Comparison of Bacterial Contamination Between O‘ahu Water Bodies and Wai Kai Lagoon

Comparison with O‘ahu Beaches

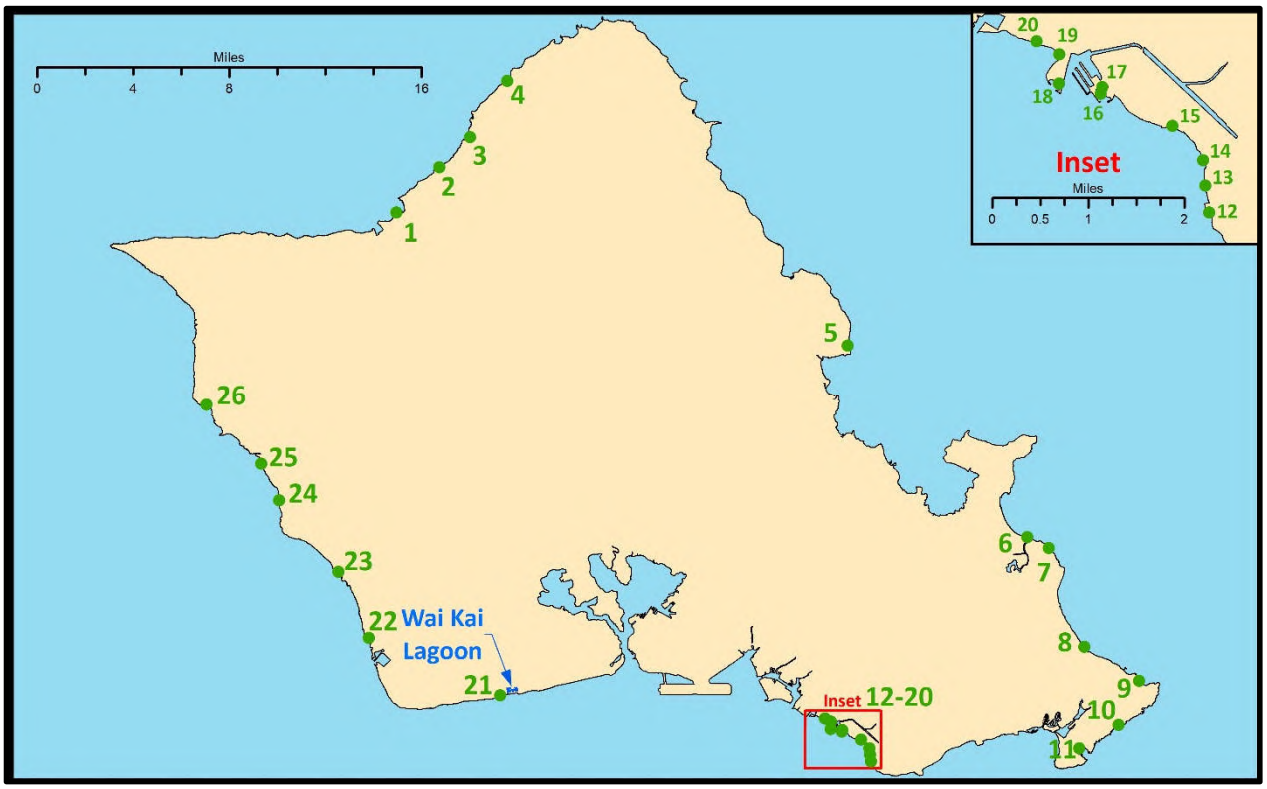
The Hawai‘i State Department of Health Clean Water Branch (CWB) collects water quality data, including bacteria levels, at many Hawaiian beaches, and it posts most of the data at the following link:

http://cwb.doh.hawaii.gov/CleanWaterBranch/WaterQualityData/SpreadSheetQuery.aspx).

Figure 1 shows the 26 stations where more than 100 samples were collected directly by CWB and by others during the 2012-2018 period, during which Haseko also routinely collected the same data at the Wai Kai Lagoon. The number labels in Figure 1 correspond to those in the labels in the time-series plots presented below.

The State of Hawai‘i Clean Water Branch regulations (Hawai‘i Administrative Rules §11-54-8(b)) specify a value of 35 CFU/100ml[1] as the threshold level below which recreational waters in the state should normally remain to ensure the safety of users. Specifically, these regulations state that the geometric mean of values collected within any 30-day interval should fall below this level.

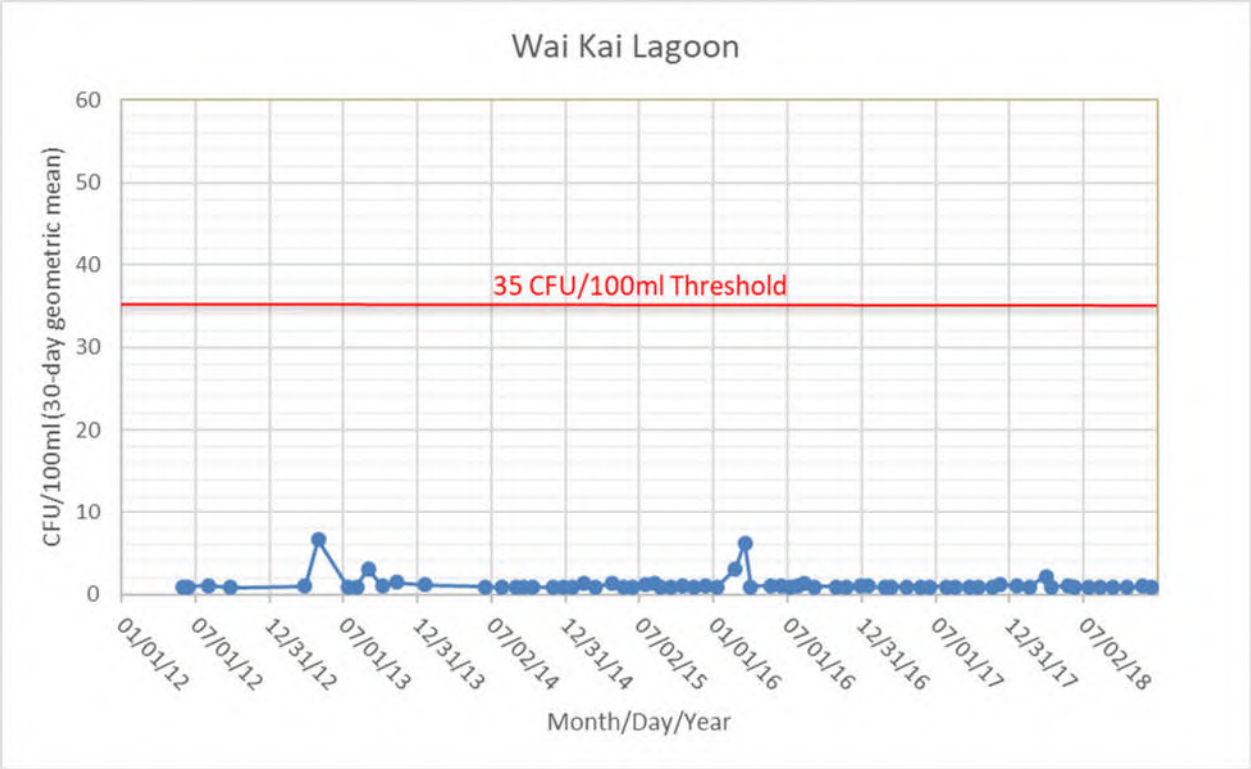
Figure 1 Sample Stations Monitoring Bacterial Contamination in Wai Kai Lagoon and O`ahu Beaches (>100 records), 2012-2018



[1] Water samples are diluted as necessary and then cultured on growth media conducive for *Enterococcus* bacteria growth for 24 hours to determine how many “colony-forming units” (CFU) per 100 milliliters of water sample (CFU/100ml) reproduce to form visible colonies during that time (e.g. *Standard Methods for the Examination of Water and Wastewater*, Clesceri, L. S., A. E. Greenberg, and D.A. Eaton. 1998. American Public Health Association. Washington, DC.). For most beaches, the minimum level (no colonies formed) was recorded as 10 CFU/100ml until the third quarter of 2016, and 2.3 CFU/100ml after that. For the Wai Kai and Hilton Lagoons, measurements below the detection limit of this method (1 CFU/100ml) are assumed to be 0.9 CFU/100ml in the mean calculation.

The time-series plots presented below show the data from water samples collected at the Wai Kai Lagoon (Figure 2) and at the 26 O'ahu stations where, at each, at least 100 samples were collected during this period (Figures 3 – 28). The horizontal red line in the plots represents the Clean Water Branch's 35 CFU/100ml threshold level. Samples with measured bacteria levels above the red line exceed the standard for safe use for water recreation. The date assigned to each geometric mean is the mid-point value between the first and last measurements taken within the 30-day span.

Figure 2 Wai Kai Lagoon



The time-series plots in Figure 2 show that bacterial levels in the Wai Kai Lagoon have always been far below the State standard. During most months, bacteria levels in the Wai Kai Lagoon are at or below the detection limit of 1 CFU/100ml. Comparing this plot for the Wai Kai Lagoon with the plots of data from other O'ahu beaches shows that bacteria levels in the Lagoon are typically much lower than bacterial levels at other O'ahu stations.

It is important to note that, to date, the Wai Kai Lagoon is not used to its full capacity, and the levels of contamination may rise when more people are using this recreational lagoon. However, unlike many other water bodies included in this report, the Wai Kai Lagoon is not intended to be primarily a swimming venue. Instead, users are encouraged to participate in kayaking, canoeing, stand-up-paddling, and other watercraft sports that can benefit from the deep, calm, enclosed water of the lagoon, but which do not require complete immersion in the water. Sustained swimming is not encouraged in the 20-ft. deep water, and Haseko anticipates that this will continue to be the case. Thus, it is likely that the lagoon water will remain relatively contamination-free even when used to its full capacity. Routine testing will continue as the lands around the Lagoon are developed.

