State of Hawaii
Annual Summary
2021
Air Quality Data

Lahaina, Maui, Hawaii

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Section 1
INTRODUCTION

The Department of Health, Clean Air Branch, monitors the ambient air in the State of Hawaii for various gaseous and particulate air pollutants. The U.S. Environmental Protection Agency (EPA) has set national ambient air quality standards (NAAQS) for six criteria pollutants: carbon monoxide, nitrogen dioxide, sulfur dioxide, lead, ozone, and particulate matter (PM_{10} and $PM_{2.5}$). Hawaii has also established a state ambient air standard for hydrogen sulfide. The primary purpose of the statewide monitoring network is to measure ambient air concentrations of these pollutants and ensure that these air quality standards are met. During 2021, the stations were initially maintained and the data collected by the Air Quality Monitoring Section of the State Laboratories Division. Those responsibilities were assumed by the Clean Air Brach towards the end of the year.

In addition to monitoring the ambient air for criteria pollutants, the State of Hawaii also participates in the NCore multi pollutant monitoring network; the NCore station in Hawaii is located at the Kapolei monitoring station. The NCore network addresses the following objectives:

- Timely reporting of data to public by supporting AIRNow, air quality forecasting, and other public reporting mechanisms;
- Support for development of emission strategies through air quality model evaluation and other observational methods;
- Accountability of emission strategy progress through tracking long-term trends of criteria and non-criteria pollutants and their precursors;
- Support for long-term health assessments that contribute to ongoing reviews of the NAAQS;
- Compliance through establishing nonattainment/attainment areas through comparison with the NAAQS;
- Support to scientific studies ranging across technological, health, and atmospheric process disciplines;
- Support to ecosystem assessments recognizing that national air quality networks benefit ecosystem assessments and, in turn, benefit from data specifically designed to address ecosystem analyses; and
- $PM_{2.5}$ speciation monitoring that EPA determined to be essential for establishing a relationship between particle concentrations and adverse health effects and would provide valuable information in characterizing aerosols, determining the effectiveness of control strategies, and understanding the effects of particle pollution on atmospheric and regional haze.

Air pollution is caused by many different man-made and natural sources. There are industrial sources of pollution, such as power plants and refineries; mobile sources, such as cars, trucks, and buses; agricultural sources, such as agricultural burning; and natural sources, such as windblown dust and volcanic activity. In 2021, for the most part, the state maintained 20 air monitoring stations on 4 islands. Most commercial, industrial, and

transportation activities and their associated air quality effects occur on Oahu, where 6 of the stations are located. The monitoring stations on Maui measure the air quality impacts from commercial, industrial, transportation and agricultural activities. The majority of stations are located on the island of Hawaii to measure air quality impacts from the volcano and geothermal energy production. The monitoring station on Kauai is mainly to measure the air quality impacts from cruise ships. The state's ambient air monitoring network is reviewed annually and relocations, additions and/or discontinuations can occur in the future as the need arises.

This report summarizes the validated air pollutant data collected at the 20 monitoring stations during calendar year 2021. Tabular summaries are provided which compare the measured concentrations of criteria pollutants with federal ambient air quality standards and of hydrogen sulfide with the state standard. The 2021 speciation data is also included in this report. Trend summaries of criteria pollutants parameters are shown graphically.

The Department of Health has a web site that displays near real-time air quality data updated throughout the day from the air monitoring stations. The data has not been reviewed for quality assurance and is subject to change but provides the public with viewing access to current air pollutant and meteorological information. To view this data online, go to http://health.hawaii.gov/cab and link to "Hawaii Ambient Air Quality Data."

Additionally, because emissions from the Kilauea volcano may affect communities on the island of Hawaii on a daily basis, the Department of Health has a webpage dedicated to displaying short term SO_2 data from stations located on the island. It provides near real-time 15-minute SO_2 averages and advisory level guidance to help individuals protect themselves against possible health effects. To view this data online, go to https://air.doh.hawaii.gov/home/text/118.

To view this entire book as well as books from 2016 through 2020 online, go to: http://health.hawaii.gov/cab and link to "Hawaii Air Quality Data Book."

Questions or comments regarding data in this report and other air quality information should be addressed to:

Clean Air Branch
Department of Health
2827 Waimano Home Road #130
Pearl City, HI, 96782

Phone: (808)586-4200
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The Department of Health provides access to its programs and activities without regard to race, color, national origin (including language), age, sex, religion, or disability. Write our Affirmative Action Officer at P.O. Box 3378, Honolulu, Hawaii 96801-3378, or call (808)586-4616 (voice) within 180 days of a problem.

Section 2
DEFINITIONS

98th Percentile Value	The $PM_{2.5}$ 24-hour average or the maximum daily 1-hour NO_2 average in the year below which 98% of all values fall.
99th Percentile Value	The maximum daily 1-hour SO_2 value in the year below which 99% of all values fall.
Ambient Air	The general outdoor atmosphere, external to buildings, to which the general public has access.
Ambient Air Quality Standard	A limit in the quantity and exposure to pollutants dispersed or suspended in the ambient air. Primary standards are set to protect public health, including sensitive populations such as asthmatics, children, and the elderly. Secondary standards are set to protect public welfare including protection against visibility degradation, and damage to animals, crops, vegetation and buildings.
Carbon Monoxide	Carbon monoxide (CO) is a colorless, odorless, tasteless gas under atmospheric conditions. It is produced by the incomplete combustion of carbon fuels with the majority of emissions coming from transportation sources.
CFR	Code of Federal Regulations is the codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the Federal government. Title 40 is the Protection of the Environment.
Collocated	This is a procedure required for a certain percentage of PM_{10} and $PM_{2.5}$ samplers in the monitoring network. Collocated samplers determine precision or variation in the PM_{10} or $PM_{2.5}$ concentration measurements of identical samplers run in the same location under the same sampling conditions.
Criteria Pollutants	These are the six pollutants for which the EPA has established national air quality standards. The pollutants are ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, lead and particulate matter (PM_{10} and $PM_{2.5}$).
DRR	Data Requirements Rule for 1-hour SO_2 NAAQS.

EPA	The U.S. Environmental Protection Agency; established to protect human health and the natural environment.
Hydrogen Sulfide	Hydrogen sulfide (H_2S) is a toxic, colorless gas with a characteristic “rotten egg” odor detectable at very low levels. It occurs naturally during the decomposition of organic matter, near geothermal sources and is also produced during certain industrial processes, including wastewater treatment facilities.
Micron	One micron is one millionth of a meter or approximately 1/25,000 of an inch.
$\mu g/m^3$	Micrograms per cubic meter. This is the measurement of air quality expressed as mass per unit volume.
NAAQS	National Ambient Air Quality Standards. These are pollutant standards that the EPA has established to protect public health and welfare. NAAQS have been set for carbon monoxide, nitrogen dioxide, PM_{10}, $PM_{2.5}$, ozone, sulfur dioxide, and lead. These are commonly referred to as criteria pollutants.
NCore	A multi-pollutant network that integrates several advanced measurement systems for particles, pollutant gases and meteorology. Most NCore stations have been operating since the formal start of the network on January 1, 2011, including Hawaii’s.
Nitrogen Dioxide	Nitrogen dioxide (NO_2) is a brownish, highly corrosive gas with a pungent odor. It is formed in the atmosphere from emissions of nitrogen oxides (NO_x). Sources of nitrogen oxides include electric utilities, industrial boilers, motor vehicle exhaust and combustion of fossil fuels. NO_2 is also a component in the atmospheric reaction that produces ground-level ozone.
Ozone	Ozone (O_3) is the main constituent in photochemical air pollution. It is formed in the atmosphere by a chemical reaction of nitrogen oxides (NO_x) and volatile organic compounds (VOCs) in the presence of sunlight. In the upper atmosphere, O_3 shields the earth from harmful ultraviolet radiation; however, at ground level, it can cause harmful effects in humans and plants.

Particulate Matter	This refers to any solid or liquid matter dispersed in the air. Particulate matter (PM) includes dust, soot, smoke, and liquid droplets from sources such as factories, power plants, motor vehicles, construction, agricultural activities, and fires.
PM_{10}	Particulate matter that is 10 microns or less in aerodynamic diameter. These are considered “coarse” particles, generally from sources such as road and windblown dust, and crushing and grinding operations.
$PM_{2.5}$	Particulate matter that is 2.5 microns or less in aerodynamic diameter. Considered “fine” particles, these are generally a result of fuel combustion such as from motor vehicles, utility generation and industrial facilities. Fine particles can also be formed when gases, such as sulfur dioxide and nitrogen dioxide, are chemically transformed into particles.
ppm	Parts per million is one particle in 1,000,000 other particles. It is approximately one drop in 13 gallons.
SLAMS	State and Local Air Monitoring Stations. The Clean Air Act requires that every state establish a network of air monitoring stations for criteria pollutants.
SPM	Special Purpose Monitoring stations. These are stations established to provide data for special studies in support of air program interests and activities. SPM stations supplement the SLAMS network as special circumstances require and adequate resources permit.
Sulfur Dioxide	Sulfur dioxide (SO_2) is a colorless gas that easily combines with water vapor forming sulfuric acid. Emissions of sulfur dioxide are largely from sources that burn fossil fuels such as coal and oil. In Hawaii, another possible major source of sulfur dioxide emissions is from any active eruption of Kilauea Volcano on the Big Island.
Vog	Vog is a local term used to express volcanic smog. Vog occurs when volcanic gas and particles combine with air and sunlight to produce atmospheric haze.

Table 2-1 **State and Federal Ambient Air Quality Standards**

Sources: State standards HAR §11-59; Federal standards 40 CFR Part 50

Air Pollutant	Averaging Time	Standards		
		Hawaii State Standard	Federal Primary Standard [a]	Federal Secondary Standard [b]
Carbon Monoxide (CO)	1-hour 8-hour	9 ppm 4.4 ppm	35 ppm 9 ppm	None
Nitrogen Dioxide (NO_2)	1-hour Annual	--- 0.04 ppm	100 ppb 53 ppb	--- 0.053 ppm
PM_{10}	24-hour Annual [c]	150 µg/m^3 50 µg/m^3	150 µg/m^3 ---	--- ---
$PM_{2.5}$	24-hour Annual	---	35 µg/m^3 12 µg/m^3	35 µg/m^3 15 µg/m^3
Ozone (O_3)	8-hour	0.08 ppm	0.070 ppm	0.070 ppm
Sulfur Dioxide (SO_2)	1-hour 3-hour 24-hour Annual	--- 0.5 ppm 0.14 ppm 0.03 ppm	75 ppb --- --- ---	--- 0.5 ppm --- ---
Lead (Pb)	Rolling 3-month	1.5 µg/m^3 [d]	0.15 µg/m^3	0.15 µg/m^3
Hydrogen Sulfide	1-hour	25 ppb	None	None

[a] ***Primary Standards*** set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children and the elderly.

[b] ***Secondary Standards*** set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

[c] Due to a lack of evidence linking health problems to long-term exposure to coarse particle pollution, EPA revoked the annual PM_{10} standard effective December 17, 2006. However, the state still has an annual standard.

[d] The state standard is based on calendar quarter.

Compliance with the National Ambient Air Quality Standards

CO 1-hour: May not be exceeded more than once per year.

CO 8-hour: May not be exceeded more than once per year.

NO_2 1-hour: The 3-year average of the 98th percentile daily maximum 1-hour averages must not exceed the standard.

NO_2 Annual: Average of all 1-hour values in the year may not exceed the level of the standard.

PM_{10} 24-hour: Must not be exceeded more than one day per year, after compensating for days when monitoring did not occur (estimated number of exceedances).

$PM_{2.5}$ 24-hour: The 3-year average of the 98th percentile 24-hour concentrations must not exceed the level of the standard.

$PM_{2.5}$ Annual: The 3-year average of 24-hour values must not exceed the level of the standard.

Ozone 8-hour: The 3-year average of the fourth highest daily maximum value must not exceed the level of the standard.

SO_2 1-hour: The 3-year average of the 99th percentile daily maximum 1-hour averages must not exceed the standard.

SO_2 3-hour: Not be exceeded more than once per year.

Lead: Average of all 24-hour values in any rolling 3-month period may not exceed the level of the standard.

Section 3
SITE LOCATIONS AND DESCRIPTIONS

Figure 3-1: Island of Oahu – Air Monitoring Stations

Station	Name	Location	Pollutants/Parameters Monitored
1	Honolulu	1250 Punchbowl St.	CO, SO_2, $PM_{2.5}$, PM_{10}
2	Sand Island	1039 Sand Island Pkwy.	O_3, $PM_{2.5}$
3	Pearl City	860 4th St.	$PM_{2.5}$, PM_{10}
4	Kapolei / NCore	2052 Lauwiliwili St.	CO, SO_2, NO_2 / CO $_{trace}$, $SO_{2\ trace}$, NO/NO_y, O_3, $PM_{2.5}$, $PM_{2.5}$ speciation, PM_{10}, $PM_{10-2.5}$, WS/WD
5	Kahe	Palehua Road	SO_2
6	Waiau	689 Kamehameha Hwy.	SO_2

The following station descriptions include latitude and longitude in decimal degrees and altitude in meters above mean sea level.

Honolulu (DH)		
	Location:	1250 Punchbowl St., Honolulu
	Latitude:	21.30758
	Longitude:	-157.85542
	Altitude:	20 m
	Parameters:	SO_2, CO, PM_{10}, $PM_{2.5}$
	Established:	February 1971
	Brief Description:	
	Located in downtown Honolulu on the roof of the Department of Health building, across from the Queen's Medical Center, in a busy commercial, business and government district.	

