

# NAWILIWILI STREAM, KALAPAKI BEACH User SURVEY



By VanNghi Vo  
Kaua'i Community College  
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## INTRODUCTION

Public health refers to the science and art of preventing disease, promoting health, and prolonging life through organized measures. A public health risk has been identified at the Nawiliwili Stream at Kalapaki Beach in Lihue. Enterococcus is a fecal-indicating bacteria from the gastro-intestinal tract of warm blooded animals. The most probable source is seepage from cesspools and septic systems in Nawiliwili's watershed. The bacteria can cause a slew of clinical infections including urinary tract infections. Surfrider Kauai's Blue Water Task Force has been measuring concentrations of enterococcus bacteria in Nawiliwili Stream since 06/28/2008 and, because of the chronically high values exceeding State standards, has established that there is a risk to the health of its visitors. In this study, people's usage of this area is quantified by taking an inventory of those in the stream, or on boards or canoes in the estuary. This shows the number of people who have direct exposure to the bacteria on a daily basis. By documenting extensive public exposure to the polluted waters, I hope the Hawaii Department of Health will post visible signs to warn visitors of the health risks involved.

## METHODOLOGY

A spreadsheet was filled out for every day of the week, to survey the number of people at Kalapaki Beach between the hours of 8:00am to 5:00pm during the winter of 2016 (11/9/16 – 1/29/16). Because exposure to bacteria from the stream varies dependent on contact, the visitor profile was divided into the 3 areas where activity predominated:

- River – (Nawiliwili Stream)

- Surf - which is adjacent to the river mouth

- Kalapaki Beach – to east of stream

The River visitors were distinguished between "Swimmers" (to include those walking through the river) and "Boarders" (typically children playing in the river on boards). Beach-goers were separated between those in contact with the water ("Swimmers"), and those on sand without water contact ("Sand"). Those in the Surf break were divided into "Swimmers," which included surfers and boogie-boarders; and "Boarders," which included stand-up boards, canoes, and boats. I took a count every fifteen minutes. Each day totaled 216 tallies (*e.g.* Appendix 1).

