nitrite + Nitrate, Filtered	NO23F	mg/L as N
	Dissolved Inorganic Nitrogen	DIN	mg/L as N
Plant Pigments:			
	*Chlorophyll a	CHLA_N	µg/L
Other Lab Parameters:			
	Silicate, Filtered	SiO4F	mg/L as SI
Field Parameters:			
	Water Temperature	WTEM_N	ºC
	Specific Conductance	SCON_N	mS/cm
	Salinity	SALT_N	ppt
	% Dissolved Oxygen Saturation	DO_S_N	%
	Dissolved Oxygen	DO_N	mg/L
	pH	PH_N	SU
	Turbidity – Nephelometer Turbidity Units	TURB_N	NTU

Notes:
1. Time is coded based on a 2400 clock and is referenced to Standard Time.
2. NO2 and NO3 are not reported individually and are reported together as NO23, as NO2 is a minor component (in the 0-1 nanomolar range) in Hawai'i's ocean and rain-fed systems relative to NO3 (https://hahana.soest.hawaii.edu/hot/hot-dogs/interface.html).

11) Measured or calculated laboratory parameters –

a) **Parameters measured directly**

Nitrogen species:	NH4F, NO23F
Phosphorus species:	PO4F
Other:	CHLA_N, SiO4F

b) **Calculated parameters**

DIN	NO23F+NH4F

12) Limits of detection –

Method Detection Limits (MDL), the lowest concentration of a parameter that an analytical procedure can reliably detect, have been established by the S-LAB using these EPA protocols. The MDLs used for each nutrient and chlorophyll *a* were calculated June 2020 and the results are reported here. As the results were reported in µM, they were multiplied by 0.014007, 0.03097, and 0.02809 to yield concentrations in mg/L as N, P, and Si, respectively. These values are reviewed and revised annually.

Parameter	Start Date	End Date	MDL	Revisited
NH4F	01/01/20	12/31/20	0.00042	
NO23F	01/01/20	12/31/20	0.00001	
PO4F	01/01/20	12/31/20	0.00028	
SiO4F	01/01/20	12/31/20	0.0025	
CHLA_N	01/01/20	12/31/20	0.03	

13) Laboratory methods –

All dissolved nutrient samples are stored frozen until analysis. Samples are thawed overnight in a refrigerator. Standards are made from concentrated stock solutions daily. For determination of NO23F and TN, a NO_2 and NO_3 is included in the run to determine efficiency of cadmium column reduction. For TN and TP determination an organic TN and TP sample is included in the run to determine efficiency of UV digestion. Every 15 samples the following sequence is completed: deionized baseline, deionized water blank, low nutrient seawater blank, two replicate standards at the middle concentration (to determine consistent recovery and accuracy), a low concentration QA/QC sample, a high concentration QA/QC sample, and finally, the high standard (to determine instrument drift).

QA/QC samples analyzed throughout the run are collected by the Hawaii Ocean Time-series program. These are collected with the CTD- niskin bottles at 250 m and 4000 m. The 250 m sample acts as the high concentration sample for total dissolved nitrogen and total dissolved phosphorus and acts as the low concentration sample for the suite of inorganic dissolved nutrients. The 4000 m sample acts as the low concentration sample for total dissolved nitrogen and total dissolved phosphorus and acts as the high concentration sample for the suite of inorganic dissolved nutrients.

Refer to document "S-LAB Description of Procedures" on file with CDMO for specific procedures and references.

a) **Parameter: NH4F**

S-LAB Laboratory Method: *S-LAB Description of Procedures*
Method Reference: *Kerouel and Aminot (1997)*

Method Descriptor: *The sample is reacted with o-phthaladehyde (OPA) at 75°C in the presence of borate buffer and sodium sulfite to form a fluorescent species proportional to the ammonia concentration. The fluorescence is measured at 460 nm following excitation at 370 nm.*

Preservation Method: *Samples filtered and stored at -20 °C up to 28 days.*

b) **Parameter: NO23F**

S-LAB Laboratory Method: *S-LAB Description of Procedures*

Method Reference: *Armstrong et al. (1967); Grasshof (1969); Grasshof et al. (1983)*