Kapolei (KA)		
	Location:	2052 Lauwiliwili St., Kapolei
	Latitude:	21.32374
	Longitude:	-158.08861
	Altitude:	17.9 m
	Parameters:	SO_2, CO, NO_2, PM_{10}, $PM_{2.5}$, $PM_{2.5}$ speciation, NCore
	Established:	July 2002
	Brief Description:	
	Located in Kapolei Business Park, southeast of Kapolei Fire Station, next to a drainage canal that separates the park from Barber's Point. Approximately 1.5 miles from Malakole Street in Campbell Industrial Park.	

Pearl City (PC)		
	Location:	860 4th St., Pearl City
	Latitude:	21.39283
	Longitude:	-157.96913
	Altitude:	23.1 m
	Parameters:	PM_{10}, $PM_{2.5}$
	Established:	May 1979
	Brief Description:	
	Located on the roof of the Leeward Health Center in a commercial, residential and light industrial area approximately 1.5 miles northwest of the Waiau power plant and near the Pearl Harbor Naval Complex.	

Sand Island (SI)

Location:	1039 Sand Island Pkwy., Honolulu
Latitude:	21.30384
Longitude:	-157.87117
Altitude:	5.3 m
Parameters:	O_3, $PM_{2.5}$
Established:	February 1981

Brief Description:

Located in a light industrial, commercial and recreational area approximately two miles downwind of downtown Honolulu near the entrance to the Sand Island State Recreation Area.

Kahe (KE) (Data Requirements Rule)

Location:	Palehua Road, Makakilo
Latitude:	21.3678
Longitude:	-158.103
Altitude:	388 m
Parameters:	SO_2
Established:	January 2017

Brief Description:

Located on the hillside south of Palehua Road, approximately 2.7 kilometers northeast of the Kahe Generating Station. The area around the station is undeveloped and is currently used for cattle grazing. The city of Makakilo is located to the east and southeast. The areas immediately to the west through north are undeveloped.

Waiau (WI) (Data Requirements Rule)

Location:	689 Kamehameha Hwy., Pearl City
Latitude:	21.3909
Longitude:	-157.9653
Altitude:	7 m
Parameters:	SO_2
Established:	January 2017

Brief Description:

Located in an urban area approximately 400 meters northwest of the Waiau Power Generating Station in Pearl City, Oahu. The station is surrounded by a residential area to the north, the H-1 Freeway from the east to southwest and the business district to the west.

Figure 3-2: Island of Maui – Air Monitoring Stations

Station		Name	Location	Pollutants Monitored
1		Kihei	Hale Piilani Park	$PM_{2.5}$
2		Kahului	TMK (2)-3-8-007-153	$PM_{2.5}$

Kihei (KH)		
	Location:	Hale Piilani Park, Kihei
	Latitude:	20.780997
	Longitude:	-156.44637
	Altitude:	46.5 m
	Parameters:	$PM_{2.5}$
	Established:	February 1999
	Brief Description:	
	Located in a residential community park, next to a recent residential development on what was once agricultural land.	

Kahului (KL)		
	Location:	TMK (2)-3—8-007-153, Kahului
	Latitude:	20.869444
	Longitude:	-156.492417
	Altitude:	55.5 m
	Parameters:	$PM_{2.5}$
	Established:	January 2016
	Brief Description:	
	Located within a fenced area off of Mauilani Parkway, TMK 2-3-8-007-153. The area is surrounded primarily by residential land.	

Figure 3-3: Island of Hawaii – Air Monitoring Stations

Station	Name	Location	Pollutants Monitored
1	Hilo	1099 Waianuenue Ave.	SO_2, $PM_{2.5}$
2	Keeau	16-714 Volcano Rd.	SO_2, $PM_{2.5}$
3	Mountain View	18-1235 Volcano Rd.	SO_2, $PM_{2.5}$
4	Leilani	13-3441 Moku St.	H_2S, SO_2
5	Pahala	96-3150 Pikake St.	SO_2, $PM_{2.5}$
6	Naalehu-TP/S (temporary)	Naalehu Fire Station/Elem. School	SO_2, $PM_{2.5}$
7	Ocean View	92-6091 Orchid Mauka Circ.	SO_2, $PM_{2.5}$
8	Honaunau (temporary)	DWS Keei Well C, Painted Church Rd.	$PM_{2.5}$
9	Kona	81-1043 Konawaena School Rd.	SO_2, $PM_{2.5}$
10	Kailua-Kona	DWS Puapua'a Reservoir	$PM_{2.5}$
11	Waikoloa	TMK 3-6-8-002-019	$PM_{2.5}$

Hilo (HL)

Location:	1099 Waianuenue Ave., Hilo
Latitude:	19.71756
Longitude:	-155.11053
Altitude:	136.8 m
Parameters:	SO_2, $PM_{2.5}$
Established:	January 1997
Brief Description:	
Located near the Hilo Medical Center, this station was established to monitor vog during “Kona” or southerly wind conditions.	

Kona (KN)

Location:	81-1043 Konawaena School Rd., Kona
Latitude:	19.50978
Longitude:	-155.91342
Altitude:	517.2 m
Parameters:	SO_2, $PM_{2.5}$
Established:	September 2005
Brief Description:	
Located on the upper campus of Konawaena High School, this station monitors for vog on the west side of the island of Hawaii.	

Mt. View (MV)

Location:	18-1235 Volcano Rd., Mt. View
Latitude:	19.57002
Longitude:	-155.08046
Altitude:	436.5 m
Parameters:	SO_2, $PM_{2.5}$
Established:	December 2010
Brief Description:	
Located on the grounds of the Mt. View Elementary School, this station was established to monitor vog during southerly wind conditions.	

Ocean View (OV)

Location:	92-6091 Orchid Mauka Circle, Ocean View
Latitude:	19.11756
Longitude:	-155.77814
Altitude:	862.6 m
Parameters:	SO_2, $PM_{2.5}$
Established:	April 2010
Brief Description:	
This station is located in Hawaii Ocean View Estates at the Ocean View Fire Station and monitors for volcanic emissions.	

Pahala (PA)

Location:	96-3150 Pikake St., Pahala
Latitude:	19.2039
Longitude:	-155.48018
Altitude:	320 m
Parameters:	SO_2, $PM_{2.5}$
Established:	August 2007
Brief Description:	
The station is on the grounds of the Kau High and Pahala Elementary School, monitoring for volcanic emissions.	

Honaunau – Temporary (HN)

Location:	DWS Keei Well C, Painted Church Rd., Honaunau
Latitude:	19.44276389
Longitude:	-155.88583333
Altitude:	274 m
Parameters:	$PM_{2.5}$
Established:	August 2018
Brief Description:	
This temporary station is located in a residential subdivision within a fenced area that contains a Hawaii County Department of Water Supply water tank and pump house, monitoring for volcanic emissions.	

KAILUA-KONA (KK)

Location:	DWS Puapua'a Reservoir, Kailua-Kona
Latitude:	19.61815833
Longitude:	-155. 9711111
Altitude:	92.4 m
Parameters:	$PM_{2.5}$
Established:	November 2018
Brief Description:	
This station is located in the middle Kailua-Kona town within a fenced area that contains a County of Hawaii water reservoir and pump house, monitoring for volcanic emissions.	

KEEAU (KS)

Location:	Kamehameha Schools,16-714 Volcano Road, Keaau, HI 96749
Latitude:	19.60533889
Longitude:	-155.05138889
Altitude:	179.8 m
Parameters:	$PM_{2.5}$, SO_2
Established:	June 2018
Brief Description:	
This temporary station is located in the town of Keaau on the Kamehameha Schools Hawaii campus, monitoring for volcanic emissions during southerly wind conditions.	

Leilani (LE)

Location:	13-3441 Moku St., Pahoa
Latitude:	19.46555556
Longitude:	-154.91583333
Altitude:	229 m
Parameters:	H_2S, SO_2
Established:	September 2019
Brief Description:	
This station is located in a residential subdivision within a fenced area that contains the Leilani Community Association Center, monitoring emissions from the nearby geothermal energy facility.	

Naalehu – Temporary $PM_{2.5}$ (NA-TP)

Location:	Naalehu Volunteer Fire Station, Kaalaiki Road., Naalehu
Latitude:	19.061379
Longitude:	-155.586748
Altitude:	207.9 m
Parameters:	$PM_{2.5}$
Established:	June 2018
Brief Description:	
This temporary station is located at the Naalehu Volunteer Fire Station monitoring for volcanic emissions.	

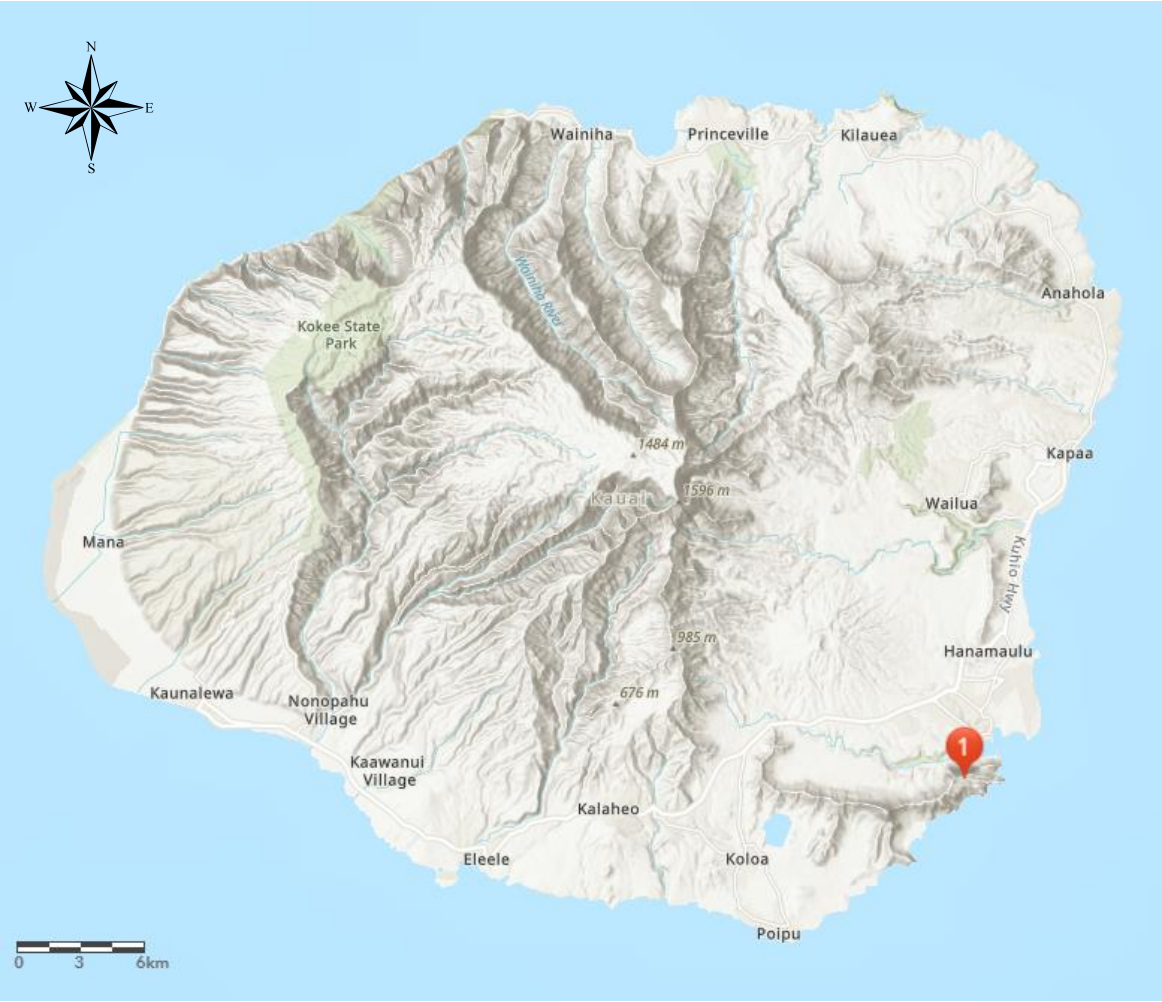
Naalehu – SO_2 (NA-S)

Location:	Naalehu Elementary School, 95-5547 Mamalahoa Hwy., Naalehu
Latitude:	19.060656
Longitude:	-155.579167
Altitude:	196.3 m
Parameters:	SO_2
Established:	August 2018
Brief Description:	
This station is located i inside the USGS Seismograph building on the campus of Naalehu Elementary School, monitoring for volcanic emissions.	

Waikoloa (WL)

Location:	TMK 3-6-8-002-019, Waikoloa
Latitude:	19.977500
Longitude:	-155.798056
Altitude:	182.9 m
Parameters:	$PM_{2.5}$
Established:	July 2021
Brief Description:	
This temporary station is located within a fenced area that contains a County of Hawaii water tank and pump house, approximately 3 km northeast of Waikoloa, monitoring for volcanic emissions.	

Figure 3-4: Island of Kauai – Air Monitoring Station



Station	Name	Location	Pollutants Monitored
1	Niumalu	2342 Hulemalu Road	SO_2, NO_2, $PM_{2.5}$

Niumalu (NI)		
	Location:	2342 Hulemalu Road, Lihue
	Latitude:	21.9495
	Longitude:	-159.365
	Altitude:	11 m
	Parameters:	SO_2, NO_2, $PM_{2.5}$
	Established:	April 2011
	Brief Description:	
	Located in the Niumalu residential subdivision, this station monitors for emissions from the cruise ships in Nawiliwili Harbor approximately 1.0 mile upwind.	