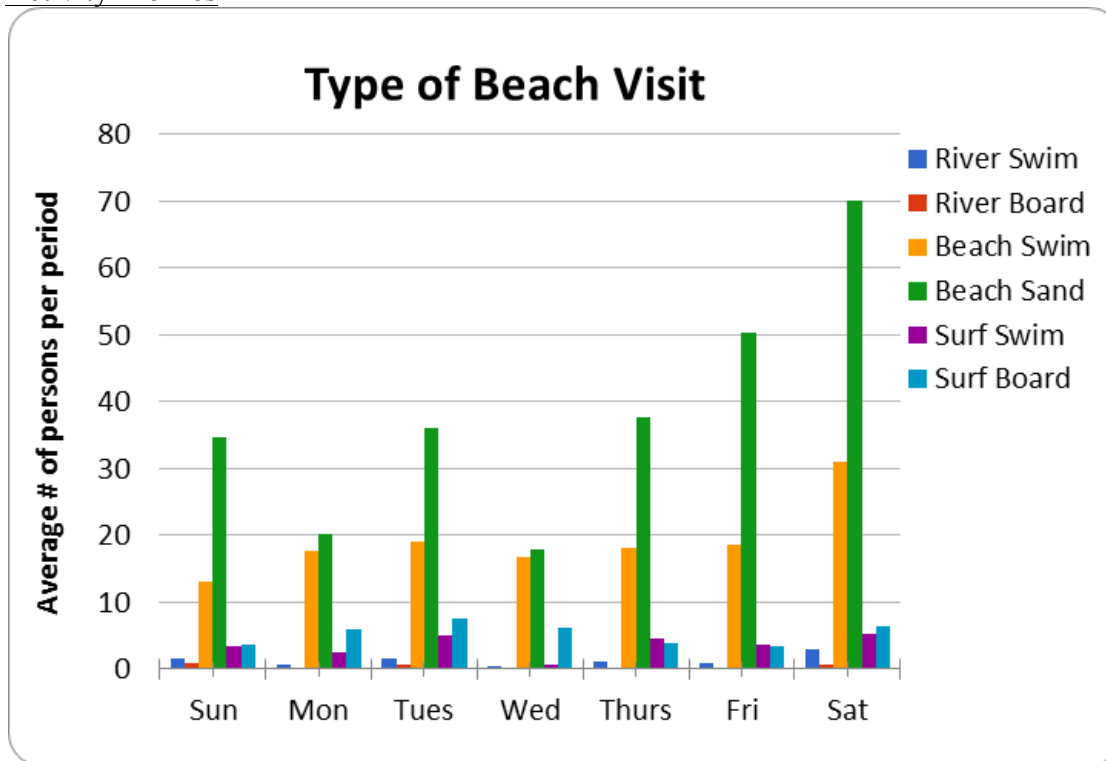
## RESULTS

A total of 17,128 people-observations were recorded during 252 observation periods per week, for an average of 2447 people-observations per day, or an average of 68 people per 15-minute period.

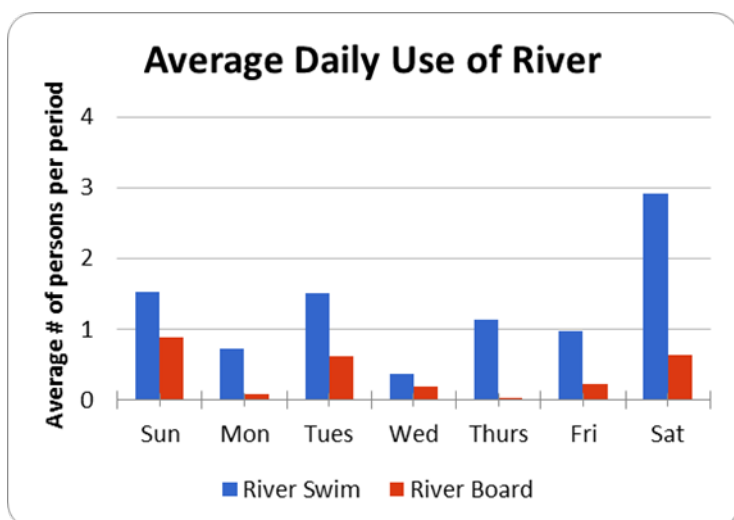
The geometric means of the fecal indicating bacteria Enterococcus counts for the three-month study period were 20.1 mpn/100 ml for the beach, 34.5 mpn/100 ml for the surf and 528.9 mpn/100 ml for the stream according to Hawaii Department of Health's data for the beach and Surfrider's BWTF data for the surf and for the stream. The Hawaii state standard is 35 mpn/100

ml, so the stream count is 15 times the standard. Eight years of BWTF data shows that the stream is chronically polluted.