Method Descriptor: *The determination of nitrate and nitrite uses a procedure whereby nitrate is reduced to nitrite by a copper-cadmium redactor column. The nitrite then reacts with sulfanilamide under acidic conditions to form a diazo compound. This compound then couples with N-1-napthylethylene diamine dihydrochloride to form a purple azo dye. The method is based on the nitrate determination in Standard Methods and in the DIN/ISO Standards for automatic nitrate measurements. Detection is at 520 nm.*

Preservation Method: *Samples filtered and stored frozen at –20 °C up to 28 days.*

c) **Parameter: PO4F**

S-LAB Laboratory Method: *S-LAB Description of Procedures*

Method Reference: *Grasshoff (1965)*

Method Descriptor: *Automated procedure for the determination of orthophosphate based on the colorimetric method in which blue color is formed by the reaction orthophosphate, molybdate ion and antimony ion followed by reduction with ascorbic acid at a pH<1. The reduced blue phosphor-molybdenum complex is colorimetrically read at 880 nm.*

Preservation Method: *Samples filtered and stored at -20 °C up to 28 days.*

d) **Parameter: SiO4F**

S-LAB Laboratory Method: *S-LAB Description of Procedures*

Method Reference: *Grasshoff et al. (1983)*

Method Descriptor: *This automated procedure for the determination of soluble silicates is based on the reduction of silicomolybdate in acidic solution to molybdenum blue by ascorbic acid. Oxalic acid is introduced to the sample stream before the addition of ascorbic acid to minimize interference from phosphates. Detection is at 820 nm.*

Preservation Method: *Samples filtered and stored at -20 °C up to 28 days.*

e) **Parameter: CHLA_N**

S-LAB Laboratory Method: *S-LAB Description of Procedures*

Method Reference: *Welschmeyer (1994)*

Method Descriptor: *Samples are extracted with a 90% acetone solution at the end of the day (after 3 PM). They are stored in the freezer overnight for extraction. Sample extraction ranges between 16-19 hours. Sample extraction is never less than 2 hours or greater than 24 hours. Samples are brought to room temperature prior to analysis. At the start and end of each day a high and low solid standard is analyzed on the Turner 10AU fluorometer to monitor any long-term instrument drift. The Turner 10 AU fluorometer is calibrated every 6 months or as needed based on solid standard drift (not to exceed 5 %). A blank of 90% acetone is analyzed at the start and end of each day. Samples are homogenized and the 90% acetone solution is decanted into a new borosilicate test tube for analysis. If dilution is required, a known volume of the original sample is pipetted into a new test tube, diluted with a known volume of 90% acetone, homogenized, and analyzed. The Turner 10 AU is equipped with a non-acidification module that does not require acidification to account for chlorophyll b and pheopigments*

Preservation Method: *Samples filtered and stored at -20 °C up to 30 days.*

14) Field and Laboratory QAQC programs –

a) **Precision**

i) **Field variability** –

Field replicates: 44 replicates / 80 total samples =55%

Nutrients: From January to May 2020, lab replicates were collected from the same Van Dorn sampler (hence same collection times, denoted as a "Split" sample below) and analyzed. Lab triplicate samples were collected in February 2020 at Reef 9. True field replicates were collected for all sites beginning May 2020.

Chlorophyll *a*: From January to May 2020, lab replicates were collected from the same Van Dorn sampler (hence same collection times, denoted as a "Split" sample below) and analyzed. Lab triplicate samples were collected in February 2020 at Reef 9. True field replicates were collected for all sites beginning May 2020.

*S indicates "Split" sample.