Table 3-1 **State of Hawaii Ambient Air Monitoring Network**

	Pollutants Monitored and Station Type								
SITE	**PM_{10}**	**$PM_{2.5}$**	**CO**	**O_3**	**SO_2**	**NO_2**	**H_2S**	**MONITORING OBJECTIVE**	**LOCATION SETTING**
OAHU									
Honolulu	S	S	S	-	S	-	-	Population Exposure	Urban and Center City
Kapolei[1]	S	S,C	S	S	S	S	-	Population Exposure	Suburban
Pearl City	S	S	-	-	-	-	-	Population Exposure	Urban and Center City
Sand Island	-	S	-	S	-	-	-	Maximum Concentration (O_3)/ Transport ($PM_{2.5}$)	Urban and Center City
Kahe[2]	-	-	-	-	S	-	-	Source Impact (DRR)	Neighborhood
Waiau[2]	-	-	-	-	S	-	-	Source Impact (DRR)	Suburban
MAUI									
Kihei	-	S	-	-	-	-	-	Population Exposure	Suburban
Kahului	-	SPM	-	-	-	-	-	Population Exposure	Neighborhood
HAWAII									
Hilo	-	SPM	-	-	S	-	-	Population Exposure	Suburban
Kona	-	SPM	-	-	S	-	-	Population Exposure (SO_2)/ Maximum concentration ($PM_{2.5}$)	Suburban
Mountain View	-	SPM	-	-	SPM	-	-	Source Impact	Suburban
Ocean View	-	SPM	-	-	SPM	-	-	Welfare Impact (SO_2)/ Source Impact ($PM_{2.5}$)	Rural
Pahala	-	SPM	-	-	SPM	-	-	Maximum concentration (SO_2)/ Source Impact ($PM_{2.5}$)	Rural
Honaunau	-	SPM	-	-	-	-	-	Source Impact	Rural
Kailua-Kona	-	SPM	-	-	-	-	-	Source Impact	Suburban
Keeau	-	SPM	-	-	SPM	-	-	Source Impact	Suburban
Leilani	-	-	-	-	SPM	-	SPM	Source Impact (geothermal)	Rural
Naalehu[3]	-	SPM	-	-	SPM	-	-	Source Impact	Rural
Waikoloa	-	SPM	-	-	-	-	-	Source Impact	Rural
KAUAI									
Niumalu	-	SPM		-	SPM	SPM	-	Source Impact (cruise ships)	Suburban

C = Collocated Site S = (SLAMS) State and Local Air Monitoring Station
SPM = Special Purpose Monitoring Station (for monitoring vog, geothermal energy production and cruise ships)
[1] Includes NCore station;
[2] As required by the Data Requirements Rule;
[3] Two closely located temporary stations, one $PM_{2.5}$ and one SO_2.

Table 3-2 **Sampling Equipment at Each Monitoring Station**

Monitoring Station	PM_{10} Continuous Ambient Particulate Monitor	$PM_{2.5}$ Manual Particulate Monitor	$PM_{2.5}$ Continuous Monitor	CO Continuous Gas Filter Correlation Analyzer	SO_2 Continuous Pulsed Fluorescence Ambient Air Analyzer	O_3 Continuous UV Photometric Analyzer	NO_2 Continuous Chemiluminescence Analyzer	H_2S Continuous Pulsed Fluorescence Ambient Air Analyzer
OAHU Honolulu	■		■	■	■			
Kapolei	■	■	■	■	■	■	■	
Pearl City	■		■					
Sand Island			■			■		
MAUI Kihei			■					
Kahului			■					
HAWAII Hilo			■		■			
Kona			■		■			
Mt. View			■		■			
Ocean View			■		■			
Pahala			■		■			
Honaunau			■					
Kailua-Kona			■					
Keeau			■		■			
Leilani					■			■
Naalehu-P			■					
Naalaehu-S					■			
Waikoloa			■					
KAUAI Niumalu			■		■		■	

Section 4
2021 AIR QUALITY DATA

To protect the state's air quality from degradation, the Department of Health's Clean Air Branch is responsible for regulating and monitoring pollution sources to ensure that the levels of criteria pollutants remain well below the state and federal ambient air quality standards. Data collected from the ambient air network is validated by the Clean Air Branch Monitoring Section to ensure that the reported data is of good quality and meets all quality control and assurance requirements.

In 2021 the State of Hawaii was in attainment of all NAAQS.

Explanation of Summary Tables 4-1 through 4-17:

- Summaries are by pollutant and averaging period, with the number of occurrences exceeding the NAAQS or, in Table 4-11, the number of exceedances of the state H_2S standard (there is no federal H_2S standard);
- The "Maximum" is the highest and second highest valid values recorded in the year for the averaging period. For $PM_{2.5}$, the maximum and 98th percentile concentrations are provided and for O_3, the 4th highest daily maximum value is also displayed;
- The "Annual Mean" is the arithmetic mean of all valid values recorded in the year;
- "Possible Periods" is the total number of possible sampling periods in the year for the averaging period;
- "Valid Periods" is the total number of acceptable sampling periods after data validation;
- "Percent Recovery" represents the amount of quality data reported;
- Attainment with the NAAQS is determined according to 40 CFR 50.

Explanation of Tables 4-18 through 4-27:

- For each pollutant and averaging period, the highest concentration for each month is presented;
- The month with the highest value recorded in the year for each site is highlighted.

Table 4-1. 2021 Summary of the 24-Hour PM_{10} Averages

	Maximum		Annual Mean	No. of 24-Hour Averages Greater than 150 µg/m^3														
	1st High	2nd High	All Hours	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Possible Periods	Valid Periods	Percent Recovery
OAHU																		
Honolulu	26	25	9.8	0	0	0	0	0	0	0	0	0	0	0	0	365	360	98.6%
Kapolei[1]	46	34	9.2	0	0	0	0	0	0	0	0	0	0	0	0	365	273	74.8%
Pearl City	25	24	11.4	0	0	0	0	0	0	0	0	0	0	0	0	365	345	94.5%

[1] Does not meet summary criteria, <50% data recovery in 3rd quarter.

Table 4-2. Attainment Determination of the 24-Hour PM_{10} NAAQS

Station	Exceedances in 2019	Exceedances in 2020	Exceedances in 2021	Sites in Violation of the NAAQS
Honolulu	0	0	0	0
Kapolei	0	0	0	0
Pearl City	0	0	0	0
Attainment: The standard not to be exceeded more than once per year on average over 3 years. **In 2021, Hawaii was in attainment with the 24-hour PM_{10} NAAQS.**				

Table 4-3. 2021 Summary of the 24-Hour $PM_{2.5}$ Averages: SLAMS Stations

	Maximum		Annual Mean	No. of 24-Hour Averages Greater than 35 µg/m³														
	1st High	98th %	All Hours	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Possible Periods	Valid Periods	Percent Recovery
OAHU																		
Honolulu	9.7	6.0	3.0	0	0	0	0	0	0	0	0	0	0	0	0	365	349	95.6%
Kapolei[1]	8.5	6.7	2.9	0	0	0	0	0	0	0	0	0	0	0	0	365	336	92.1%
Pearl City	8.0	6.1	3.2	0	0	0	0	0	0	0	0	0	0	0	0	365	338	92.6%
Sand Island	8.8	6.2	3.3	0	0	0	0	0	0	0	0	0	0	0	0	365	354	97.0%
MAUI																		
Kihei	15.4	5.7	2.5	0	0	0	0	0	0	0	0	0	0	0	0	365	355	97.3%

[1] Valid periods supplemented by collocated monitor, providing an additional 13 back-up sampling periods – design value valid for attainment determination.

Table 4-4. Attainment Determination of the 24-Hour $PM_{2.5}$ NAAQS: SLAMS Stations

Station	2019 98th Value	2020 98th Value	2021 98th Value	3-Year Average	Sites in Violation of the NAAQS
Honolulu	6.7	6.2	6.0	6.3	0
Kapolei	5.2	6.9	6.7	6.3	0
Pearl City	6.3	6.2	6.1	6.2	0
Sand Island	7.7	7.2	6.2	7.0	0
Kihei	16.9	7.2	5.7	9.9	0

Attainment: The 3-year average of the 98th percentile values must be less than or equal to 35 µg/m³.
In 2021, Hawaii was in attainment with the 24-hour $PM_{2.5}$ NAAQS.

Table 4-5. Attainment Determination of the Annual $PM_{2.5}$ NAAQS: SLAMS Stations

Station	2019 Ann. Avg.	2020 Ann. Avg.	2021 Ann. Avg.	3-Year Average	Sites in Violation of the NAAQS
Honolulu	3.2	3.0	3.0	3.1	0
Kapolei	1.8	3.4	2.9	2.7	0
Pearl City	3.3	3.2	3.2	3.2	0
Sand Island	3.9	3.9	3.3	3.7	0
Kihei	4.1	2.9	2.5	3.2	0

Attainment: The 3-year average of annual mean values must be less than 12 µg/m³.
In 2021, Hawaii was in attainment with the annual $PM_{2.5}$ NAAQS.

Table 4-6. 2021 Summary of the 24-Hour $PM_{2.5}$ Averages: SPM Stations

	Maximum		Annual Mean	No. of 24-Hour Averages Greater than 35 µg/m³														
	1st High	98th %	All Hours	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Possible Periods	Valid Periods	Percent Recovery
HAWAII																		
Hilo[1]	8.4	6.5	3.7	0	0	0	0	0	0	0	0	0	0	0	0	365	238	65.2%
Kona	16.2	10.0	3.6	0	0	0	0	0	0	0	0	0	0	0	0	365	364	99.7%
Mt. View	8.8	4.6	1.7	0	0	0	0	0	0	0	0	0	0	0	0	365	336	92.1%
Ocean View	14.2	9.6	3.5	0	0	0	0	0	0	0	0	0	0	0	0	365	329	90.1%
Pahala	11.7	6.7	2.5	0	0	0	0	0	0	0	0	0	0	0	0	365	351	96.2%
Honaunau[2]	13.9	9.5	1.9	0	0	0	0	0	0	0	0	0	0	0	0	365	322	88.2%
Kailua-Kona[2, 3]	15.9	11.5	4.7	0	0	0	0	0	0	0	0	0	0	0	0	365	319	87.4%
Keeau[2]	18.9	5.9	2.8	0	0	0	0	0	0	0	0	0	0	0	0	365	327	89.6%
Naalehu[2]	7.8	5.3	2.4	0	0	0	0	0	0	0	0	0	0	0	0	365	342	93.7%
Waikoloa[2, 4]	10.4	8.5	1.8	-	-	-	-	-	-	-	-	-	0	0	0	92	92	100.0%
KAUAI																		
Niumalu	8.4	7.2	3.2	0	0	0	0	0	0	0	0	0	0	0	0	365	342	93.7%
MAUI																		
Kahului	9.1	7.3	3.9	0	0	0	0	0	0	0	0	0	0	0	0	365	336	92.1%

The special purpose stations on Hawaii island were established to monitor ambient air concentrations of $PM_{2.5}$ from volcanic emissions. The special purpose station on Kauai was established to monitor emissions from cruise ships. The special purpose station on Maui was established to monitor air quality impacts from commercial, industrial, transportation and agricultural activities .

[1] Does not meet summary criteria, <50% data recovery in 1st quarter and <75% in 2nd and 4th quarters, substitution test not allowed.
[2] Preliminary data – for information only. Temporary stations may not meet all federal siting requirements.
[3] Preliminary data – for information only. Does not meet summary criteria, <75% data recovery in a quarter.
[4] Station was temporarily located at Waikoloa E.S at the beginning of the year and relocated to it's long-term location on 7/28/21. 4th quarter data presented only.

Table 4-7. 2021 Summary of the 8-Hour O_3 Averages

	Maximum			Annual Mean	No. of Daily Maximum 8-Hour Averages Greater than 0.070 ppm														
	1st High	2nd High	4th High	All Hours	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Possible Periods	Valid Periods	Percent Recovery
OAHU																			
Sand Island	0.046	0.046	0.045	0.029	0	0	0	0	0	0	0	0	0	0	0	0	8755	7764	88.7%
Kapolei	0.050	0.049	0.047	0.026	0	0	0	0	0	0	0	0	0	0	0	0	8755	8212	93.8%

Table 4-8. Attainment Determination of the 8-Hour O_3 NAAQS

Station	2019 4th Highest	2020 4th Highest	2021 4th Highest	3-Year Average	Sites in Violation of the NAAQS
Sand Island	0.053	0.044	0.045	0.047	0
Kapolei	0.052	0.045	0.047	0.048	0
Attainment: The 3-year average of the annual 4th highest daily maximum 8-hour average must be less than or equal to 0.070 ppm. **In 2021, Hawaii was in attainment with the 8-hour O_3 NAAQS.**					

Table 4-9. 2021 Summary of the 1-Hour and Annual NO_2 Averages

	Maximum		Annual Mean	No. of Daily Maximum 1-Hour Averages Greater than 100 ppb														
	1st High	98th%	All Hours	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Possible Periods	Valid Periods	Percent Recovery
OAHU	**SLAMS Station**																	
Kapolei	29.5	21.5	3	0	0	0	0	0	0	0	0	0	0	0	0	8760	8451	96.5%
KAUAI	**SPM Station**																	
Niumalu	18.9	13.8	2	0	0	0	0	0	0	0	0	0	0	0	0	8760	8149	93.0%

Attainment of the annual NO_2 NAAQS: The annual mean shall not exceed 53 ppb.
In 2021, Hawaii was in attainment with the annual NO_2 NAAQS.

Table 4-10. Attainment Determination of the 1-Hour NO_2 NAAQS

Station	2019 98th Value	2020 98th Value	2021 98th Value	3-Year Average	Sites in Violation of the NAAQS
OAHU	**SLAMS Station**				
Kapolei	28.1	25.5	21.5	25.0	0

Attainment: The 3-year average of the 98th percentile values must be less than or equal to 100 ppb.
In 2021, Hawaii was in attainment with the 1-hour NO_2 NAAQS.