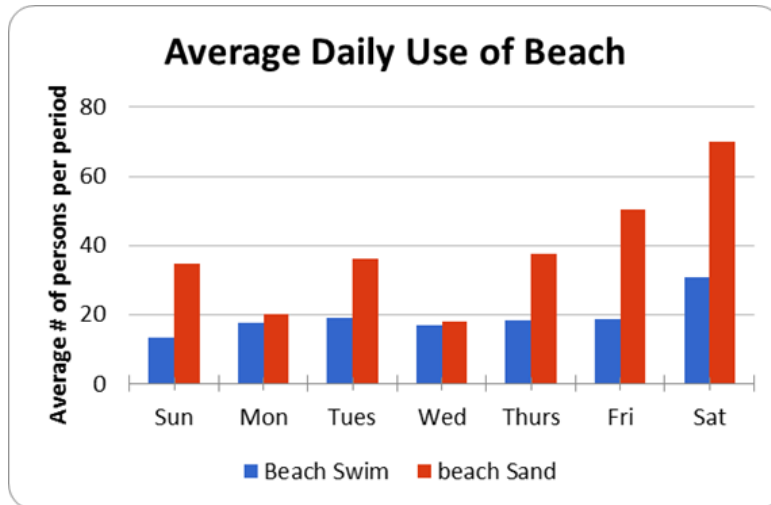
#### Activity Profiles



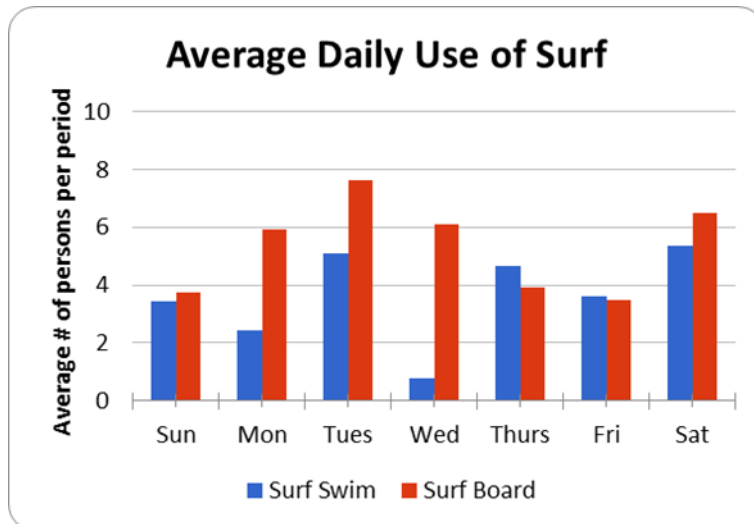
This figure shows that the most popular activities are at the Beach: on sand and in shallow beach waters. There were on average more people on the sand per observation period than there were people involved in any other activity, for every day of the week. The river mouth was the least populated area out of the three sections of the area surveyed.



As shown here more people were observed as swimming in the river per time period, as opposed to on a board.



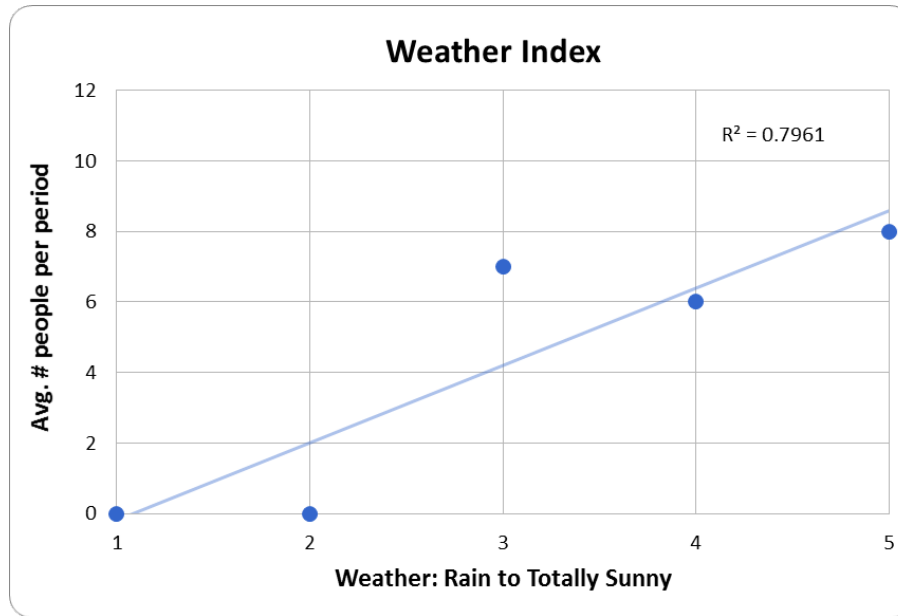
Most of the people were on the beach sand, but on Monday and Wednesday the observations per period were similar.



While out in the Surf people were observed equally in the water (surfing and boogie-boarding) or on boards (Stand-up paddling or in canoes, kayaks etc.).