			Nutrients			Chlorophyll		
Site	**Date**	**Collection times**	**Sample**	**Split**	**Replicate**	**Sample**	**Split**	**Replicate**
Wai 2	1/9/2020	9:09	1	S		1	S	
	2/10/2020	9:33	1	S		1	S	
	3/6/2020	7:26	1	S		1	S	
	4/7/2020	8:30	1			1		
	5/7/2020	7:32/7:33	1		1	1		1
	6/5/2020	7:30/7:31	1		1	1		1
	7/7/2020	8:32/8:37	1		1	1		1
	8/4/2020	8:10/8:11	1		1	1		1
	9/2/2020	8:12/8:13	1		1	1		1
	10/2/2020	7:39/7:40	1		1	1		1
	10/30/2020	7:44/7:47	1		1	1		1
	12/1/2020	8:30/8:34	1		1	1		1
	12/29/2020	8:17/8:17	1		1	1		1
	11/12/2020	6:30	1			1		
	11/12/2020	8:45	1			1		
	11/12/2020	11:00	1			1		
	11/12/2020	13:15	1			1		
	11/12/2020	15:30	1			1		
	11/12/2020	17:45	1			1		
	11/12/2020	20:00	1			1		
	11/12/2020	22:15	1			1		
	11/13/2020	0:30	1			1		
	11/13/2020	2:45	1			1		
	11/13/2020	5:00	1			1		
	11/13/2020	7:15	1			1		
	12/14/2020	9:30	1			1		
	12/14/2020	11:45	1			1		

	12/14/2020	14:00	1			1		
	12/14/2020	16:15	1			1		
	12/14/2020	18:30	1			1		
	12/14/2020	20:45	1			1		
	12/14/2020	23:00	1			1		
	12/15/2020	1:15	1			1		
	12/15/2020	3:30	1			1		
	12/15/2020	5:45	1			1		
	12/15/2020	8:00	1			1		
	12/15/2020	10:15	1			1		

			Nutrients			Chlorophyll		
Site	**Date**	**Collection times**	**Sample**	**Split**	**Replicate**	**Sample**	**Split**	**Replicate**
Reef 9	2/13/2020	14:45	1	S, S		1	S, S	
	3/5/2020	7:52/7:53	1	S		1	S	
	5/6/2020	7:17/7:18	1		1	1		1
	6/22/2020	7:30/7:31	1		1	1		1
	7/6/2020	7:25/7:26	1		1	1		1
	8/3/2020	7:27/7:28	1		1	1		1
	9/1/2020	6:58/6:59	1		1	1		1
	10/1/2020	6:42/6:44	1		1	1		1
	10/29/2020	6:46/6:49	1		1	1		1
	11/30/2020	7:42/7:46	1		1	1		1
	12/28/2020	7:40/7:46	1		1	1		1

			Nutrients			Chlorophyll		
Site	**Date**	**Collection times**	**Sample**	**Split**	**Replicate**	**Sample**	**Split**	**Replicate**
Kaho'okele	10/2/2020	7:07/7:08	1		1	1		1
	10/30/2020	7:44/7:49	1		1	1		1
	12/1/2020	7:35/7:39	1		1	1		1
	12/29/2020	7:42/7:43	1		1	1		1

ii) **Laboratory variability** – 12 Laboratory replicates / 80 total samples = 15%

iii) **Inter-organizational splits** – Samples were not split and analyzed by two different labs.

b) **Accuracy**

i) **Sample spikes** – Standards utilized are "spiked" low nutrient seawater (LNSW), though no samples are spiked. Middle LNSW spiked standards are evaluated in the same way, the %

recovery of this is reported every 15 samples (duplicate Cal 3 on each run file), and % recovery is typically 100% +/- 5%.

ii) **Standard reference material analysis –** Certified reference materials (NMIJ Seawater Standards) are analyzed during each nutrient run, and the S-LAB values are consistently within the accepted ranges. The 2019 TNI Evaluation Report using standards was conducted February-March 2019 is found here.

iii) **Cross calibration exercises** –He'eia NERR has not participated in any cross calibration exercises.

15) QAQC flag definitions –

QAQC flags provide documentation of the data and are applied to individual data points by insertion into the parameter's associated flag column (header preceded by an F_). QAQC flags are applied to the nutrient data during secondary QAQC to indicate data that are out of sensor range low (-4), rejected due to QAQC checks (-3), missing (-2), optional and were not collected (-1), suspect (1), and that have been corrected (5). All remaining data are flagged as having passed initial QAQC checks (0) when the data are uploaded and assimilated into the CDMO ODIS as provisional plus data. The historical data flag (4) is used to indicate data that were submitted to the CDMO prior to the initiation of secondary QAQC flags and codes (and the use of the automated primary QAQC system for WQ and MET data). This flag is only present in historical data that are exported from the CDMO ODIS.

