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Landscape and hazards

Saba and St Eustatius are both volcanic islands in the windward part of the Antilles. St. Eustatius and Saba are 33.6 km from each other (Land Register, 1997). They are furthermore comparable in terms of size and demography, St Eustatius is the larger of the two islands.

Saba is situated 30 kilometers south west of St Maarten it is approximately 13 square kilometers in size. The island is formed by a dormant volcano called Mount Scenery. It forms the highest point of the island at 877 meters. The slopes of the volcano descend in a steep angle to the sea and forms a rocky coastline which affects the accessibility of the island. The island can be accessed by boat as there is a small harbor close to The Bottom and by air as there is a small airport near Zion's Hill. The four population centers (the Bottom, St. Johns, Windward side and Zion's hill), the harbor and the airport are all connected with one road. With the obvious exception of the harbor, all population centers and the airport are located well above sea level.

Sint Eustatius' Geographic Location is Longitude 63.04 Latitude 17.03 and is located 36 miles from St. Maarten and is saddle-shaped, with the 602 meter-high dormant volcano called The Quill on the south east of the island and the smaller pair Signal Hill/Little Mountain (or Bergje) and Boven Mountain to the northwest. A flat area in between these highs is giving the island a saddle shape. Population areas: White wall, Oranjestad, Concordia and Princess with the hotels situated at Lower Town. The airport is positioned on the flat area, and an oil terminal is positioned at the North West, behind little mountain. In lower town lies in the harbor, connected with a single coastal road to Oranjestad.

VOLCANIC ERUPTION

A study published by the Koninklijke Nederlandse Academie voor Wetenschappen indicate that the volcano's on both St Eustatius as Saba cannot be considered to be dead, but dormant. The study also indicates that in the case of Saba the total population should be evacuated as there are no safe areas. In the case of St Eustatius, short time evacuation to the Northern part of the island could be considered, but is hampered by the fact that the only road and jetty in that area is in the vicinity of a large oil storage. (Volcanology of Saba and St Eustatius, Northern Lesser Antilles by M. John Roobol, Alan L. Smith). Remaining on St.Eustatius under

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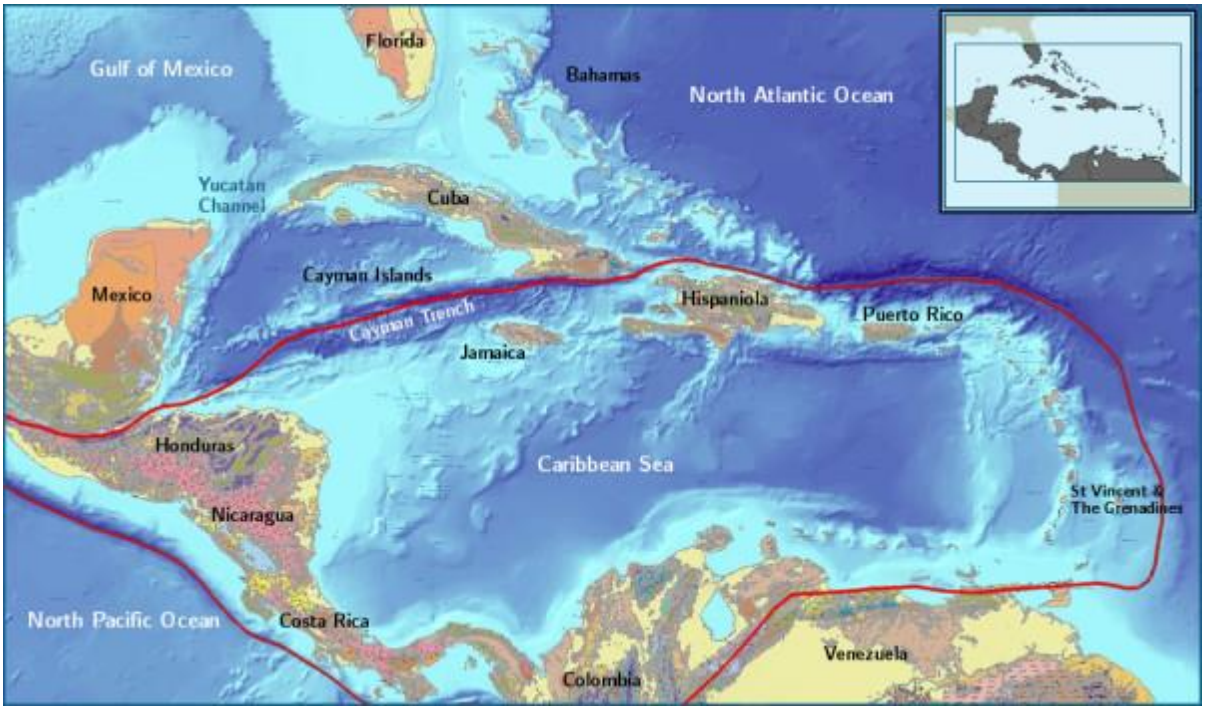
these conditions is not an option. **Volcanic eruption should be considered a high impact, low probability hazard.**