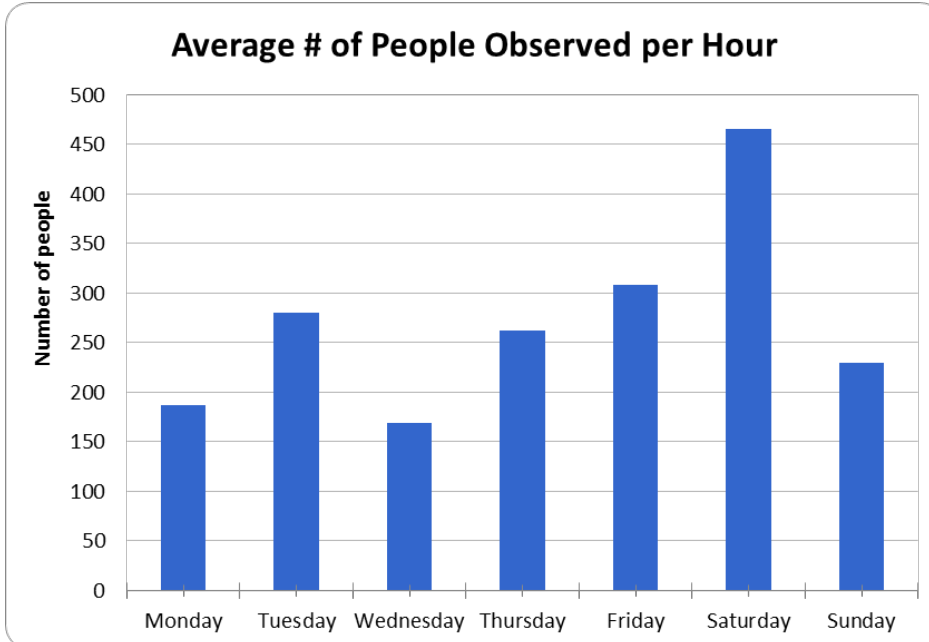
### Influence of Weather

As one would guess, clearer, sunny skies (#5) brought more beach goers than socked-in or rainy weather (#1) as shown in the following figure. It should be noted that not all days of the week had every type of weather. For instance, it never rained on Sunday while the survey was being conducted. This is reflected as “n/a” on the spreadsheet (Appendix 1).