-4 Outside Low Sensor Range
-3 Data Rejected due to QAQC
-2 Missing Data
-1 Optional SWMP Supported Parameter
0 Data Passed Initial QAQC Checks
1 Suspect Data
4 Historical Data: Pre-Auto QAQC
5 Corrected Data

16) QAQC code definitions –

QAQC codes are used in conjunction with QAQC flags to provide further documentation of the data and are also applied by insertion into the associated flag column. There are three (3) different code categories, general, sensor, and comment. General errors document general problems with the sample or sample collection, sensor errors document common sensor or parameter specific problems, and comment codes are used to further document conditions or a problem with the data. Only one general or sensor error and one comment code can be applied to a particular data point. However, a record flag column (F_Record) in the nutrient data allows multiple comment codes to be applied to the entire data record.

General errors

GCM	Calculated value could not be determined due to missing data
GCR	Calculated value could not be determined due to rejected data
GDM	Data missing or sample never collected
GQD	Data rejected due to QA/QC checks
GQS	Data suspect due to QA/QC checks
GSM	See metadata

Sensor errors

SBL	Value below minimum limit of method detection
SCB	Calculated value could not be determined due to a below MDL component
SCC	Calculation with this component resulted in a negative value

SNV	Calculated value is negative
SRD	Replicate values differ substantially
SUL	Value above upper limit of method detection

Parameter Comments

CAB	Algal bloom
CDR	Sample diluted and rerun
CHB	Sample held beyond specified holding time
CIP	Ice present in sample vicinity
CIF	Flotsam present in sample vicinity
CLE	Sample collected later/earlier than scheduled
CRE	Significant rain event
CSM	See metadata
CUS	Lab analysis from unpreserved sample

Record comments

CAB	Algal bloom
CHB	Sample held beyond specified holding time
CIP	Ice present in sample vicinity
CIF	Flotsam present in sample vicinity
CLE	Sample collected later/earlier than scheduled
CRE	Significant rain event
CSM	See metadata
CUS	Lab analysis from unpreserved sample

Cloud cover

CCL	clear (0-10%)
CSP	scattered to partly cloudy (10-50%)
CPB	partly to broken (50-90%)
COC	overcast (>90%)
CFY	foggy
CHY	hazy
CCC	cloud (no percentage)

Precipitation

PNP	none
PDR	drizzle
PLR	light rain
PHR	heavy rain
PSQ	squally
PFQ	frozen precipitation (sleet/snow/freezing rain)
PSR	mixed rain and snow

Tide stage

TSE	ebb tide
TSF	flood tide
TSH	high tide
TSL	low tide

Wave height

WH0	0 to <0.1 meters
WH1	0.1 to 0.3 meters
WH2	0.3 to 0.6 meters
WH3	0.6 to > 1.0 meters
WH4	1.0 to 1.3 meters
WH5	1.3 or greater meters

Wind direction

N	from the north

NNE	from the north northeast
NE	from the northeast
ENE	from the east northeast
E	from the east
ESE	from the east southeast
SE	from the southeast
SSE	from the south southeast
S	from the south
SSW	from the south southwest
SW	from the southwest
WSW	from the west southwest
W	from the west
WNW	from the west northwest
NW	from the northwest
NNW	from the north northwest
Wind speed	
WS0	0 to 1 knot
WS1	> 1 to 10 knots
WS2	> 10 to 20 knots
WS3	> 20 to 30 knots
WS4	> 30 to 40 knots
WS5	> 40 knots

17) Other remarks/notes –

Data may be missing due to problems with sample collection or processing. Laboratories in the NERRS System submit data that are censored at a lower detection rate limit, called the Method Detection Limit or MDL. MDLs for specific parameters are listed in the Laboratory Methods and Detection Limits Section (Section II, Part 12) of this document. Concentrations that are less than this limit are censored with the use of a QAQC flag and code, and the reported value is the method detection limit itself rather than a measured value. For example, if the measured concentration of NO23F was 0.0005 mg/l as N (MDL=0.0008), the reported value would be 0.0008 and would be flagged as out of sensor range low (-4) and coded SBL. In addition, if any of the components used to calculate a variable are below the MDL, the calculated variable is removed and flagged/coded -4 SCB. If a calculated value is negative, it is rejected and all measured components are marked suspect. If additional information on MDL's or missing, suspect, or rejected data is needed, contact the Research Coordinator at the reserve submitting the data.