Figure 3 Hale‘iwa Ali‘i Beach Park

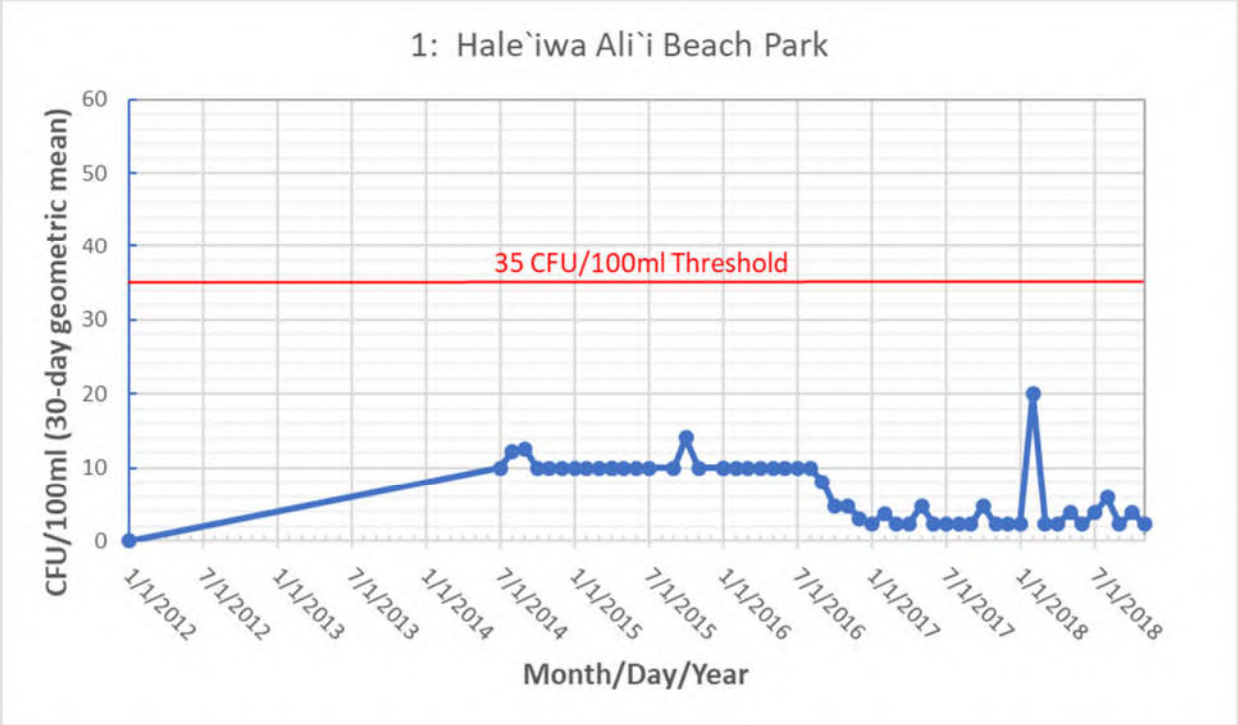


Figure 4 Chun’s Reef

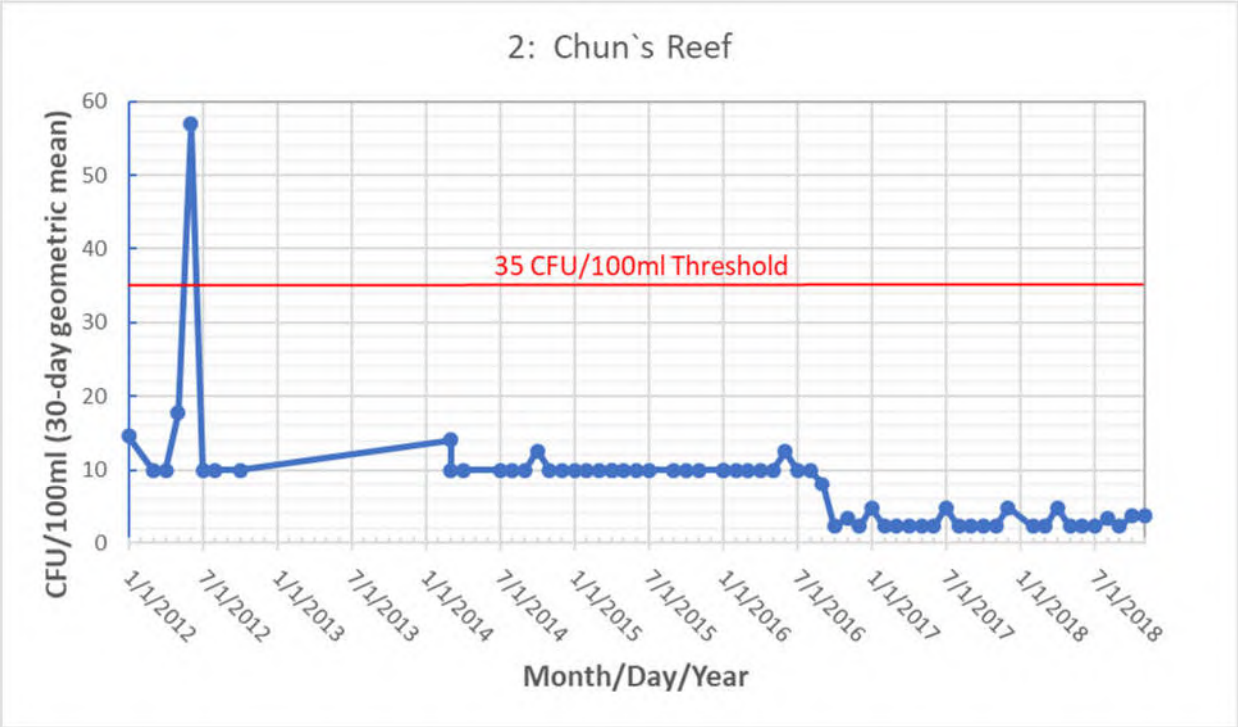


Figure 5 Waimea Bay Shoreline

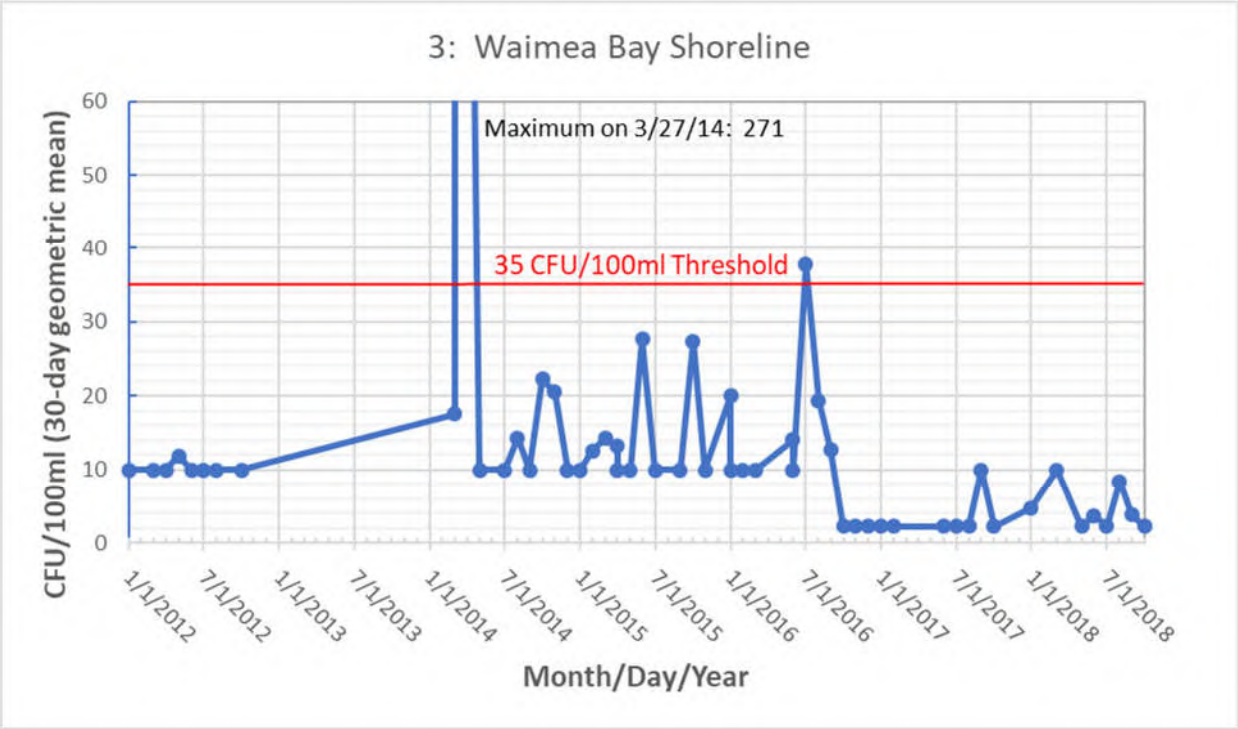


Figure 6 Sunset Beach

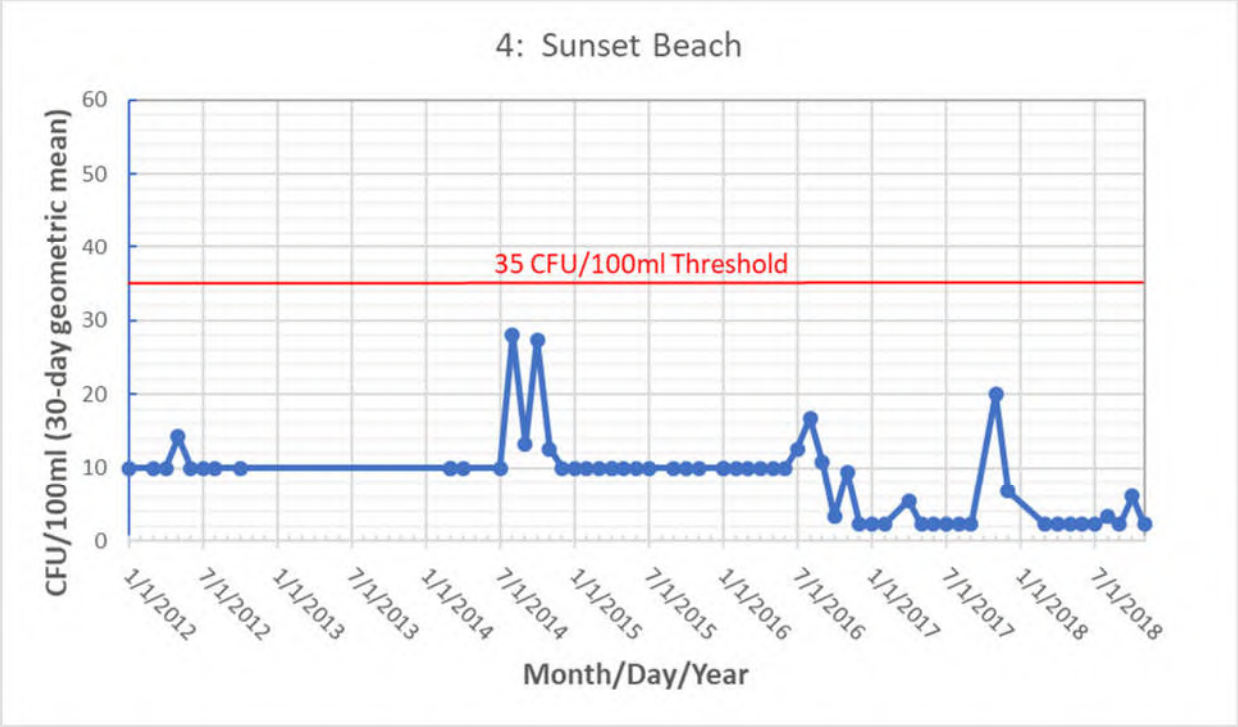


Figure 7 Kualoa Beach

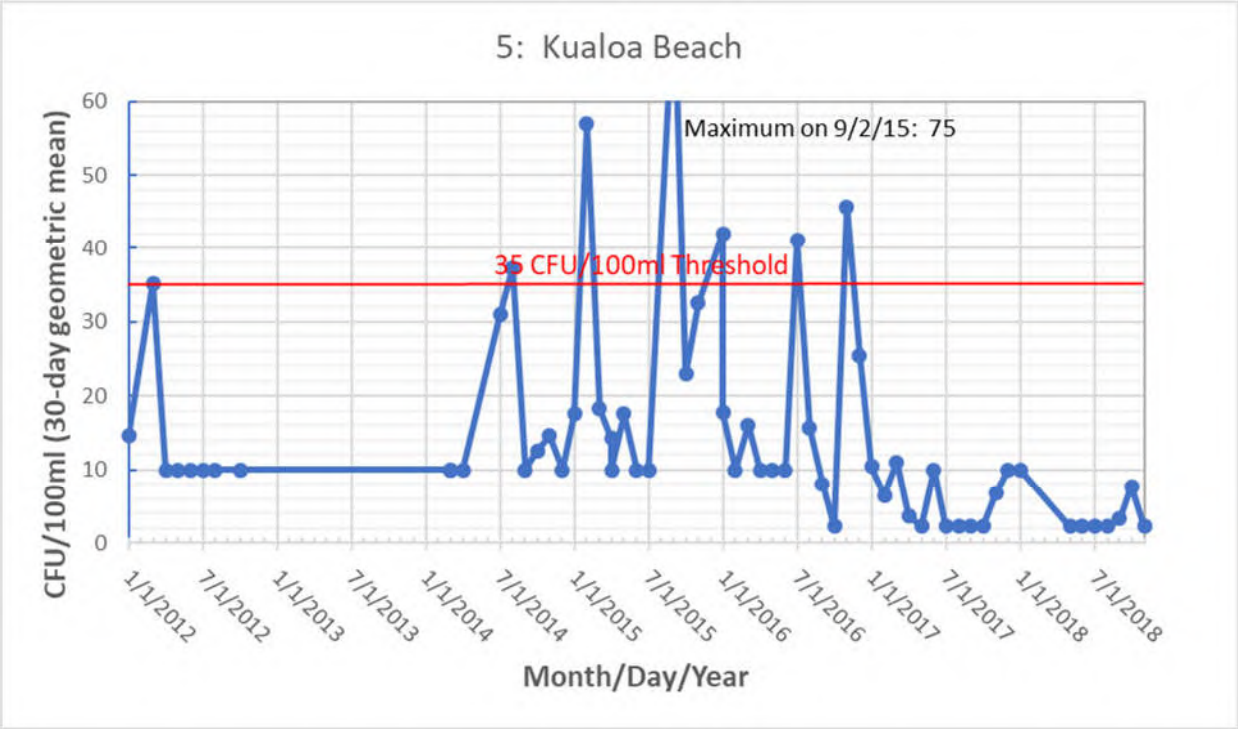


Figure 8 Kailua Beach Park

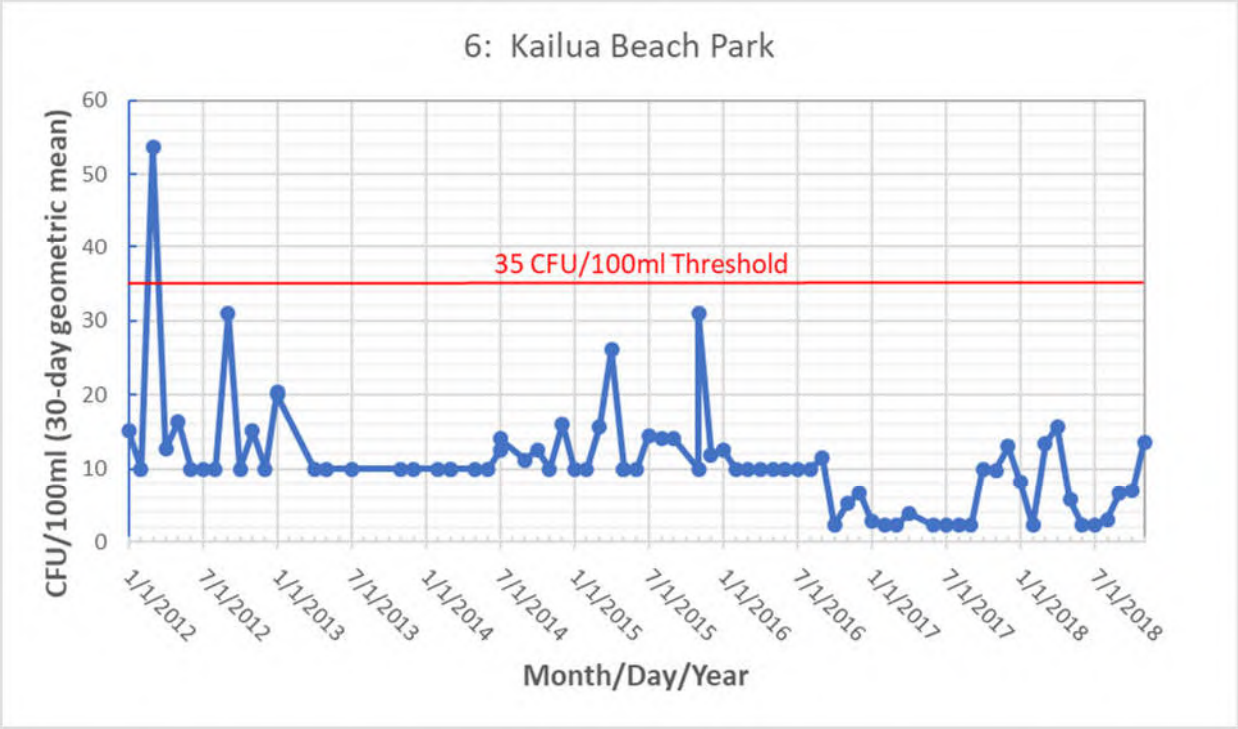


Figure 9 Lanikai Beach Shoreline

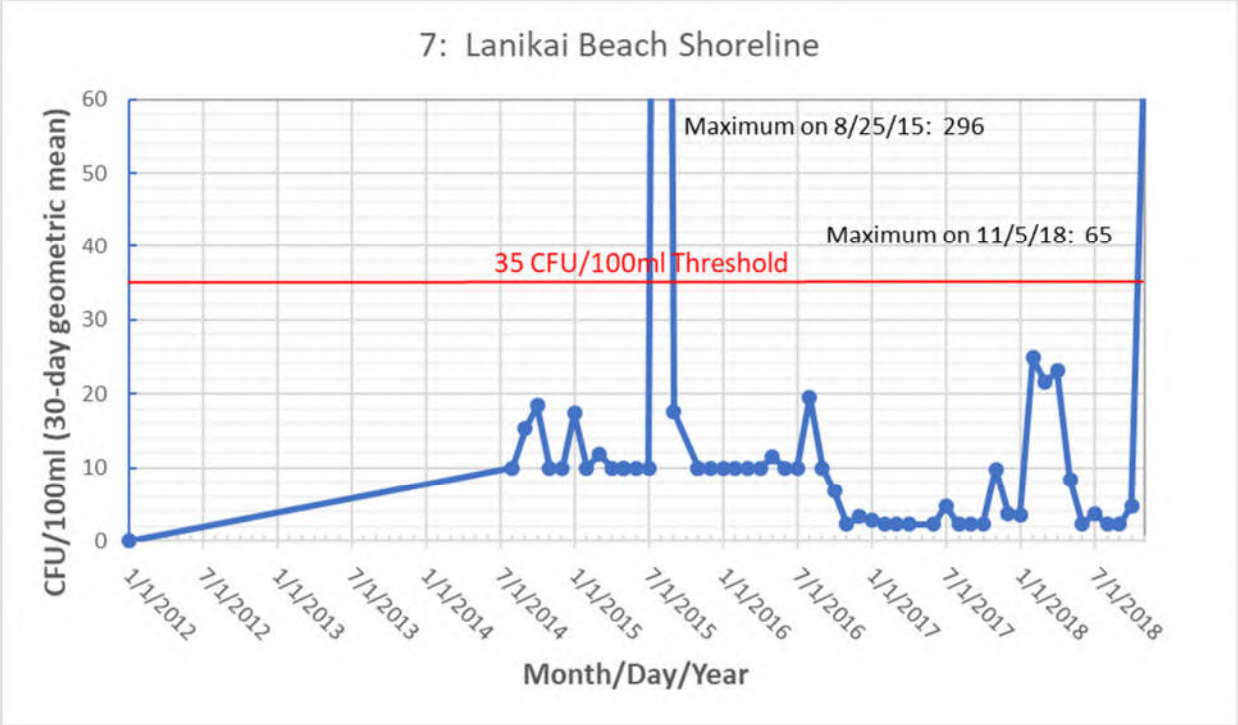


Figure 10 Waimanalo Beach

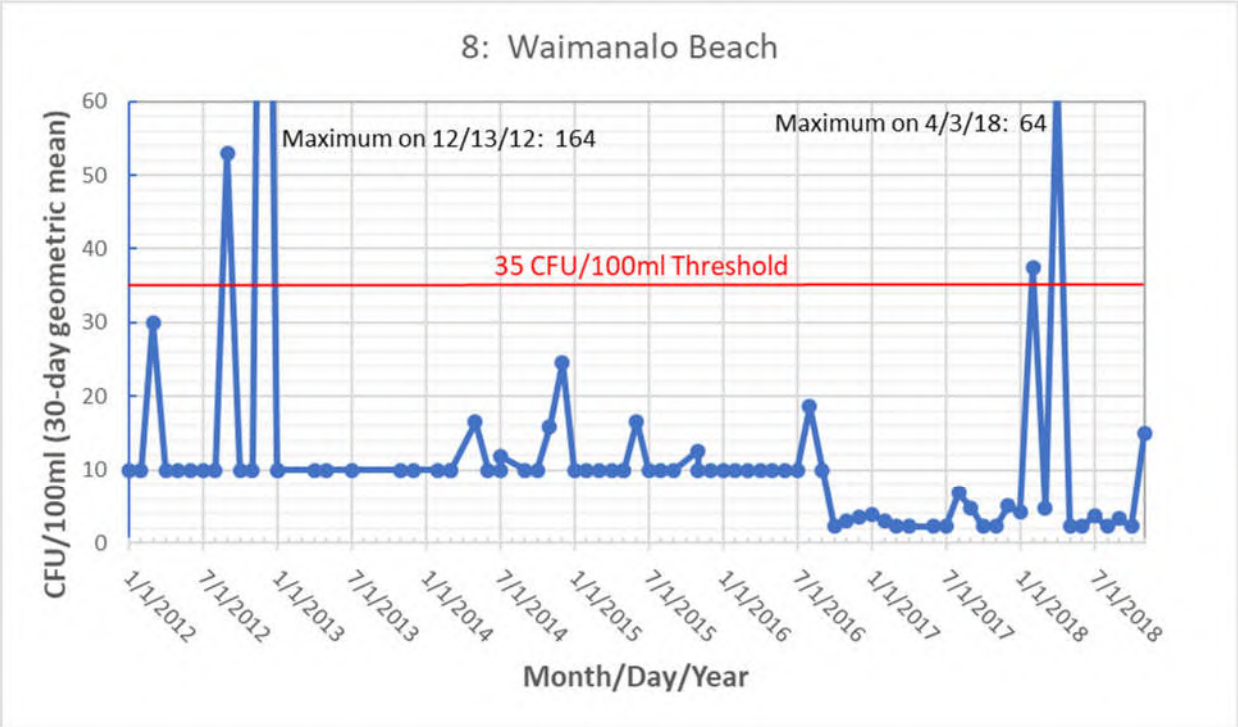


Figure 11 Makapu‘u