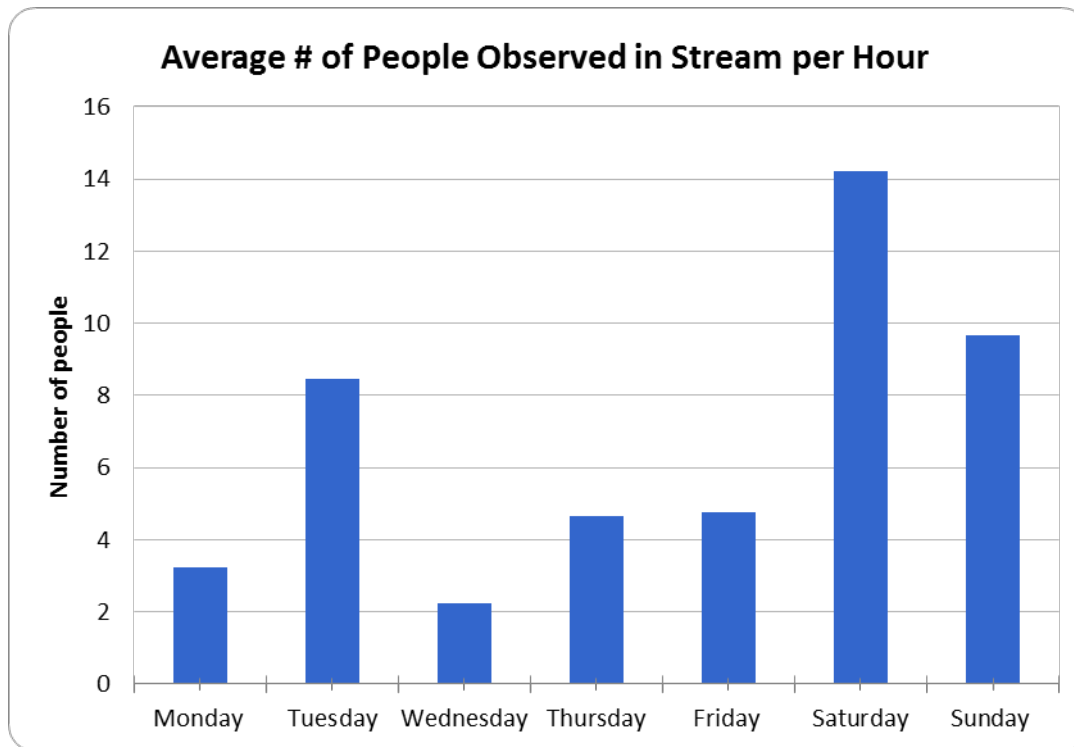
### Variation by Day of the Week

The average number of people observed per time period varied by day of the week, with Saturday as the busiest day, averaging 116 per 15-minute observation period. In winter cruise ships are in port and passengers come to the beach giving the overall use a boost on those days.



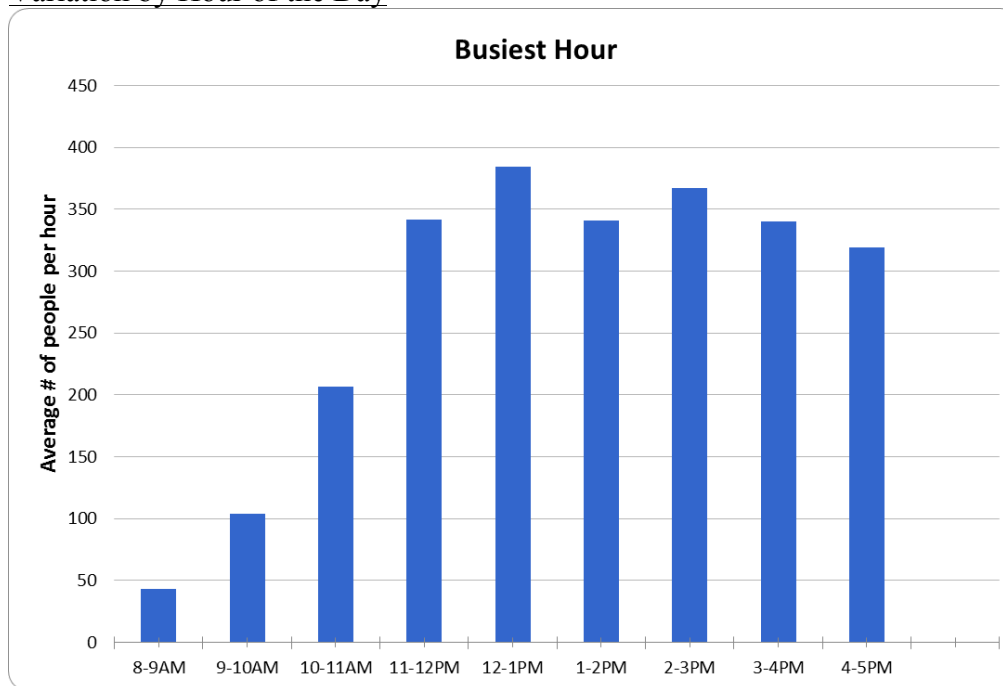
If just Nawiliwili Stream users are plotted as in the figure below, there

are also more users on the weekend.



The area is widely used by people living in Lihue area, hence more children playing in the stream on the weekend.

#### Variation by Hour of the Day



The number of observations increased over the course of the morning but varied little between 11 AM and 5 PM, with an average of 349 people-observations per hour. A mid-day dip

may be caused by beachgoers leaving for lunch. Children arrive in the afternoon, after school is out.

## CONCLUSION

Kalapaki beach itself appears to be populated mostly by tourists, and the surf and the Nawiliwili stream are seemingly dominated by locals. While tourists are recorded on the beach, many walk through Nawiliwili stream to get to shops or their cruise ship. Children, both local and tourists, play in the stream and in the waves at the stream mouth (Cover photo). On average, 6.7 people were observed in the stream per hour. The levels of fecal indicating bacteria in the stream were 15 times the geometric mean standard and exceeded the Statistical Threshold Value 100% of the time, indicating that it was polluted with fecal wastes. Thus all of the people in the stream water were probably exposed to a public health risk.