Note: The way below MDL values are handled in the NERRS SWMP dataset was changed in November of 2011. Previously, below MDL data from 2007-2010 were also flagged/coded, but either reported as the measured value or a blank cell. Any 2007-2011 nutrient/pigment data downloaded from the CDMO prior to November of 2011 will reflect this difference.

Date	Codes	Description
2/10, 2/13/2020 3/5, 3/6/2020	CHB	Chlorophyll samples held longer than 30 days, due to COVID statewide lockdown.
4/7/2020 8:30	CSM	There was only one replicate taken during this month due to COVID statewide lockdown and limited capacity.

3/5/2020 7:52-7:53	CSM	Considerably lower PO4 at Reef 9, not sure why.
5/6-5/7/2020 7:32	CSM	First round of true field replicates at all sites.
10/30/2020	CSM	Both duplicate samples considerably elevated in NO23 at Wai 2, not sure why.
12/15/2020 3:30 12/15/2020 5:45	CSM	Low SiO4 during the early morning hours of our 2nd ISCO deployment at Wai 2, 3:30 at peak high tide (2.8 ft) and 5:45 at falling tide, possibly due to salinity intrusion.
12/15/2020 8:00 12/15/2020 10:15	CSM	Considerably elevated NH4F at Wai 2 during morning hours of ISCO deployment, falling tide approaching low tide.

Sample hold times for 2020: Samples are held at -20°C. NERRS SOP allows nutrient samples to be held for up to 28 days (CHLA for 30) at -20°C, plus allows for up to 5 days for collecting, processing, and shipping samples. Samples held beyond that time period are flagged suspect and coded CHB.

*Sample held longer than allowed by NERRS protocols

	Date Analyzed				
Sample Descriptor	**PO4F**	**NH4F**	**NO23F**	**CHLA_N**	**SiO4F**
1/9/2020, all grab samples	2/4/2020	2/4/2020	2/4/2020	1/24/2020	2/4/2020
2/10, 2/13/2020, all grab samples	2/20/2020	2/20/2020	2/20/2020	*4/9/2020	2/20/2020
3/5, 3/6/2020, all grab samples	3/6/2020	3/6/2020	3/6/2020	*4/9/2020	3/6/2020
4/7/2020, all grab samples	4/8/2020	4/8/2020	4/8/2020	N/A	4/8/2020
5/6, 5/7/2020, all grab samples	5/18/2020	5/18/2020	5/18/2020	5/20/2020	5/18/2020
6/5, 6/22/2020, all grab samples	6/8/2020 6/23/2020	6/8/2020 6/23/2020	6/8/2020 6/23/2020	6/23/2020	6/8/2020 6/23/2020
7/6, 7/7/2022, all grab samples	7/8/2020	7/8/2020	7/8/2020	7/10/2020	7/8/2020
8/3, 8/4/2020, all grab samples	8/7/2020	8/7/2020	8/7/2020	8/6/2020	8/7/2020
9/1, 9/2/2020, all grab samples	9/16/2020	9/16/2020	9/16/2020	9/16/2020	9/16/2020
10/1, 10/2/2020, all grab samples	10/5/2020	10/5/2020	10/5/2020	10/29/2020	10/15/2019
10/29, 10/30/2020, all grab samples	11/5/2020	11/5/2020	11/5/2020	11/3/2020	11/5/2020
11/30, 12/1/2020, all grab samples	12/15/2020	12/15/2020	12/15/2020	12/23/2020	12/15/2020
12/28, 12/29/2020, all grab samples	1/11/2021	1/11/2021	1/11/2021	1/6/2021	1/11/2021