Table 4-11. 2021 Summary of the 1-Hour H_2S Averages (State Standard)

	Maximum		Annual Mean	No. of 1-Hour Averages Greater than 25 ppb														
	1st High	2nd High	All Hours	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Possible Periods	Valid Periods	Percent Recovery
HAWAII																		
Leilani	5.5	5.1	1.9	0	0	0	0	0	0	0	0	0	0	0	0	8760	7103	81.1%

Attainment of the state standard: 1-hour values not to exceed 25 ppb.
In 2021, Hawaii was in attainment of the state 1-hour H_2S standard.

Table 4-12. 2021 Summary of the 1-Hour SO_2 Averages

	Maximum		Annual Mean	No. of 1-Hour Averages Greater than 75 ppb														
	1st High	99th%	All Hours	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Possible Periods	Valid Periods	Percent Recovery
OAHU	**SLAMS Stations**																	
Honolulu	4.7	1.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0	8760	7601	86.8%
Kapolei[1]	4.0	2.8	0.7	0	0	0	0	0	0	0	0	0	0	0	0	8760	5985	68.3%
Kahe	64.9	44.1	0.6	0	0	0	0	0	0	0	0	0	0	0	0	8760	8574	97.9%
Waiau	21.3	15.3	0.3	0	0	0	0	0	0	0	0	0	0	0	0	8760	8584	98.0%
HAWAII	**SPM Stations (see NOTE)**																	
Hilo[1, 2]	216.3	26.7	2.1	0	1	0	0	0	0	0	0	1	0	1	0	8760	7144	81.6%
Kona[1]	13.5	9.5	1.8	0	0	0	0	0	0	0	0	0	0	0	0	8760	8048	91.9%
Mt. View[2]	103.4	61.4	2.1	0	1	0	0	0	0	0	0	0	0	0	1	8760	8162	93.2%
Ocean View[1, 2]	303.5	166.5	3.6	1	0	0	0	0	0	0	0	1	9	4	1	8760	7499	85.6%
Pahala[2]	591.6	420.0	8.9	8	0	1	0	0	0	0	0	1	12	13	5	8760	7956	90.8%
Keeau[2, 3]	122.8	25.9	0	0	0	0	0	0	0	0	0	1	0	0	0	8760	6188	70.6%
Naalehu[1, 2]	72.9	54.1	3.7	0	0	0	0	0	0	0	0	0	0	0	0	8760	8035	91.7%
Leilani	9.6	3.1	0.3	0	0	0	0	0	0	0	0	0	0	0	0	8760	8020	91.6%
KAUAI	**SPM Station**																	
Niumalu	2.8	2.7	0.6	0	0	0	0	0	0	0	0	0	0	0	0	8760	7703	87.9%

Attainment: The 3-year average of the 99th percentile values must be less than or equal to 75 ppb. Effective June 2, 2010.
In 2021, Hawaii was in attainment with the 1-hour SO_2 NAAQS (SLAMS stations only).

NOTE: The SPM stations on Hawaii Island were established to monitor ambient air concentrations of SO_2 from volcanic emissions. Although Hilo and Kona stations are designated SLAMS, the values are still mostly attributed to volcanic emissions. Volcanic eruptions are considered natural events and therefore EPA may exclude the exceedances of the 1-hour NAAQS from attainment determinations. The SPM station on Kauai was established to monitor emissions from cruise ships.

[1] Does not meet summary criteria, <75% data recovery in a quarter, substitution test valid.
[2] Elevated values due to emissions from Dec. 20, 2020 and Sep. 29, 2021 eruptions at Halema'uma'u crater on the summit of Kilauea volcano.
[3] Does not meet summary criteria, <50% data recovery in 1st quarter and <75% data recovery in 4th quarter.

Table 4-13. Attainment Determination of the 1-Hour SO_2 NAAQS: SLAMS Stations

	2019 99th Value	2020 99th Value	2021 99th Value	3-Year Average	Violation of the NAAQS
OAHU SLAMS Stations					N= NO Y= YES
Honolulu	5.9	0.6	1.6	3	N
Kapolei[1]	5.8	5.8	8.9	8	N
Kahe	61.8	57.1	44.1	54	N
Waiau	16.3	17.7	15.3	16	N
HAWAII SPM Stations (see NOTE)					
Hilo[2]	10.6	11.6	26.7	16	N
Kona[2]	2.5	12.0	9.5	8	N
Mt. View[3]	8.0	4.6	61.4	25	N
Ocean View[2, 3]	2.6	204.8	166.5	125	Y
Pahala[3]	9.1	273.8	420.0	234	Y
KAUAI SPM Station (see NOTE)					
Niumalu[2]	1.3	3.7	2.7	3	N

Attainment: The 3-year average of the 99th percentile values must be less than or equal to 75 ppb. Effective June 2, 2010.
In 2021, Hawaii was in attainment with the 1-hour SO_2 NAAQS (SLAMS stations only).

NOTE: The SPM stations on Hawaii Island were established to monitor ambient air concentrations of SO_2 from volcanic emissions. Although Hilo and Kona stations are designated SLAMS, the values are still mostly attributed to volcanic emissions. Volcanic eruptions are considered natural events and therefore EPA may exclude the exceedances of the 1-hour NAAQS from attainment determinations. The SPM station on Kauai was established to monitor emissions from cruise ships.

[1] Kapolei design value uses the higher value between Kapolei and NCore; using NCore for 2019 and 2021 and Kapolei for 2020.
[2] Does not meet summary criteria, <75% data recovery in 1st quarter, substitution test valid.
[3] Elevated values due to emissions from Dec. 20, 2020 and Sep. 29, 2021 eruptions at Halema'uma'u crater on the summit of Kilauea volcano.

Table 4-14. 2021 Summary of the 3-Hour SO_2 Averages

	Maximum		Annual Mean	No. of 3-Hour Averages Greater than 0.5 ppm														
	1st High	2nd High	All Hours	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Possible Periods	Valid Periods	Percent Recovery
OAHU	**SLAMS Stations**																	
Honolulu	0.003	0.002	0.000	0	0	0	0	0	0	0	0	0	0	0	0	2920	2515	94.7%
Kapolei[1]	0.003	0.002	0.001	0	0	0	0	0	0	0	0	0	0	0	0	2920	1967	67.4%
Kahe	0.047	0.042	0.001	0	0	0	0	0	0	0	0	0	0	0	0	2920	2826	96.8%
Waiau	0.010	0.009	0.000	0	0	0	0	0	0	0	0	0	0	0	0	2920	2830	96.9%
HAWAII	**SPM Stations (see NOTE)**																	
Hilo[1, 2]	0.134	0.049	0.002	0	0	0	0	0	0	0	0	0	0	0	0	2920	2346	80.3%
Kona[1]	0.010	0.010	0.002	0	0	0	0	0	0	0	0	0	0	0	0	2920	2604	89.2%
Mt. View[2]	0.074	0.069	0.002	0	0	0	0	0	0	0	0	0	0	0	0	2920	2645	90.6%
Ocean View[1, 2]	0.244	0.188	0.004	0	0	0	0	0	0	0	0	0	0	0	0	2920	2462	84.3%
Pahala[2]	0.463	0.336	0.009	0	0	0	0	0	0	0	0	0	0	0	0	2920	2593	88.8%
Keeau[2, 3]	0.076	0.027	0.000	0	0	0	0	0	0	0	0	0	0	0	0	2920	1960	67.1%
Naalehu[1, 2]	0.046	0.043	0.004	0	0	0	0	0	0	0	0	0	0	0	0	2920	2655	90.9%
Leilani	0.007	0.005	0.000	0	0	0	0	0	0	0	0	0	0	0	0	2920	2602	89.1%
KAUAI	**SPM Station**																	
Niumalu	0.003	0.003	0.001	0	0	0	0	0	0	0	0	0	0	0	0	2920	2492	85.3%

Attainment: 3-hour values not to exceed 0.5 ppm more than once per year.
In 2021, Hawaii was in attainment with the 3-hour SO_2 NAAQS (SLAMS stations only).

NOTE: The SPM stations on Hawaii island were established to monitor ambient air concentrations of SO_2 from volcanic emissions. Although Hilo and Kona stations are designated SLAMS, the values are still mostly attributed to volcanic emissions. Volcanic eruptions are considered natural events and therefore EPA may exclude the exceedances of the 3-hour NAAQS from attainment determinations.

[1] Does not meet summary criteria, <75% data recovery in a quarter, substitution test valid.
[2] Elevated values due to emissions from Dec. 20, 2020 and Sep. 29, 2021 eruptions at Halema'uma'u crater on the summit of Kilauea volcano.
[3] Does not meet summary criteria, <50% data recovery in 1st quarter and <75% data recovery in 4th quarter.

Table 4-15. 2021 Summary of the 24-Hour and Annual SO_2 Averages

	Maximum		Annual Mean	No. of 24-Hour Averages Greater than 0.14 ppm														
	1st High	2nd High	All Hours	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Possible Periods	Valid Periods	Percent Recovery
OAHU	**SLAMS Stations**																	
Honolulu	0.001	0.001	0.000	0	0	0	0	0	0	0	0	0	0	0	0	365	319	87.4%
Kapolei[1]	0.002	0.002	0.001	0	0	0	0	0	0	0	0	0	0	0	0	365	252	69.0%
Kahe	0.010	0.009	0.001	0	0	0	0	0	0	0	0	0	0	0	0	365	361	98.9%
Waiau	0.004	0.002	0.000	0	0	0	0	0	0	0	0	0	0	0	0	365	365	100%
HAWAII	**SPM Stations (see NOTE)**																	
Hilo[1, 2]	0.024	0.017	0.002	0	0	0	0	0	0	0	0	0	0	0	0	365	303	83.0%
Kona[1]	0.005	0.005	0.002	0	0	0	0	0	0	0	0	0	0	0	0	365	338	92.6%
Mt. View[2]	0.022	0.015	0.002	0	0	0	0	0	0	0	0	0	0	0	0	365	343	94.0%
Ocean View[1, 2]	0.065	0.055	0.004	0	0	0	0	0	0	0	0	0	0	0	0	365	315	86.3%
Pahala[2]	0.130	0115	0.009	0	0	0	0	0	0	0	0	0	0	0	0	365	336	92.1%
Keeau[2, 3]	0.013	0.008	0.000	0	0	0	0	0	0	0	0	0	0	0	0	365	223	61.1%
Naalehu[1, 2]	0.016	0.011	0.004	0	0	0	0	0	0	0	0	0	0	0	0	365	338	92.6%
Leilani	0.004	0.002	0.000	0	0	0	0	0	0	0	0	0	0	0	0	365	341	93.4%
KAUAI	**SPM Station**																	
Niumalu	0.003	0.003	0.001	0	0	0	0	0	0	0	0	0	0	0	0	365	325	89.0%

Attainment: 24-hour values not to exceed 0.14 ppm more than once per year.
In 2021, Hawaii was in attainment of the state 24-hour SO_2 standard (SLAMS stations only).

NOTE: The SPM stations on Hawaii island were established to monitor ambient air concentrations of SO_2 from volcanic emissions. Although Hilo and Kona stations are designated SLAMS, the values are still mostly attributed to volcanic emissions. Volcanic eruptions are considered natural events and therefore EPA may exclude the exceedances of the 24-hour NAAQS from attainment determinations.

Attainment: Annual average (from SLAMS stations only) not to exceed 0.03 ppm.
In 2021, Hawaii was in attainment of the state annual SO_2 standard.

NOTE: The SPM stations on Hawaii island were established to monitor ambient air concentrations of SO_2 from volcanic emissions. Although Hilo and Kona stations are designated SLAMS, the values are still mostly attributed to volcanic emissions. Volcanic eruptions are considered natural events and therefore EPA may exclude the exceedances of the annual NAAQS from attainment determinations.

[1] Does not meet summary criteria, <75% data recovery in a quarter, substitution test valid.
[2] Elevated values due to emissions from Dec. 20, 2020 and Sep. 29, 2021 eruptions at Halema'uma'u crater on the summit of Kilauea volcano.
[3] Does not meet summary criteria, <50% data recovery in 1st quarter and <75% data recovery in 4th quarter.

Table 4-16. 2021 Summary of the 1-Hour CO Averages

	Maximum		Annual Mean	No. of 1-Hour Averages Greater than 35 ppm														
	1st High	2nd High	All Hours	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Possible Periods	Valid Periods	Percent Recovery
OAHU	**SLAMS Stations**																	
Honolulu	0.9	0.9	0.5	0	0	0	0	0	0	0	0	0	0	0	0	8760	6892	78.7%
Kapolei	0.8	0.6	0.1	0	0	0	0	0	0	0	0	0	0	0	0	8760	8453	96.5%

Attainment: 1-hour values not to exceed 35 ppm more than once per year.
In 2021, Hawaii was in attainment with the 1-hour CO NAAQS.

Table 4-17. 2021 Summary of the 8-Hour CO Averages

	Maximum		Annual Mean	No. of 8-Hour Averages Greater than 9 ppm														
	1st High	2nd High	All Hours	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Possible Periods	Valid Periods	Percent Recovery
OAHU	**SLAMS Stations**																	
Honolulu	0.7	0.7	0.5	0	0	0	0	0	0	0	0	0	0	0	0	8755	6585	75.2%
Kapolei	0.4	0.3	0.1	0	0	0	0	0	0	0	0	0	0	0	0	8755	8298	94.8%

Attainment: 8-hour values not to exceed 9 ppm more than once per year.
In 2021, Hawaii was in attainment with the 8-hour CO NAAQS.