Area use varies during the course of the week and presumably by season. Local families, especially children, would tend to use the area more on weekends, except during school vacations when use by children would increase. The busier days also seem influenced by the number of cruise ships that dock at Nawiliwili Harbor, with Kalapaki the closest beach for cruise-ship patrons to visit. There are approximately six commercial cruise lines that visit Kaua'i regularly during the winter. The ships port throughout the week, with Tuesday, Thursday and Friday being the most common days of docking. This might explain Tuesday being one of the busier days during this winter survey. Regardless, there are on average 272 people observed in the area at any given hour. Many of these go in the water at least at some point, and a number stay for an hour or more.

The recreational use of Nawiliwili stream and adjacent waters is high enough, that combined with high fecal indicating bacteria counts greatly exceeding Hawaii state standards, there is significant public health risk to warrant the permanent posting of warning signs at the mouth of the stream.

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Project Mentor: Dr. Carl J. Berg, The Surfrider Foundation, Kauai Chapter, Blue Waster Task Force. All correspondence can be addressed to [cberg@pixi.com](mailto:cberg@pixi.com)

Appendix1. Sample tabulation sheet.

SUNDAY									
Weather	Time	Date	River	River	Beach	Beach	Surf	Surf	Hourly Total
			swim	board	swim	sand	swim	board	
2	8:00	1/24/2016	0	1	0	5	0	1	
2	:15	1/24/2016	0	0	1	8	0	1	
3	:30	1/24/2016	0	0	1	8	0	1	
3	:45	1/24/2016	0	0	1	10	0	1	39
3	9:00	1/24/2016	1	0	0	9	0	1	
3	:15	1/24/2016	0	0	3	13	0	0	
3	:30	1/24/2016	0	0	1	13	2	0	
4	:45	1/24/2016	0	0	1	19	1	0	64
4	10:00	1/24/2016	1	0	3	10	1	0	
4	:15	1/24/2016	0	1	2	8	2	0	
4	:30	1/24/2016	0	0	6	17	3	0	
4	:45	1/24/2016	0	0	6	21	5	0	86
4	11:00	1/24/2016	0	0	11	30	4	1	
4	:15	1/24/2016	0	0	8	33	6	1	
4	:30	1/24/2016	3	2	11	31	4	2	
4	:45	1/24/2016	0	1	21	35	4	0	208
4	12:00	1/24/2016	0	0	26	32	5	0	
4	:15	1/24/2016	3	0	18	43	0	4	
4	:30	1/24/2016	4	2	21	46	0	4	
4	:45	1/24/2016	3	4	21	48	1	2	287
4	13:00	1/24/2016	5	3	14	49	1	2	
5	:15	1/24/2016	3	2	17	45	3	2	
5	:30	1/24/2016	3	1	20	50	4	2	
5	:45	1/24/2016	0	1	14	48	6	2	297
5	14:00	1/24/2016	1	2	15	55	4	5	
5	:15	1/24/2016	2	2	18	59	1	10	
5	:30	1/24/2016	2	2	17	49	1	11	
5	:45	1/24/2016	3	1	26	67	6	12	371
5	15:00	1/24/2016	3	1	31	64	8	12	
3	:15	1/24/2016	3	2	24	61	7	13	
3	:30	1/24/2016	6	1	22	48	10	12	
3	:45	1/24/2016	3	1	17	40	10	9	408
3	16:00	1/24/2016	2	0	27	39	11	7	
3	:15	1/24/2016	2	0	22	41	6	6	
3	:30	1/24/2016	2	2	15	46	3	5	
3	:45	1/24/2016	0	0	14	49	5	5	309
Total			55	32	475	1249	124	134	2069
Average			2	1	13	35	3	4	
			Swim means in the water, also with boggie board						
			Board means surfboard, standup board, canoe, boat						