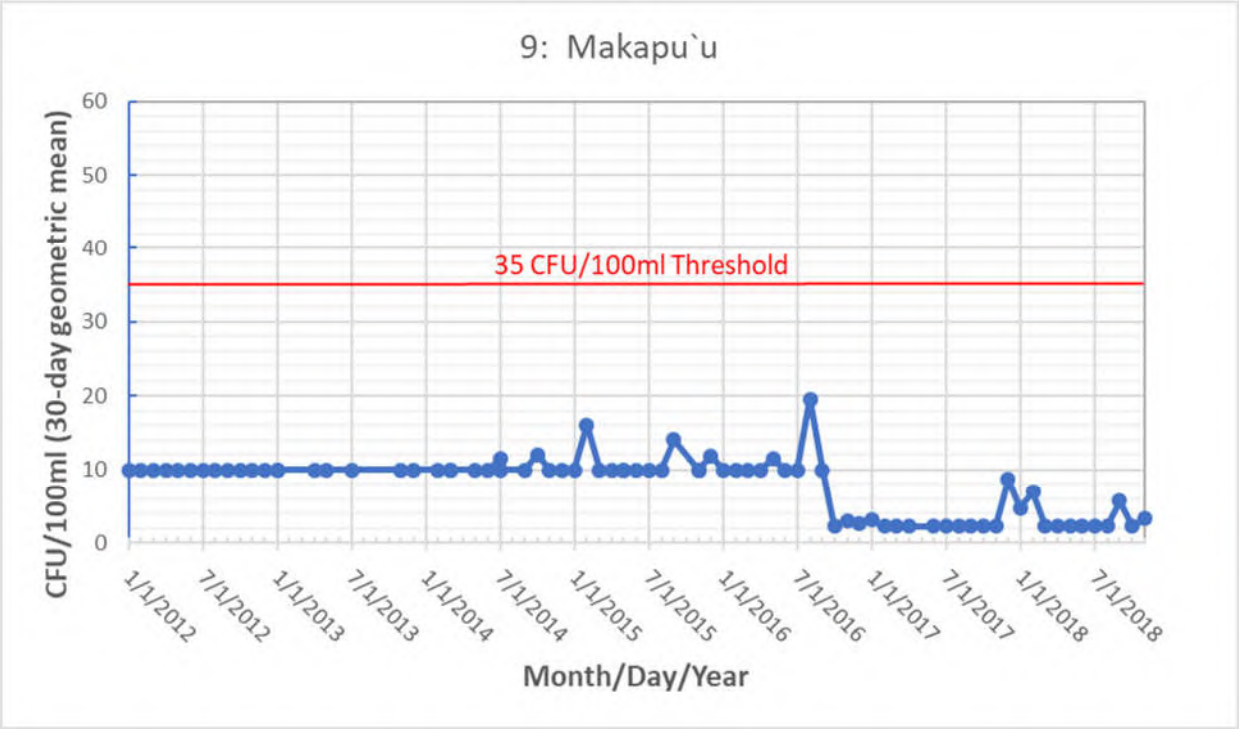


Figure 12 Sandy Beach

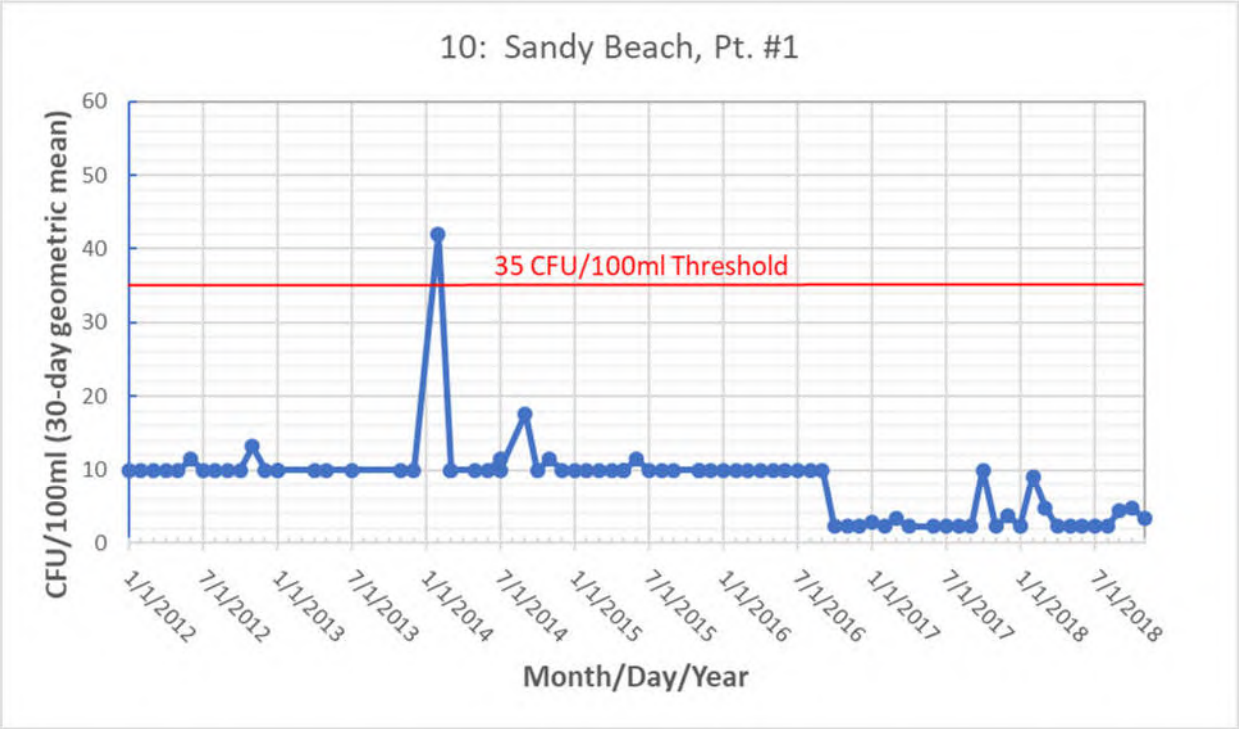


Figure 13 Hanauma Beach Park

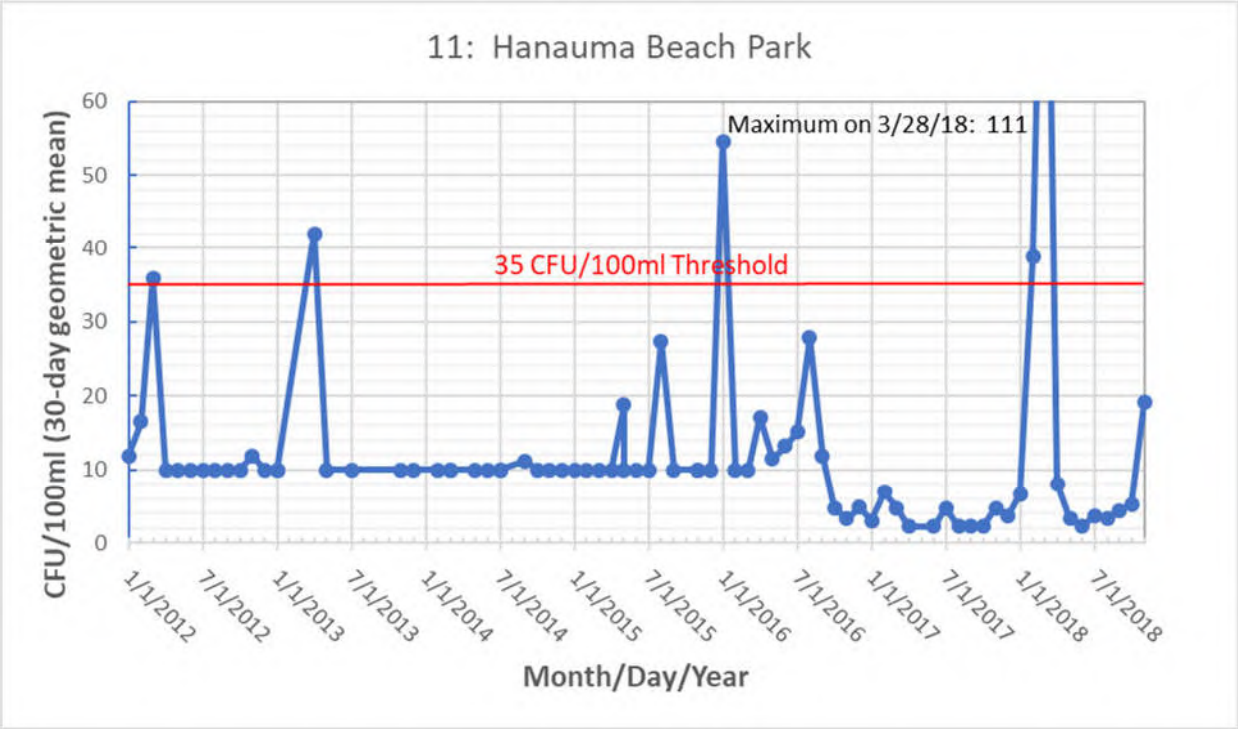


Figure 14 Sans Souci, Waikīkī

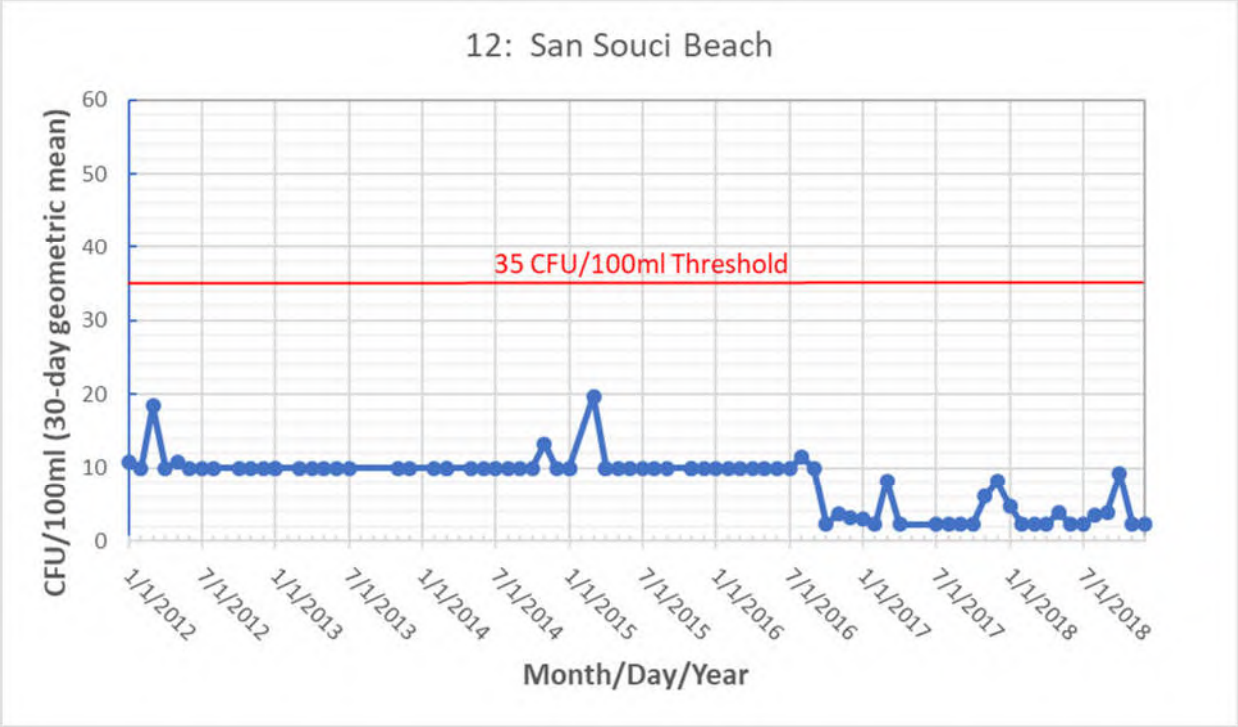


Figure 15 Public Bath Beach, Waikīkī

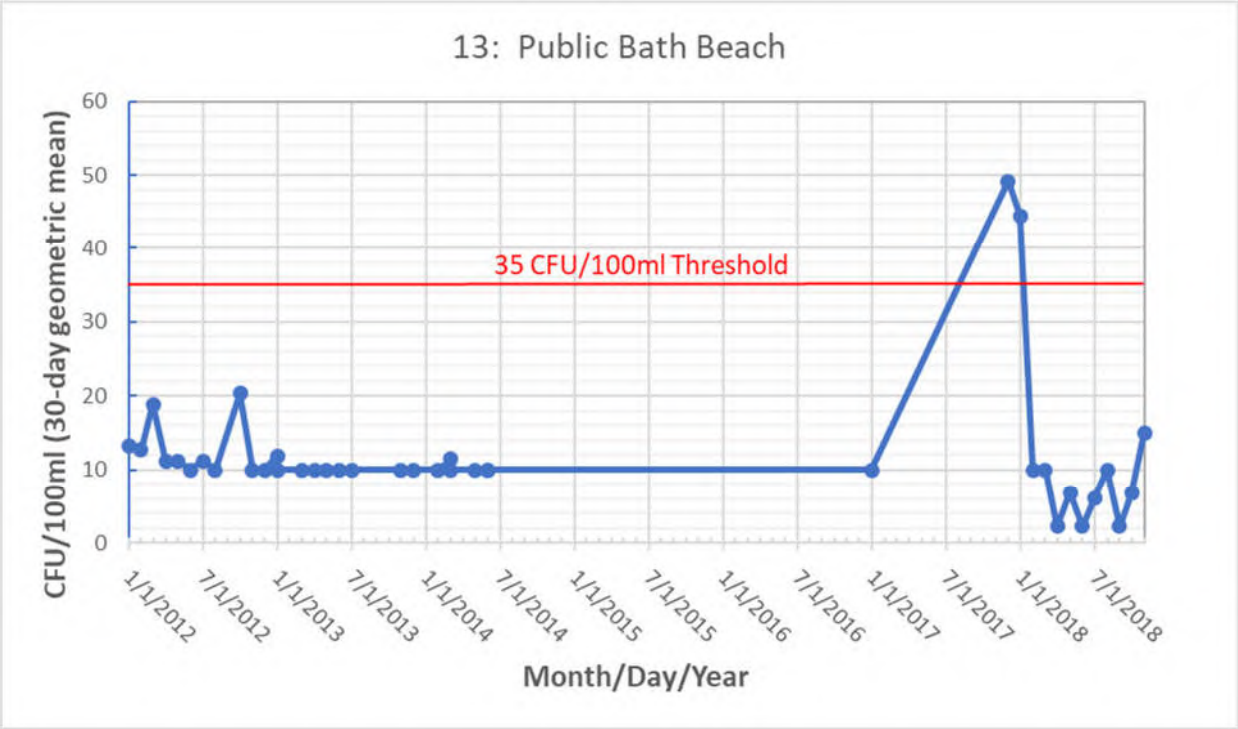


Figure 16 Kuhio Beach, Waikīkī

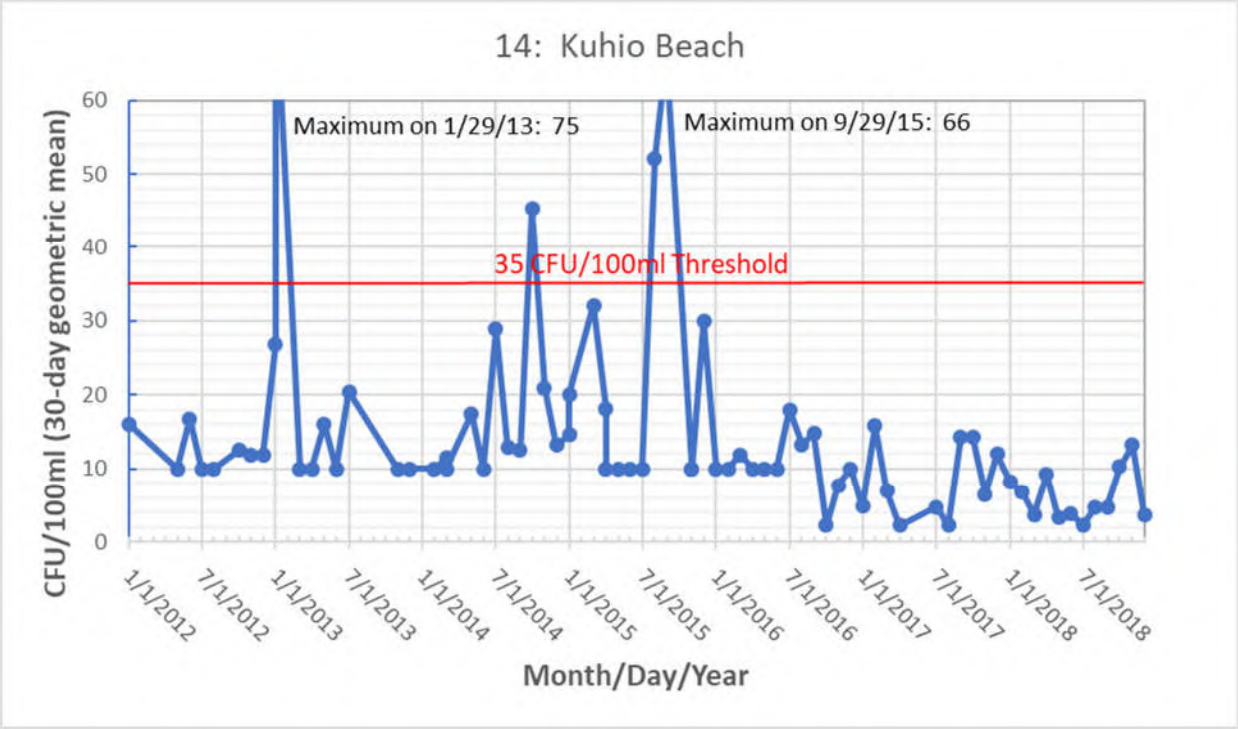


Figure 17 Moana Beach, Waikīkī

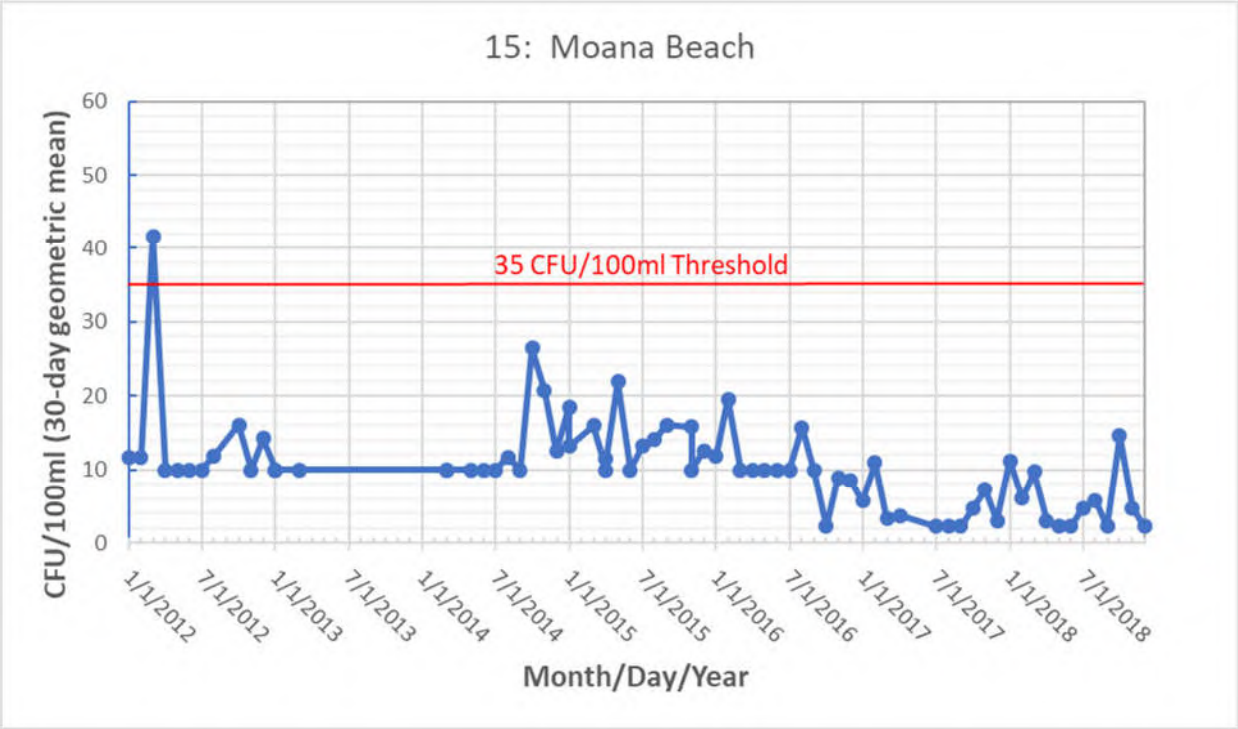


Figure 18 Kahanamoku Beach, Waikīkī

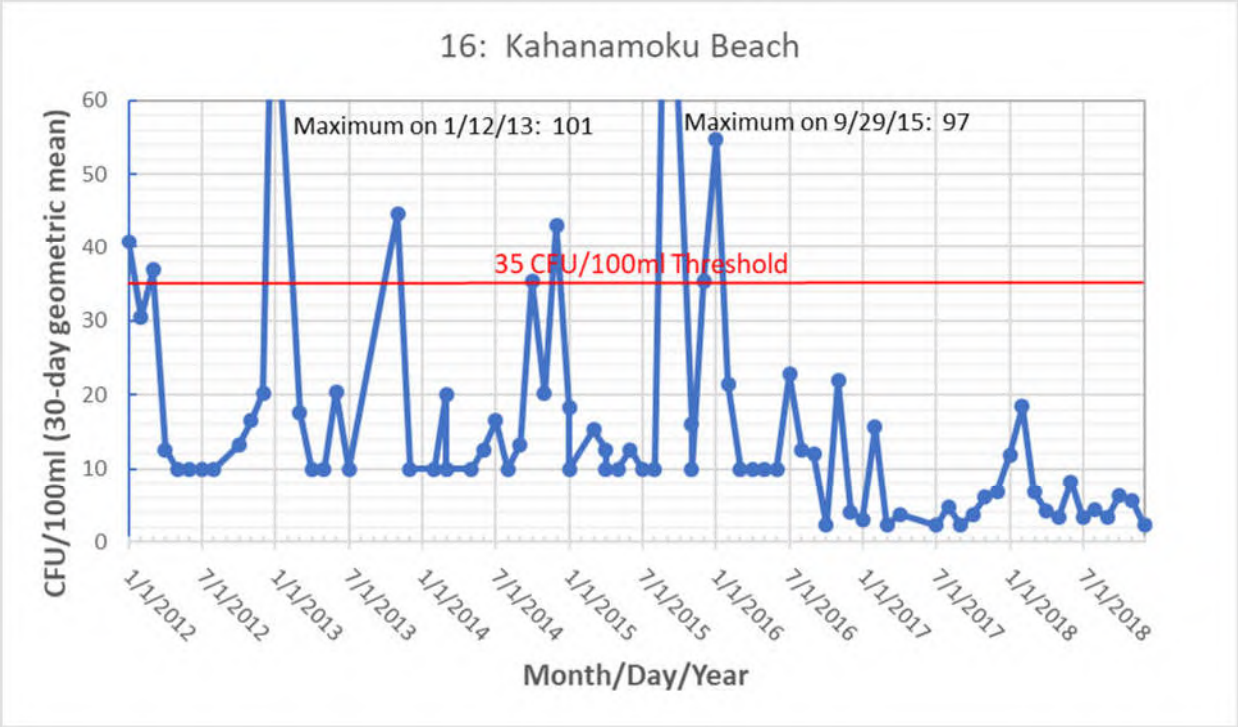