Table 4-18. 2021 Monthly Maximum of 24-Hour PM_{10} Values ($\mu g/m^3$)

The month with the highest value in the year is highlighted *The state and federal 24-hr PM_{10} standard is 150 $\mu g/m^3$*

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Honolulu	19	20	26	15	19	13	14	15	15	20	14	18
Kapolei	17	20	22	20	34	12	21	46	no data	no data	22	26
Pearl City	19	22	25	16	16	15	15	17	14	22	17	20

Table 4-19. 2021 Monthly Maximum of 24-Hour $PM_{2.5}$ Values ($\mu g/m^3$)

The month with the highest value in the year is highlighted *The federal 24-hr $PM_{2.5}$ standard is 35 $\mu g/m^3$*

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SLAMS Stations												
Honolulu	6.0	9.7	7.5	4.2	4.7	3.6	4.0	5.0	4.6	5.7	8.2	5.6
Kapolei	7.7	6.7	8.5	6.3	5.6	4.3	4.1	5.1	5.9	6.0	5.7	5.3
Pearl City	6.1	5.2	6.4	6.5	5.1	3.6	4.3	5.1	4.4	6.7	8.0	4.4
Sand Island	7.2	6.3	6.8	6.7	5.5	4.2	5.0	4.7	4.7	5.8	8.8	5.9
Kihei	5.7	5.7	6.6	6.4	4.5	4.4	5.7	4.2	3.4	6.7	5.1	15.4
SPM Stations												
Niumalu (cruise ships)	7.1	8.4	7.7	6.8	5.4	4.6	6.4	6.6	5.2	4.8	5.2	6.4
Kahului	9.1	8.0	8.2	7.0	5.6	4.8	5.6	6.4	5.3	7.4	7.1	7.3
Hilo (volcano)	8.4	7.0	6.5	no data	6.0	5.9	4.8	5.1	4.5	3.9	5.5	5.2
Kona (volcano)	9.9	8.2	6.5	5.5	3.0	4.7	7.4	16.2	3.0	14.7	9.7	7.9
Mt. View (volcano)	8.8	5.3	4.6	4.6	3.2	2.3	2.7	3.9	5.4	2.6	5.3	3.6
Ocean View (volcano)	10.1	7.0	8.7	6.9	3.6	3.2	5.4	6.1	5.6	14.2	8.2	8.0
Pahala (volcano)	11.7	9.5	7.7	5.8	3.5	2.8	3.6	3.3	9.9	8.2	7.8	5.0
Honaunau (volcano)	7.6	5.6	5.2	3.4	1.4	1.8	4.8	13.9	1.1	11.9	7.7	6.6
Kailua-Kona (volcano)	11.7	9.3	no data	6.2	5.3	6.6	7.5	15.2	3.6	15.9	10.9	11.5
Keeau (volcano)	8.9	5.6	5.4	6.3	4.5	4.2	4.8	5.0	3.2	3.5	4.3	18.9
Naalehu (volcano)	5.0	7.8	4.8	6.7	4.1	3.0	5.5	5.3	4.3	4.9	4.5	6.8
Waikoloa (volcano)[1]	no data	no data	no data	no data	no data	no data	no data	no data	no data	4.2	10.4	5.1

[1] Station was temporarily located at Waikoloa E.S at the beginning of the year and relocated to it's long-term location on 7/28/21. 4th quarter data presented only.

Table 4-20. 2021 Monthly Maximum of 1-Hour NO_2 Values (ppb)

The month with the highest value in the year is highlighted *The federal 1-hour standard for NO_2 is 100 ppb*

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kapolei	23.1	24.5	18.7	21.5	29.5	17.9	12.2	19.7	15.3	16.4	20.9	21.4
Niumalu	13.3	18.9	14.6	15.5	13.8	12.5	13.8	11.4	11.3	18.0	13.4	17.0

Table 4-21. 2021 Monthly Maximum of 1-Hour H_2S Values (ppb)

The month with the highest value in the year is highlighted *The state 1-hour standard for H_2S is 25 ppb*

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leilani	4.4	4.2	4.9	5.5	1.3	1.6	1.9	2.5	2.5	2.5	2.5	2.7

Table 4-22. 2021 Monthly Maximum of 1-Hour CO Values (ppm)

The month with the highest value in the year is highlighted *The federal 1-hr CO standard is 35 ppm, the state standard is 9 ppm*

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Honolulu	0.8	0.9	0.7	0.8	0.8	0.6	0.6	0.6	0.6	no data	0.7	0.8
Kapolei	0.4	0.5	0.5	0.2	0.2	0.3	0.3	0.5	0.4	0.4	0.8	0.5
Kapolei NCore	0.4	0.6	0.4	0.4	0.4	0.3	0.2	2.4	0.3	0.3	0.8	0.5

Table 4-23. 2021 Monthly Maximum of 8-Hour CO Values (ppm)

The month with the highest value in the year is highlighted *The federal 8-hr CO standard is 9 ppm, the state standard is 4.4 ppm*

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Honolulu	0.6	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.5	no data	0.4	0.6
Kapolei	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.4	0.4
Kapolei NCore	0.2	0.2	0.2	0.2	0.2	0.2	0.1	2.0	0.2	0.2	0.3	0.3

Table 4-24. 2021 Monthly Maximum of 8-Hour O_3 Values (ppm)

The month with the highest value in the year is highlighted *The federal 8-hr O_3 standard is 0.070 ppm*

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sand Island	0.042	0.047	0.046	0.045	0.036	0.032	0.033	0.035	0.038	0.040	0.047	0.045
Kapolei NCore	0.038	0.043	0.042	0.044	0.036	0.031	0.031	0.030	0.030	0.032	0.041	0.050

Table 4-25. 2021 Monthly Maximum of 1-Hour SO_2 Values (ppb)

The month with the highest value in the year is highlighted *The federal 1-hr SO_2 standard is 75 ppb*

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SLAMS Stations												
Honolulu	4.7	2.2	0.8	0.8	0.8	0.8	0.9	0.7	0	0	0	2.2
Kapolei	1.7	4.0	2.8	2.1	2.2	3.5	1.4	2.1	1.3	no data	no data	0.4
Kapolei NCore	2.0	10.9	1.6	3.5	9.8	8.7	1.3	3.2	0.4	0.2	0.4	0.2
Kahe	44.1	42.9	48.4	27.7	35.7	38.2	7.8	59.9	13.5	12.7	64.9	14.2
Waiau	13.7	15.7	15.4	6.9	12.3	7.1	7.1	5.2	6.8	11.8	21.3	8.7
SPM Stations (see NOTE)												
Niumalu (cruise ships)	2.8	2.6	1.0	1.1	0.9	0.5	0.2	0.3	0.5	0.5	0.7	0.7
Hilo[1] (volcano)	26.0	77.9	4.5	9.4	3.4	4.1	9.7	7.2	216.3	6.9	87.3	6.2
Kona (volcano)	11.9	7.1	4.2	5.4	2.5	3.0	3.6	3.7	4.0	7.9	13.5	5.3
Mt. View[1] (volcano)	61.4	102.5	16.0	12.4	3.6	3.8	1.0	3.2	40.0	1.6	22.8	103.4
Ocean View[1] (volcano)	98.6	42.9	41.4	20.1	16.7	1.6	2.4	3.6	127.7	303.5	166.5	85.9
Pahala[1] (volcano)	186.8	68.7	84.1	47.9	36.6	12.3	7.0	4.1	543.8	591.6	210.7	211.2
Keeau[1, 2] (volcano)	no data	0.6	6.3	0.8	2.9	4.1	3.3	2.5	122.8	2.8	19.5	44.9
Naalehu[1, 2] (volcano)	45.8	29.1	25.6	20.7	5.7	3.9	5.4	4.1	29.7	72.9	72.6	66.8
Leilani (volcano)	9.6	3.9	1.1	1.8	1.0	0.5	0.7	0.7	3.1	0.8	1.2	0.7

NOTE: The SPM stations on Hawaii Island were established to monitor ambient air concentrations of SO_2 from volcanic emissions. Although Hilo and Kona stations are designated SLAMS, the values are still mostly attributed to volcanic emissions. Volcanic eruptions are considered natural events and therefore EPA may exclude the exceedances of the 1-hour NAAQS from attainment determinations.

[1] Elevated values due to emissions from Dec. 20, 2020 and Sep. 29, 2021 eruptions at Halema'uma'u crater on the summit of Kilauea volcano.

[2] Preliminary data – for information only. Temporary stations may not meet all federal siting requirements.

Table 4-26. 2021 Monthly Maximum of 3-Hour SO_2 Values (ppm)

The month with the highest value in the year is highlighted *The state and federal 3-hr SO_2 standard is 0.5 ppm*

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SLAMS Stations												
Honolulu	0.003	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.001
Kapolei	0.001	0.003	0.002	0.002	0.002	0.002	0.001	0.002	0.001	no data	no data	0.000
Kapolei NCore	0.002	0.007	0.001	0.002	0.004	0.004	0.001	0.003	0.000	0.000	0.000	0.000
Kahe	0.019	0.017	0.020	0.018	0.027	0.018	0.004	0.047	0.007	0.005	0.042	0.010
Waiau	0.005	0.006	0.009	0.004	0.005	0.003	0.003	0.003	0.003	0.007	0.010	0.005
SPM Stations (see NOTE)												
Niumalu (cruise ships)	0.003	0.003	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.001	0.001	0.001
Hilo[1] (volcano)	0.021	0.047	0.002	0.005	0.003	0.002	0.004	0.004	0.134	0.005	0.049	0.005
Kona (volcano)	0.010	0.005	0.004	0.004	0.002	0.002	0.003	0.003	0.002	0.007	0.010	0.004
Mt. View[1] (volcano)	0.035	0.069	0.009	0.009	0.004	0.004	0.001	0.001	0.033	0.002	0.015	0.074
Ocean View[1] (volcano)	0.050	0.028	0.017	0.014	0.009	0.001	0.002	0.003	0.077	0.244	0.124	0.056
Pahala[1] (volcano)	0.164	0.050	0.076	0.028	0.025	0.008	0.005	0.003	0.463	0.336	0.160	0.123
Keeau[1, 2] (volcano)	no data	0.000	0.004	0.000	0.002	0.002	0.002	0.002	0.076	0.001	0.015	0.027
Naalehu[1, 2] (volcano)	0.034	0.019	0.016	0.011	0.005	0.004	0.004	0.004	0.017	0.046	0.035	0.030
Leilani (volcano)	0.007	0.002	0.001	0.002	0.000	0.000	0.001	0.001	0.002	0.000	0.001	0.001

NOTE: The SPM stations on Hawaii Island were established to monitor ambient air concentrations of SO_2 from volcanic emissions. Volcanic eruptions are considered natural events and therefore EPA may exclude the exceedances of the 3-hour NAAQS from attainment determinations.

[1] Elevated values due to emissions from Dec. 20, 2020 and Sep. 29, 2021 eruptions at Halema'uma'u crater on the summit of Kilauea volcano.

[2] Preliminary data – for information only. Temporary stations may not meet all federal siting requirements.

Table 4-27. 2021 Monthly Maximum of 24-Hour SO_2 Values (ppm)

The month with the highest value in the year is highlighted *The state 24-hr SO_2 standard is 0.14 ppm*

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SLAMS Stations												
Honolulu	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000
Kapolei	0.001	0.001	0.002	0.002	0.002	0.002	0.001	0.001	0.001	no data	no data	0.000
Kapolei NCore	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000
Kahe	0.004	0.006	0.009	0.005	0.008	0.007	0.001	0.010	0.001	0.002	0.008	0.003
Waiau	0.002	0.001	0.004	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002
SPM Stations (see NOTE)												
Niumalu (cruise ships)	0.003	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Hilo[1] (volcano)	0.007	0.010	0.001	0.002	0.002	0.001	0.002	0.003	0.024	0.004	0.017	0.004
Kona (volcano)	0.005	0.003	0.003	0.003	0.002	0.002	0.002	0.003	0.002	0.002	0.005	0.002
Mt. View[1] (volcano)	0.007	0.022	0.004	0.005	0.003	0.004	0.001	0.001	0.007	0.001	0.005	0.015
Ocean View[1] (volcano)	0.020	0.008	0.005	0.005	0.002	0.001	0.001	0.002	0.020	0.065	0.038	0.016
Pahala[1] (volcano)	0.067	0.019	0.022	0.013	0.009	0.005	0.001	0.001	0.115	0.130	0.049	0.032
Keeau[1, 2] (volcano)	no data	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.000	0.004	0.008
Naalehu[1, 2] (volcano)	0.008	0.009	0.005	0.006	0.003	0.003	0.003	0.004	0.006	0.016	0.009	0.010
Leilani (volcano)	0.004	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

NOTE: The SPM stations on Hawaii Island were established to monitor ambient air concentrations of SO_2 from volcanic emissions. Volcanic eruptions are considered natural events.

[1] Elevated values due to emissions from Dec. 20, 2020 and Sep. 29, 2021 eruptions at Halema'uma'u crater on the summit of Kilauea volcano.

[2] Preliminary data – for information only. Temporary stations may not meet all federal siting requirements.

Section 5
2021 $PM_{2.5}$ SPECIATION DATA

Atmospheric aerosols are solid or liquid particles suspended in air that come directly from a variety of sources (primary) or are formed by chemical reactions (secondary). Primary and secondary particles tend to have long lifetimes in the atmosphere and can travel long distances, up to hundreds or perhaps thousands of miles. Sources include dust from roads, construction, and agriculture; combustion particles from motor vehicles, electric utilities and agricultural burning; and particles from natural sources such as the ocean or volcano.

Most of the $PM_{2.5}$ is a combination of the following components: sulfates, nitrates, ammonium, elemental carbon, organic compounds, water and metals. The EPA selected target particulates of interest based on data use objectives, primary constituents of $PM_{2.5}$, and the capability and availability of current analytical methods.

The filter-based speciation sampler collects samples once every 3 days for analyses performed by an EPA contract laboratory. The speciation sampler is located at the Kapolei NCore monitoring station.

Table 5-1 lists the parameters measured, highest and second highest values recorded in the year, the annual arithmetic mean of all valid samples and the total number of samples collected in the year. Table 5-2 lists the analysis methods for each parameter.

With the exception of lead, there are no ambient air quality standards for the individual components of speciated $PM_{2.5}$.

For more information on EPA's speciation program, go to:
www.epa.gov/ttn/amtic/speciepg.html

Table 5-1. Annual Summary of $PM_{2.5}$ Speciation Data

Parameter	1st High (µg/m³)	2nd High (µg/m³)	Annual Mean (µg/m³)	No. of Samples	Percent Recovery
CARBON					
Organic Carbon	0.658	0.540	0.2561	110	90%
Elemental Carbon	0.607	0.378	0.0890	110	90%
METALS					
Aluminum	1.030	0.833	0.1213	106	87%
Antimony	0.029	0.027	0.0010	106	87%
Arsenic	0.000	0.000	0.0000	106	87%
Barium	0.070	0.049	0.0039	106	87%
Bromine	0.002	0.002	0.0002	106	87%
Cadmium	0.029	0.025	0.0008	106	87%
Calcium	1.561	0.509	0.0916	106	87%
Cerium	0.090	0.054	-0.0046	106	87%
Cesium	0.049	0.041	0.0011	106	87%
Chlorine	2.320	2.280	0.5572	106	87%
Chromium	0.008	0.005	0.0004	106	87%
Cobalt	0.003	0.003	0.0001	106	87%
Copper	0.014	0.008	0.0001	106	87%
Indium	0.025	0.021	0.0009	106	87%
Iron	0.259	0.241	0.0287	106	87%
Lead	0.016	0.013	0.0005	106	87%
Magnesium	0.161	0.154	0.0402	106	87%
Manganese	0.010	0.010	0.0002	106	87%
Nickel	0.009	0.008	0.0017	106	87%
Phosphorus	0.004	0.004	0.0002	106	87%
Potassium	0.721	0.070	0.0308	106	87%
Rubidium	0.006	0.005	0.0001	106	87%
Selenium	0.005	0.004	0.0002	106	87%
Silicon	0.293	0.138	0.0322	106	87%
Silver	0.025	0.019	-0.0015	106	87%
Sodium	1.351	1.148	0.3511	106	87%
Strontium	0.016	0.005	0.0009	106	87%
Sulfur	0.590	0.524	0.1482	106	87%
Tin	0.031	0.028	0.0018	106	87%
Titanium	0.033	0.022	0.0031	106	87%
Vanadium	0.004	0.003	0.0005	106	87%
Zinc	0.030	0.013	0.0023	106	87%
Zirconium	0.020	0.020	0.0003	106	87%

Table 5-1 Continued

Parameter	1st High (µg/m³)	2nd High (µg/m³)	Annual Mean (µg/m³)	No. of Samples	Percent Recovery
IONS					
Ammonium Ion	0.22	0.20	0.013	107	88%
Potassium Ion	0.71	0.04	0.018	107	88%
Sodium Ion	1.31	1.24	0.405	107	88%
Total Nitrate	0.36	0.31	0.137	107	88%
Sulfate	1.64	1.55	0.497	107	88%

Table 5-2. Speciation Collection and Analysis Methods

Parameter	Collection Method	Analysis Method
Carbon	URG 300N Quartz Filter	Thermal Optical Transmittance
Metals	Met-One SASS Teflon Filter	Energy Dispersive X-Ray Fluorescence
Ions	Met-One SASS Nylon Filter	Ion Chromatography

Section 6
AMBIENT AIR QUALITY TRENDS

The following graphs illustrate 5-year trends for PM_{10}, $PM_{2.5}$, SO_2, NO_2, O_3, and CO from 2017 to 2021 at all SLAMS stations monitoring for those pollutants.

Figures 6-1 and 6-2 are graphs of the PM_{10} annual and maximum 24-hour averages.

Figure 6-3 is the graph of the $PM_{2.5}$ annual averages. Attainment of the $PM_{2.5}$ 24-hour standard is based on the 98th percentile value at each station, which is depicted in Figure 6-4.

Figures 6-5 and 6-6 are graphs of the SO_2 annual and maximum 24-hour averages.

Figure 6-7 and 6-8 shows the annual and maximum 1-hour averages of NO_2 compared to the federal NAAQS.

Attainment of the 8-hour ozone standard is achieved by averaging 3 years of the fourth highest daily maximum 8-hour average concentrations, which must not exceed 0.070 ppm. Figure 6-9 is a graph of the fourth highest daily maximum values recorded at the Sand Island and Kapolei ozone monitoring stations in the past five years.

The graphs for 1-hour and 8-hour carbon monoxide (figures 6-10 and 6-11, respectively) represent the maximum 1-hour or 8-hour values recorded in the year.

Criteria pollutant levels remain below state and federal ambient air quality standards at all SLAMS stations in the state.