Figure 19 Hilton (Duke Kahanamoku) Lagoon, Waikīkī

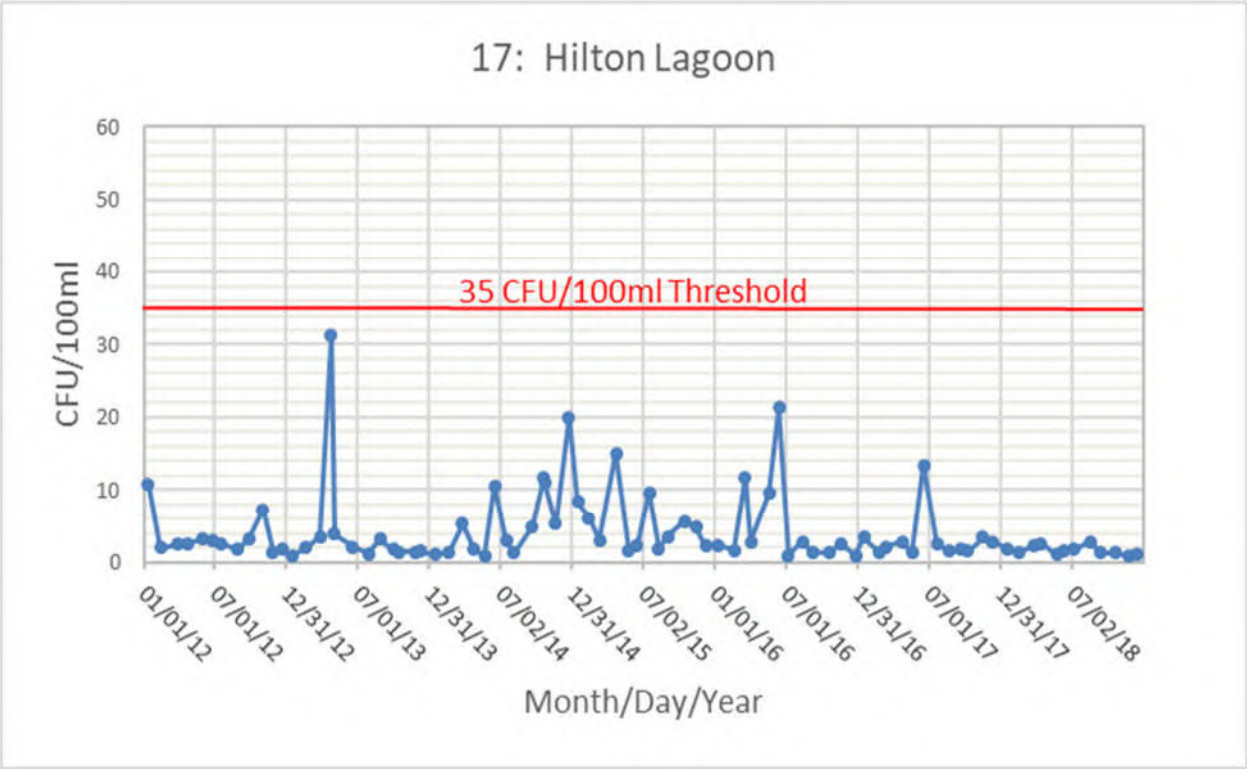


Figure 20 Ala Moana Lagoon

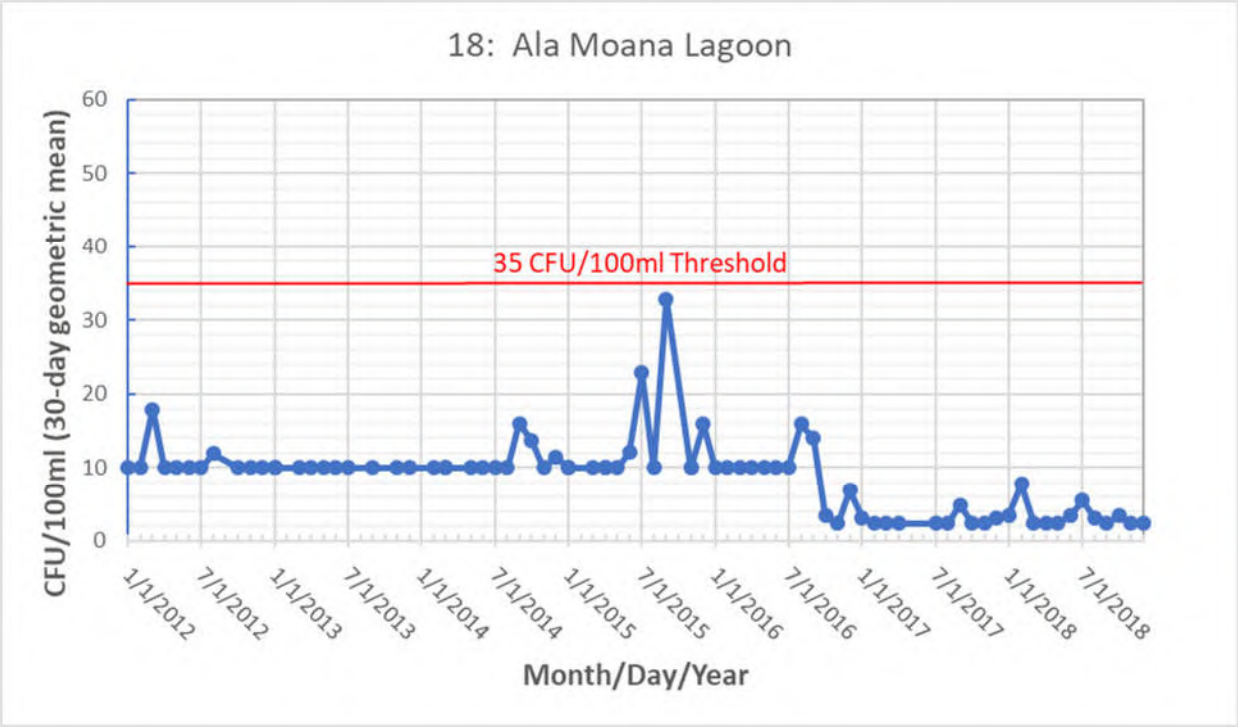


Figure 21 Ala Moana Park, Diamond Head Side

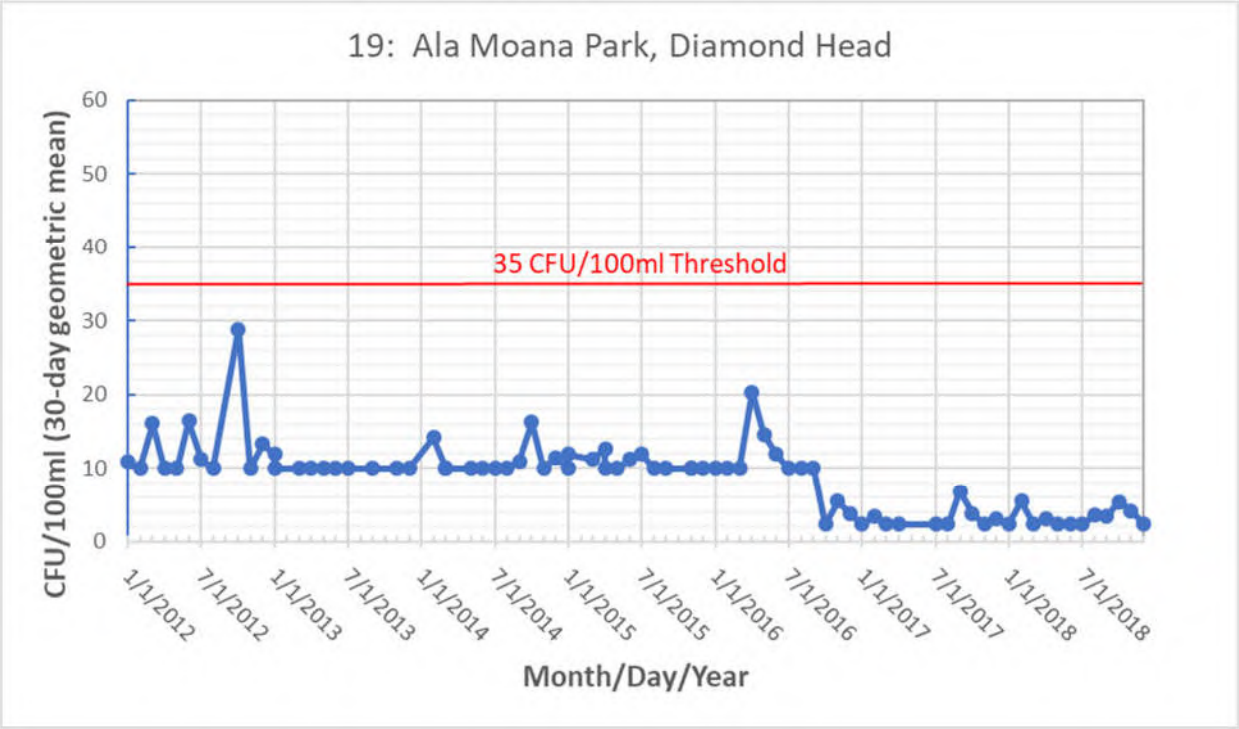


Figure 22 Ala Moana Park, Center

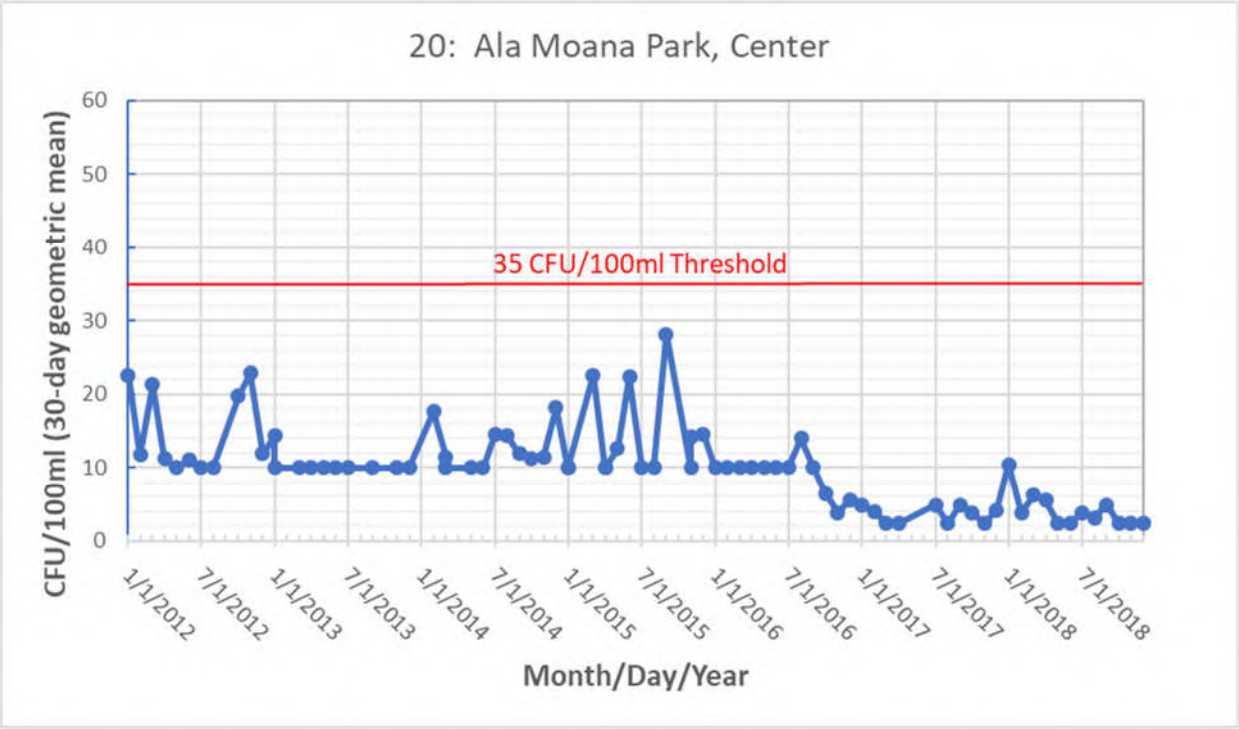


Figure 23 White Plains Beach

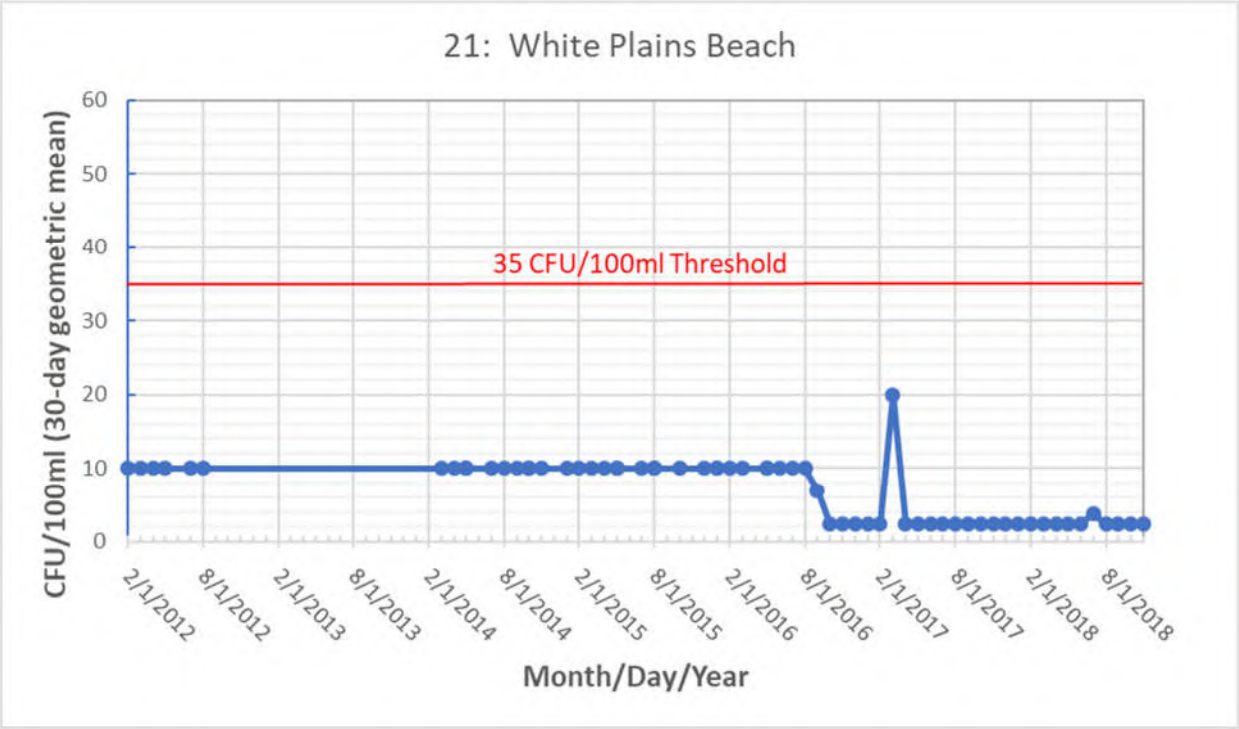


Figure 24 Ihilani-Kohola Lagoon

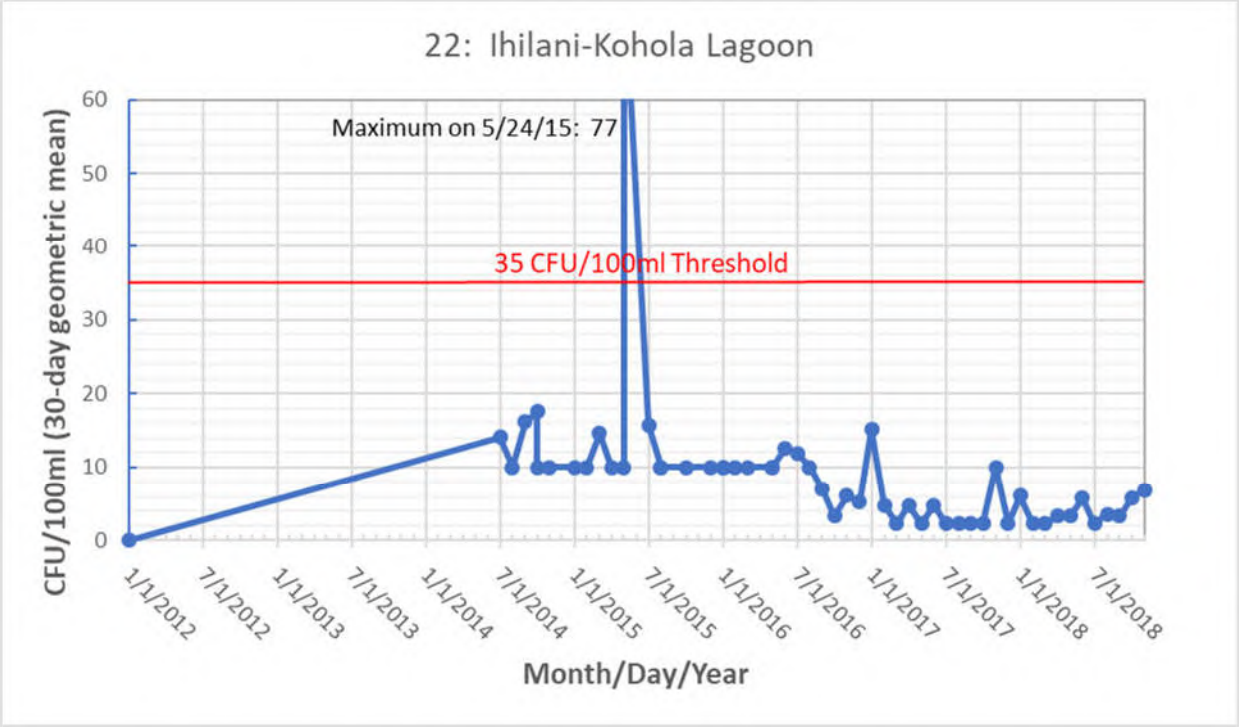


Figure 25 Nānākuli Beach Park

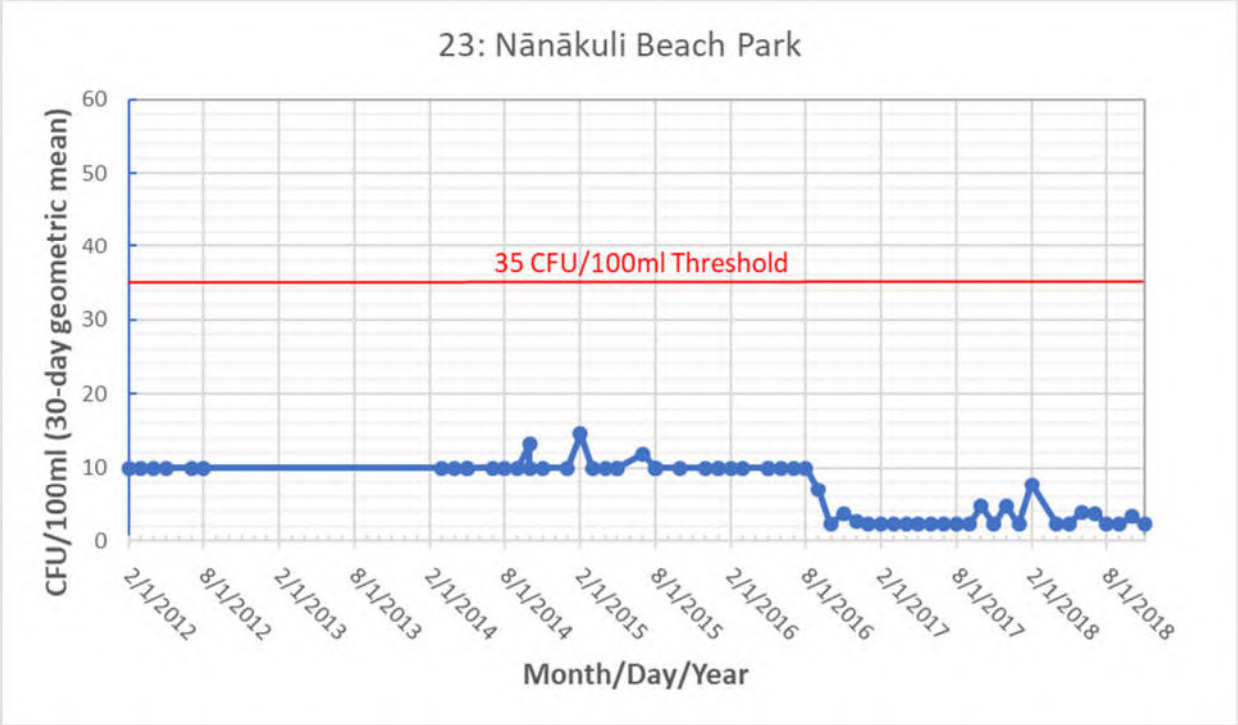


Figure 26 Mā'ili Beach Park