Figure 6-1. PM_{10} Annual Average: 2017-2021

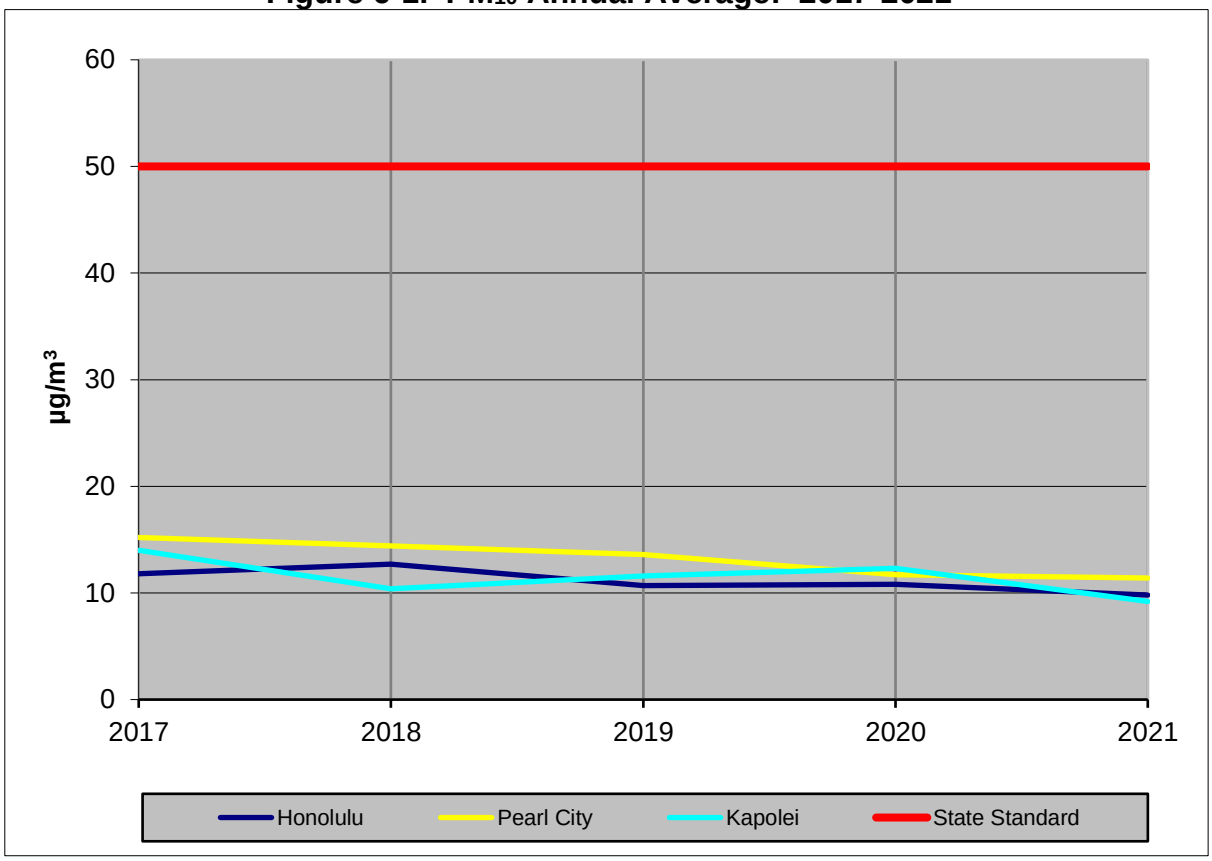


Figure 6-2. PM_{10} Maximum 24-Hour Average: 2017-2021

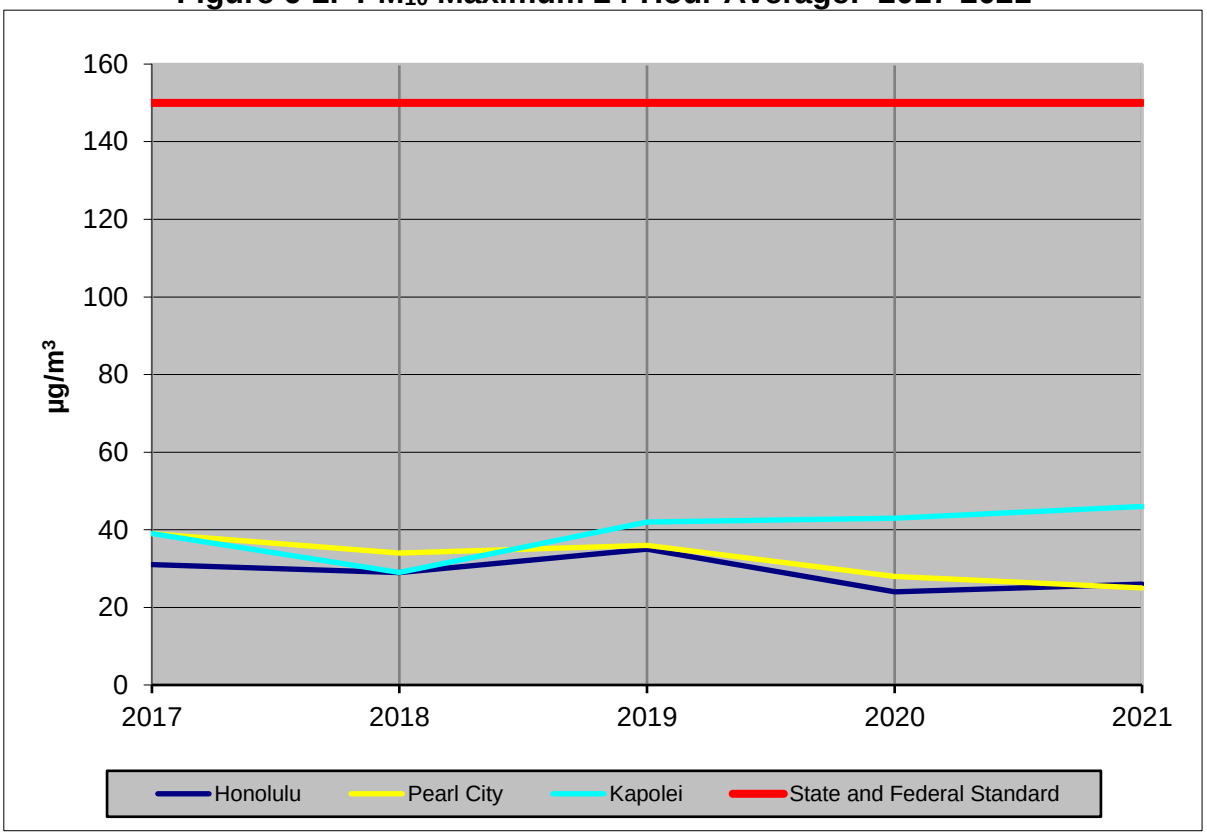


Figure 6-3. $PM_{2.5}$ Annual Average: 2017-2021

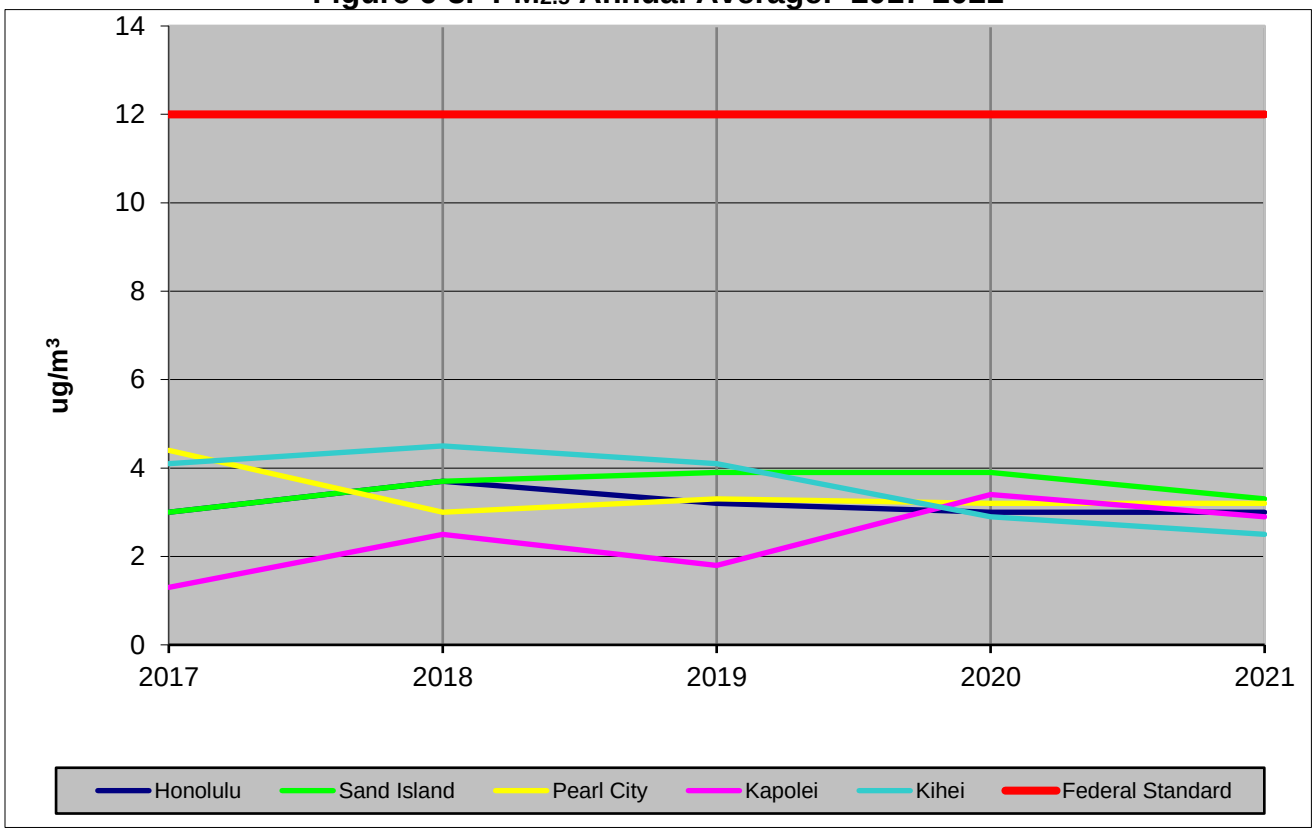


Figure 6-4. $PM_{2.5}$ 98th Percentile 24-Hour Average: 2017-2021

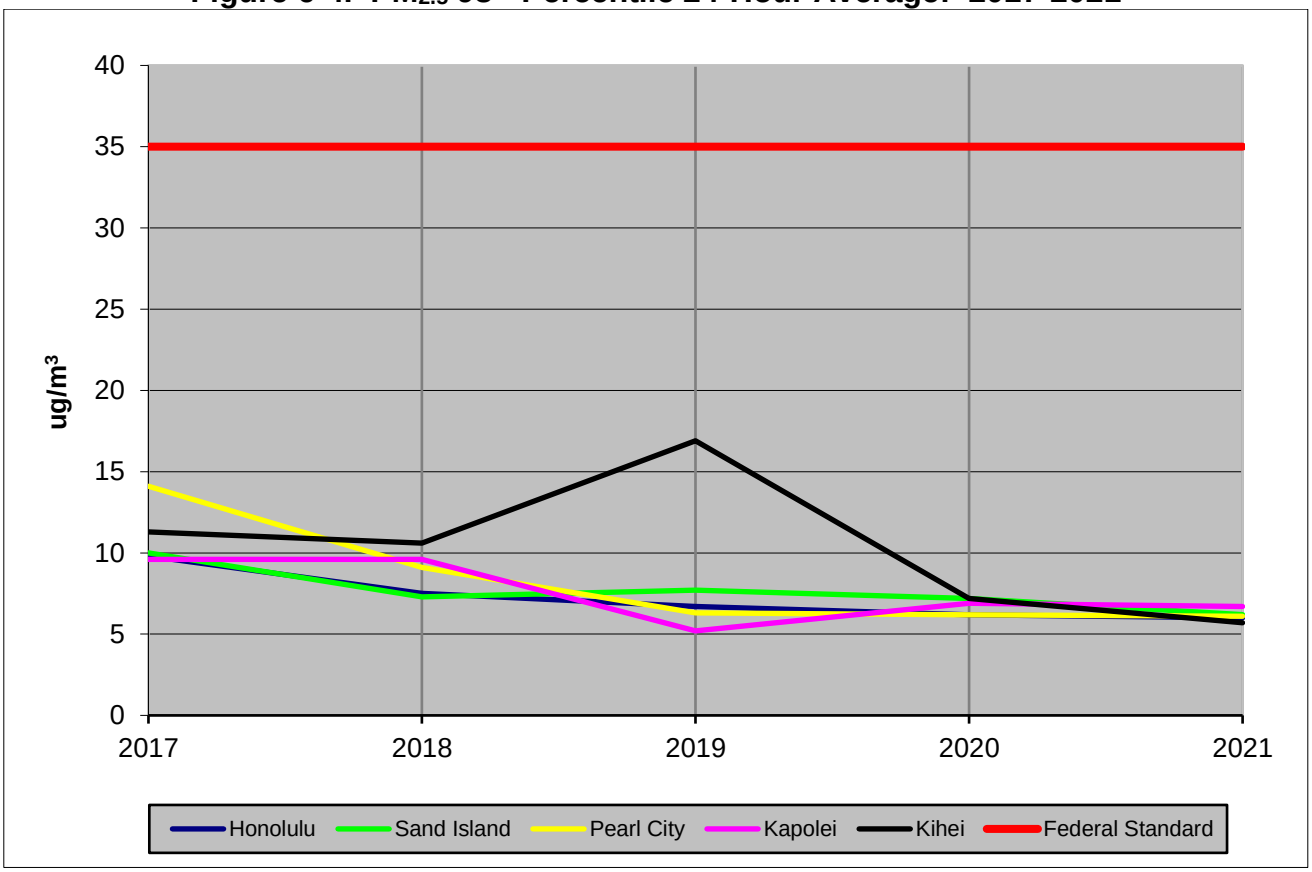


Figure 6-5. SO_2 Annual Average: 2017-2021

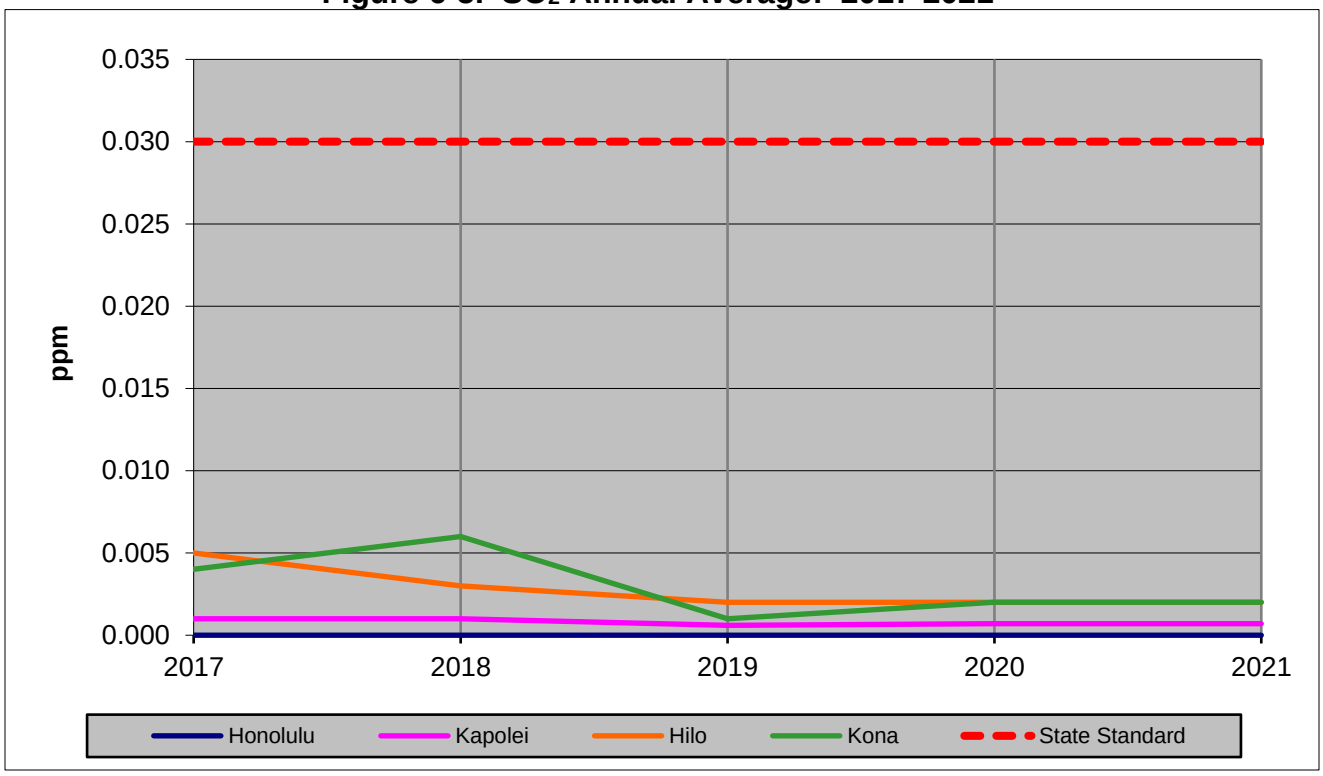


Figure 6-6. SO_2 Maximum 24-Hour Average: 2017-2021

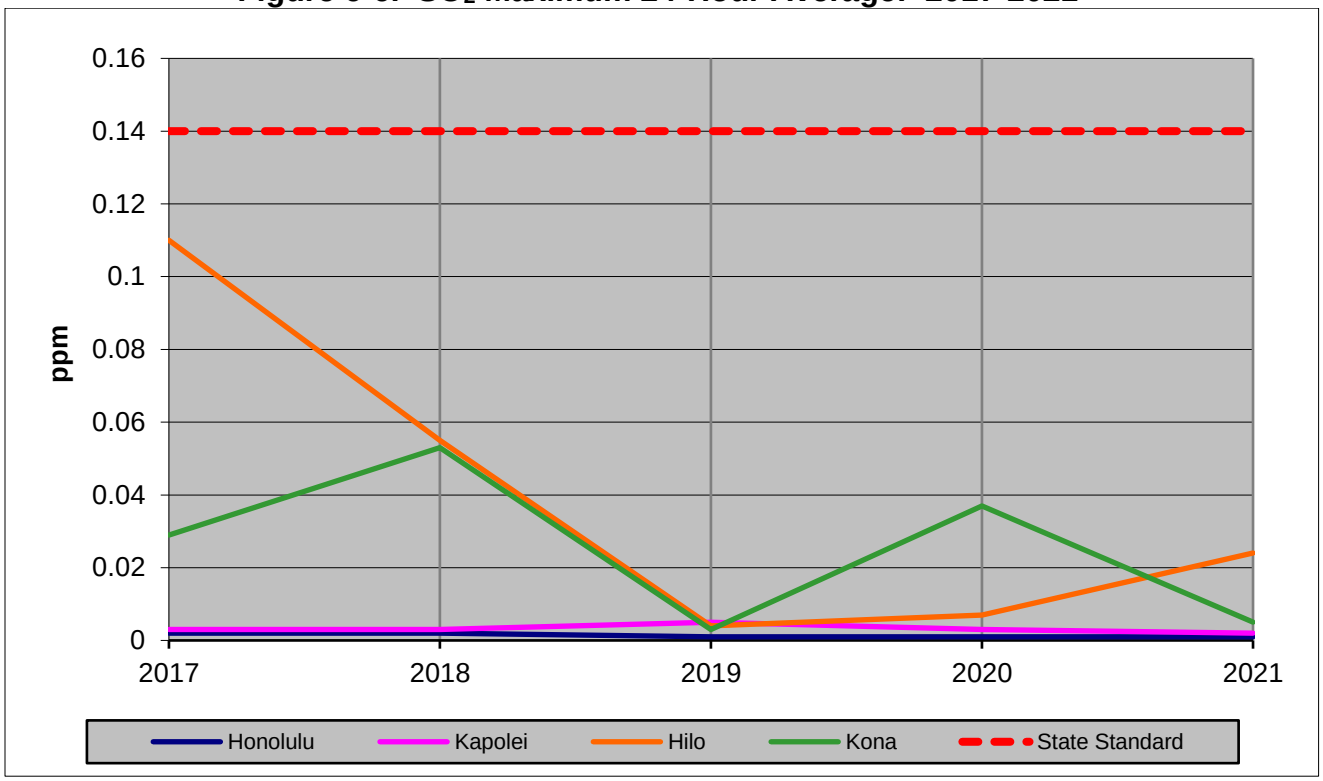


Figure 6-7. NO_2 Annual Average: 2017-2021

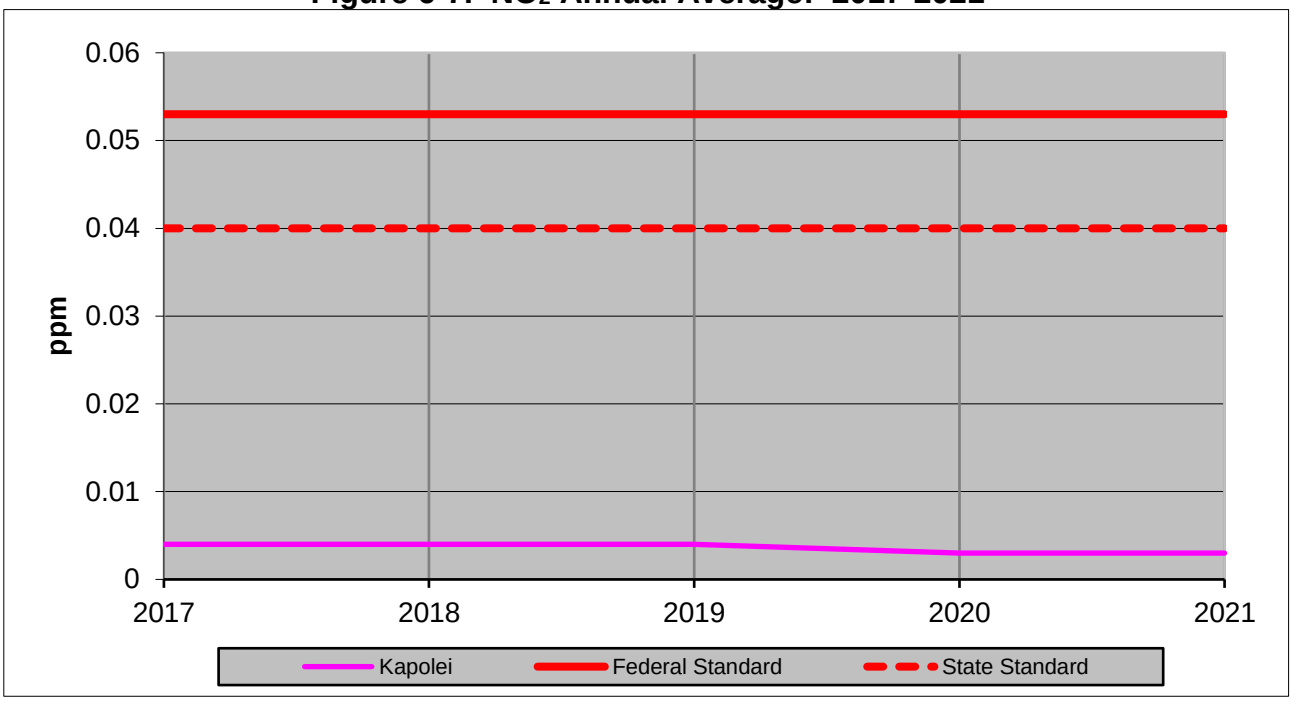


Figure 6-8. NO_2 Maximum 1-Hour Average: 2017-2021

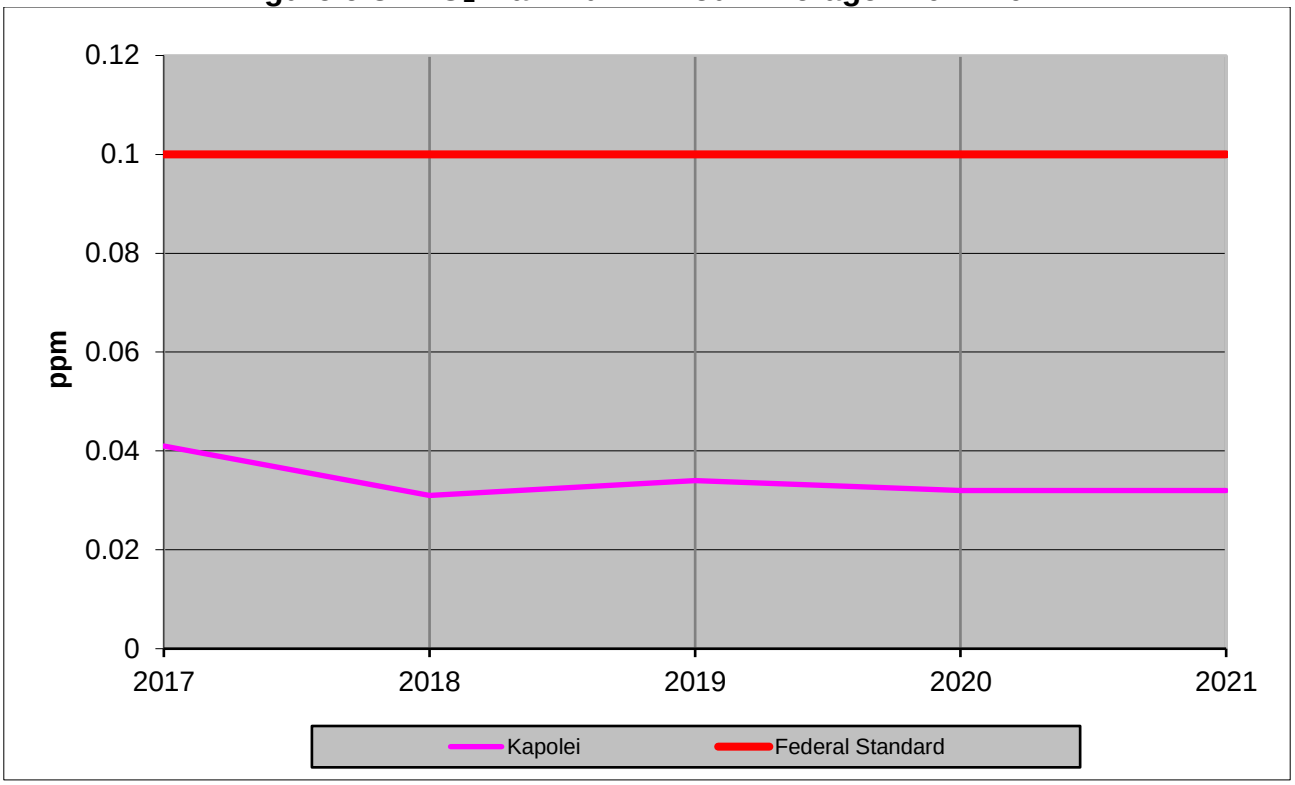


Figure 6-9. O_3 Fourth Highest Daily Maximum 8-Hour Average: 2017-2021

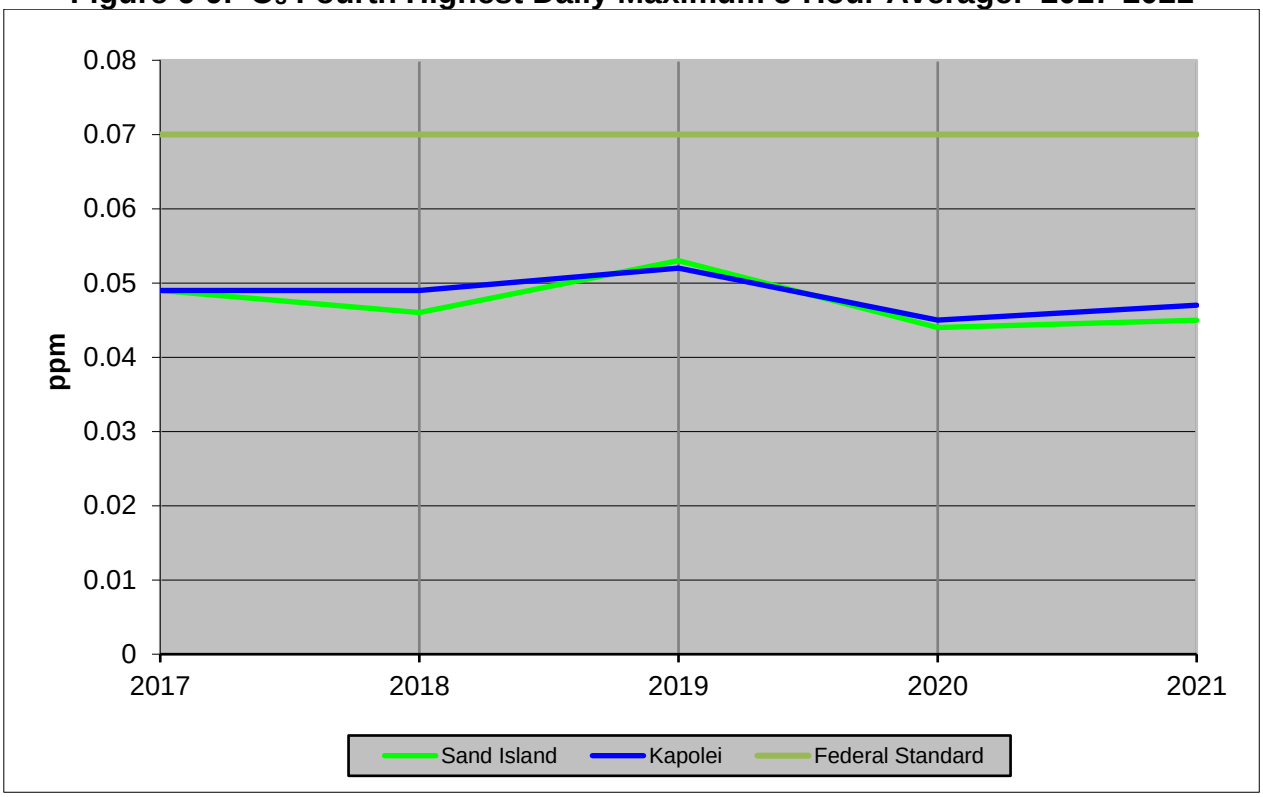


Figure 6-10. CO Maximum 1-Hour Average: 2017-2021

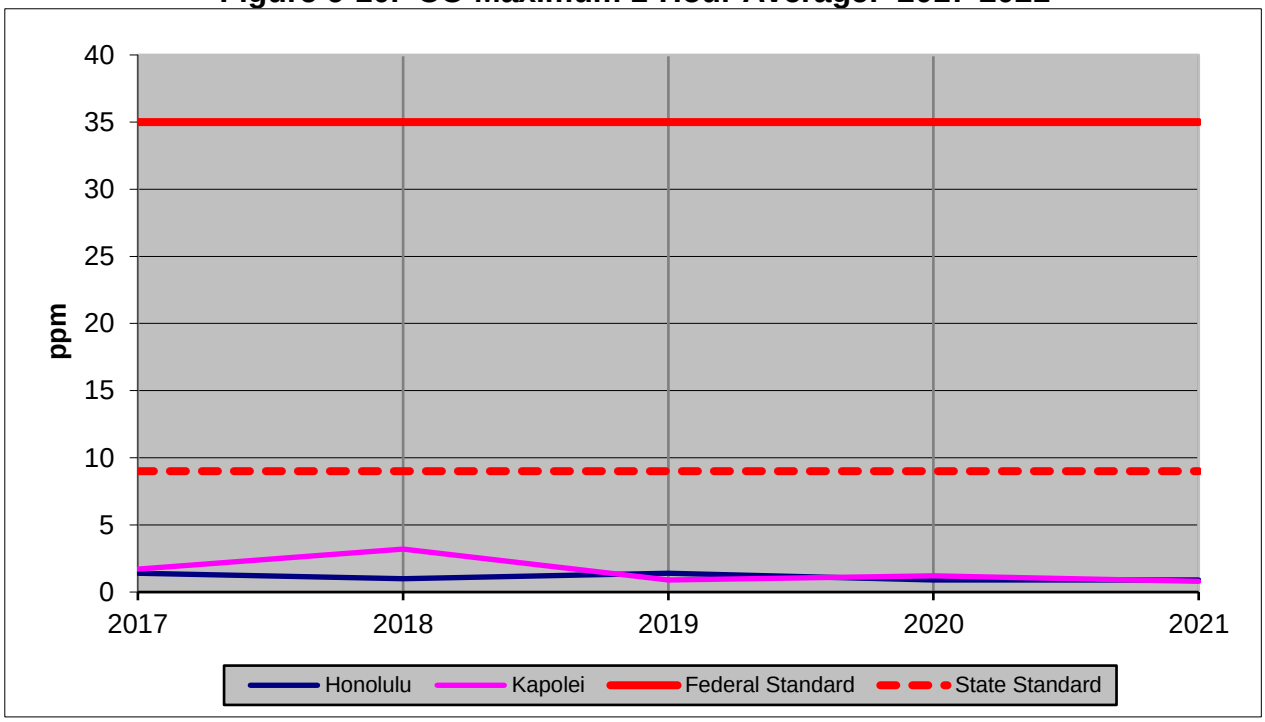
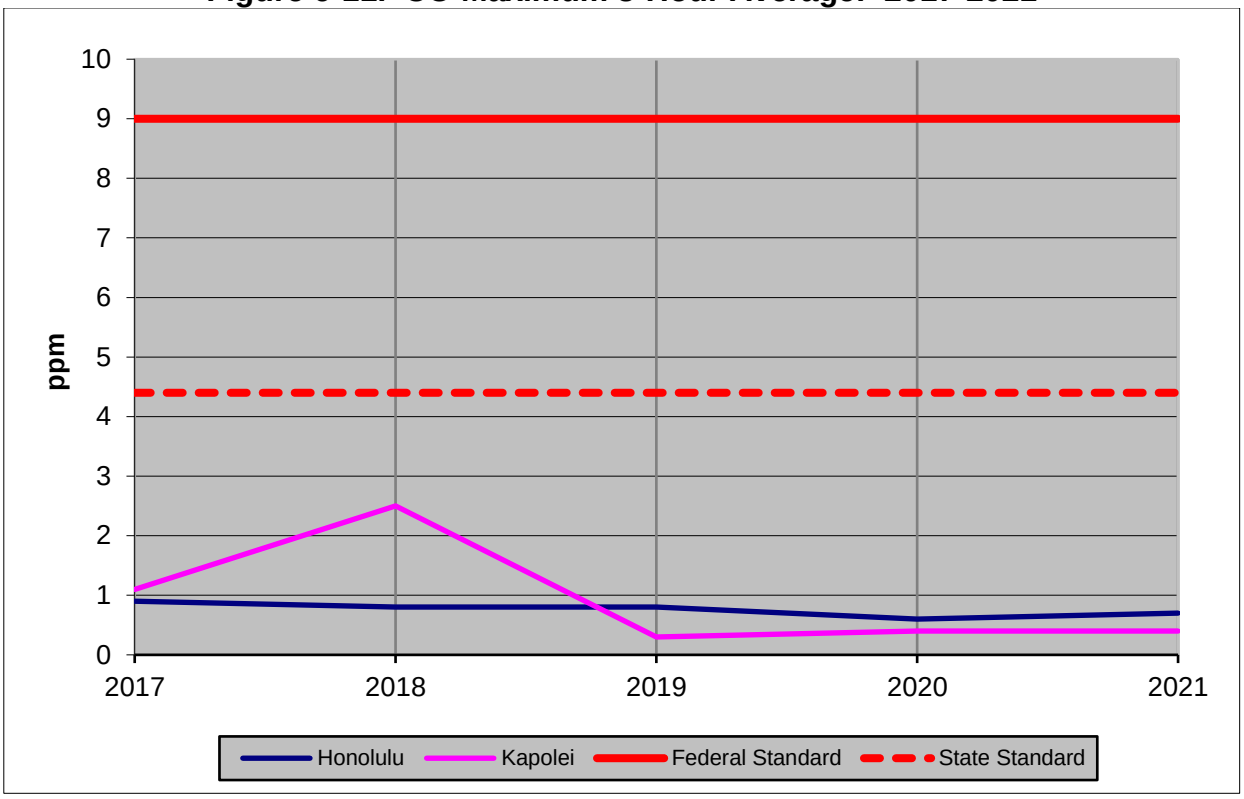



Figure 6-11. CO Maximum 8-Hour Average: 2017-2021