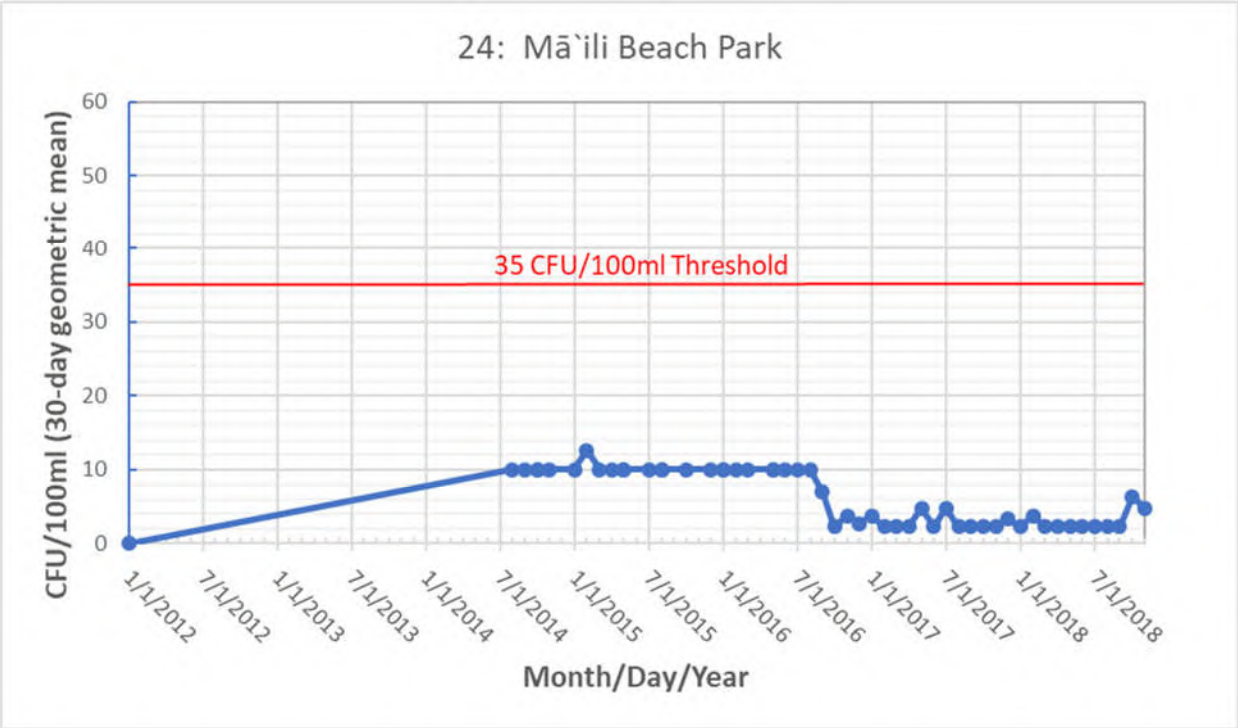


Figure 27 Pokai Bay

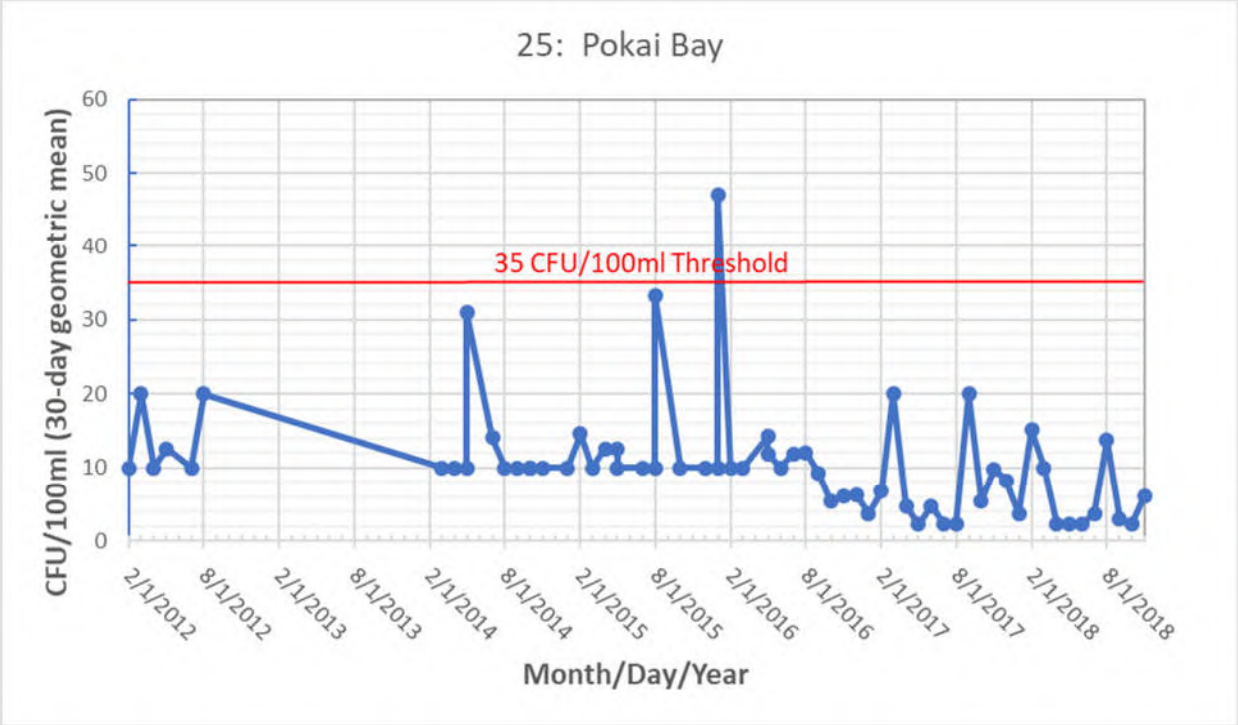
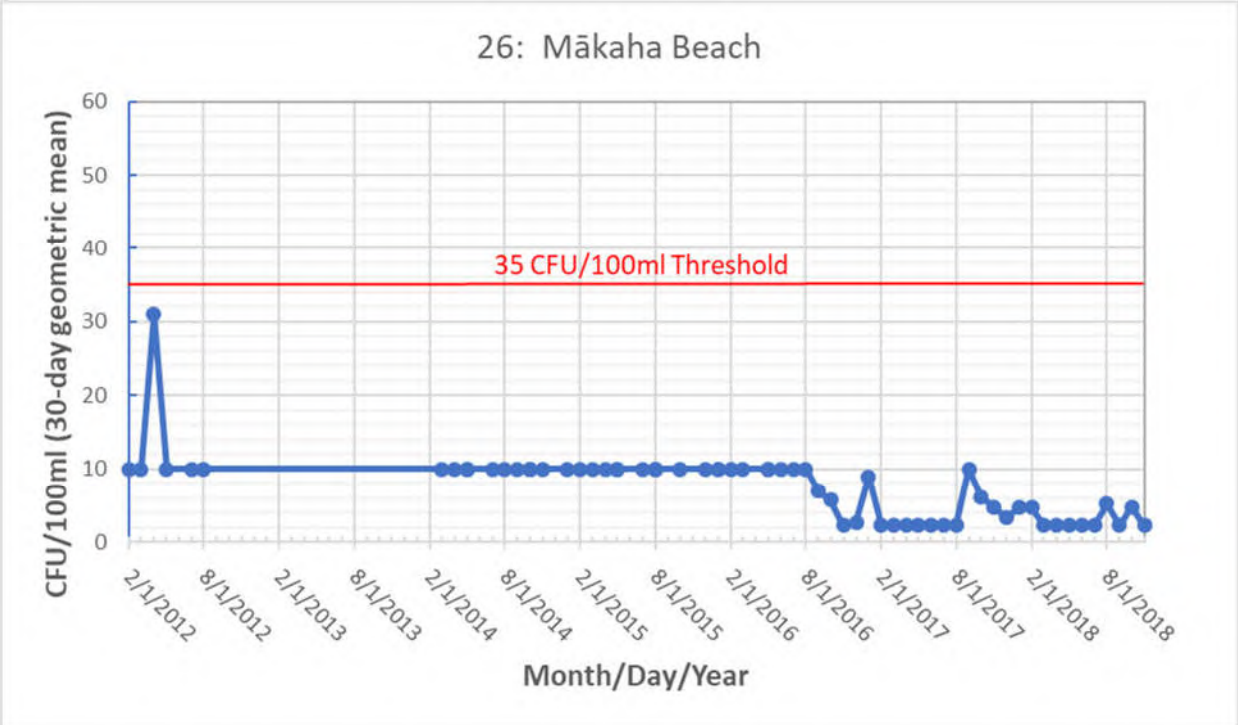


Figure 28 Mākaha Beach



Comparison with Inland Oʻahu Water Bodies

Bacterial contamination is not routinely reported publicly for most inland water bodies on Oʻahu. However, the State Clean Water Branch is required by the U.S. Environmental Protection Agency (EPA) to report annually on streams and estuaries that are known to be polluted. Specifically, the Clean Water Act requires all states annually to submit a list of waters that do not attain applicable state water quality standards and to describe the status of efforts underway to correct the situation, consistent with state regulations. The latest (2018) report from the State of Hawaiʻi can be obtained at the following link:

https://health.hawaii.gov/cwb/files/2018/09/Final-2018-State-of-Hawaii-Water-Quality-Monitoring-Assessment-Report.pdf

In this report, six Oʻahu streams and estuaries are listed as being contaminated by *Enterococci* bacteria, as defined by the standards described above:

1. Ahuimanu Stream,
2. Ala Wai Canal and Boat Harbor (multiple stations),
3. Kaelepulu Estuary (Enchanted Lakes),
4. Kahaluʻu Stream,
5. Waiahole Stream, and
6. Waiheʻe Stream

In addition, specific data on bacterial contamination are available for the Ala Wai Canal that were collected between 2006 and 2013 and reported in the Civil Beat website:

http://www.civilbeat.org/2013/05/19127-data-ala-wai-bacteria-levels-off-the-charts/

The plots of these data are reproduced below. Two plots are shown for each of the four sites surveyed, one that shows the extent of the high contamination levels found in the water and one that only extends to 500 CFU/100ml to show the approximate frequency that the levels exceed the "safe limit" of 33 CFU/100ml, which was changed after this survey to the current value of 35 CFU/100ml. As shown in these plots, the bacterial contamination commonly exceeds by orders of magnitude the 33 CFU/100 ml levels, and, at most or all of these locations, the levels are above this level more than they are below it.

Figure 29 Ala Wai Canal, McCully St. and Yacht Club (2006 – 2013)

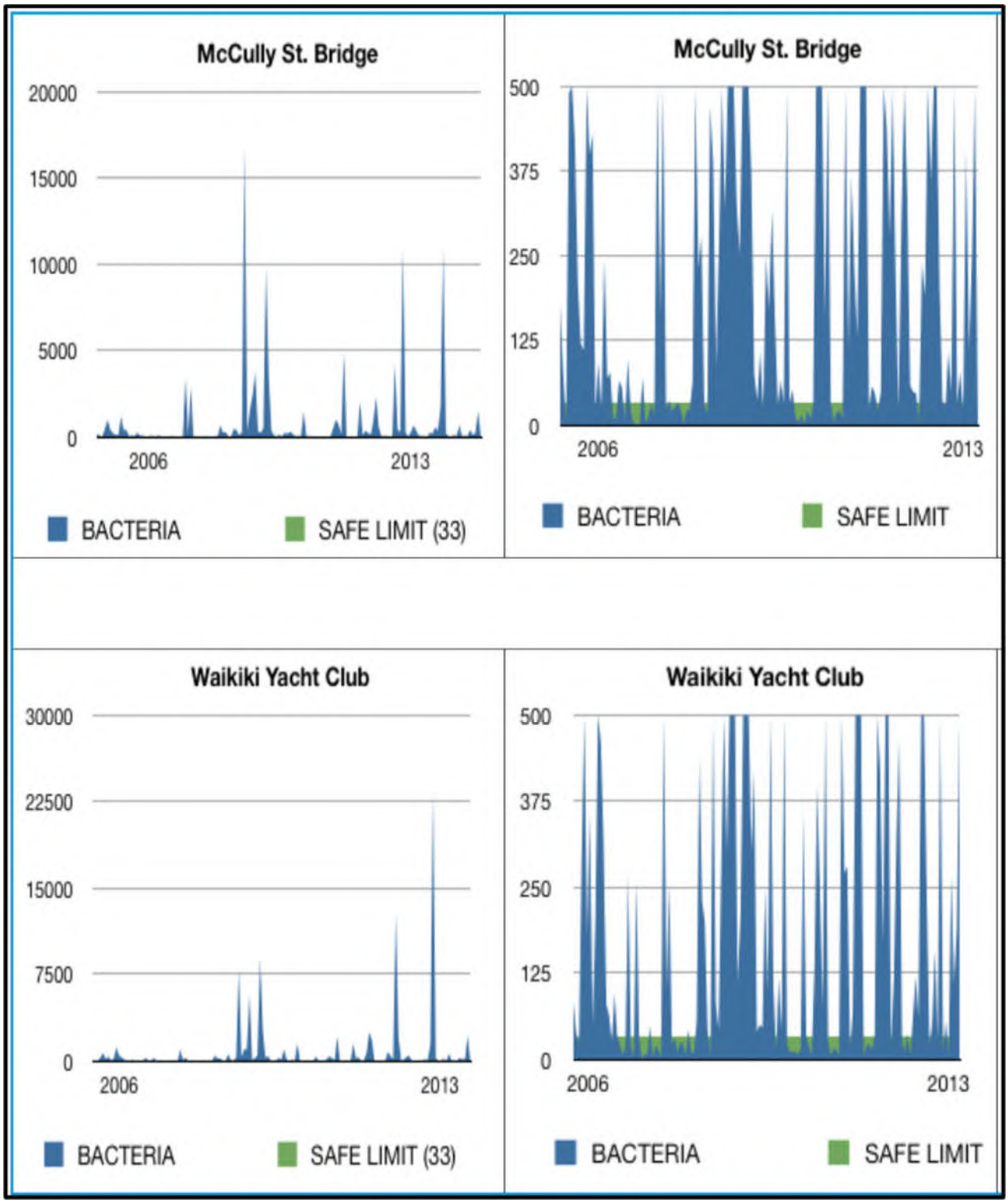


Figure 30 Ala Wai Canal, Kaiolu St. and Date St. (2006-2013)