EARTHQUAKE

On the 1 December, 1867 Saba was reportedly affected by a larger earthquake at the same time as St.Thomas, accompanied by tsunami of reportedly 50 feet high (between 15 and 20 meters)

On the 4th of January 2008 two light earthquakes 4.3 and 4.1 respectfully – (as per scale of Richer: 4.0-4.9 - Light -Noticeable shaking of indoor items, rattling noises. Significant damage unlikely) were registered on registered and felt on Saba and St. Eustatius.

On January 17, 2008, minor earthquakes were felt again on the island of St Eustatius and Saba. The epicenter was at approximately 6 miles (10 km) Northwest of the island at a depth of approximately 3 to 6 miles (5 to 10 km.) around 17:46 and 18:32 in the afternoon and evening. The magnitudes varied between 3.5 and 3.6 on the Richter scale. The Meteorological institute KNMI and the Meteorological Service of the Neth. Antilles & Aruba are receiving the seismic signals in real-time.



These series of earthquakes in this region, up to now, do not have a pattern in which at first instance a main big tremor followed by different smaller tremors are experienced. It seems more like a swarm of small quakes of same magnitude at an extended period of time. This was also the case in 1992 and in the period

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between 1995 and 1997 that such swarms of quakes where experienced. The actual location of the tremors is the same as that during the year 1992 which lasted approximately three weeks. Meteorological service of the Neth. Antilles & Aruba. On August 12 2009 a series of earthquakes took place on St.Eustatius

• 03:00 hours • 14:35 hours • 14:47 hours 17:57 hours

A moderate earthquake rattled St Maarten and nearby Caribbean islands on, Monday 5 October 2009, sending hundreds of jarred islanders and tourists running out of buildings. There were no immediate reports of injuries or damage from the magnitude 4.5 quake. It struck at a depth of 22 miles and the epicenter was located east of St Maarten. The US Geological Survey said the temblor hit today around 12.30pm US eastern time (15.30 BST). It was also felt on the Caribbean islands of Anguilla, St Barths, St Kitts and St Eustatius.

In 2006, three seismometers were installed in St. Maarten, Saba and St. Eustatius in cooperation with the Dutch Meteorological Institute (KNMI). The data recordings are sent in real-time to and monitored by the University of Puerto Rico, KNMI, IRIS-DMC, the Seismic Research Unit of Trinidad, PTWC and MDNAA. In the event of an earthquake, information will be processed and send to other Caribbean seismic observatories. In case an earthquake has been felt in one of the islands of the Netherlands Antilles and Aruba, the MDNAA will issue an Informative Bulletin, containing relevant information on that specific earthquake. In case an earthquake is capable of generating a tsunami in the Caribbean Area, the PTWC will send watch or warning bulletins to the MDNAA. The MDNAA will then immediately pass on any relevant information to authorities and the general public. In case a strong earthquake is felt at your location and you are at or near the shore, you are strongly urged to seek higher ground and to listen to official information.

Earthquake should be considered as a low impact (building standards and no high rising buildings) and medium in terms of probability.

Read how to prepare for an earthquake here.

TIDAL WAVE OR TSUNAMI

"Deformation along the margin of the Caribbean Plate is the principal cause of the tsunami threat in the Caribbean. That margin parallels the northern coast of South America, the Lesser Antilles, and extends along the Greater Antilles from Puerto Rico through Jamaica. The eastern boundary of the Caribbean plate near the Lesser Antilles is the locus of subduction of Atlantic seafloor. At least three distinct, shallow tectonic regimes parallel the margin. They are: an outer tectonic belt where the North America Plate bends to enter the subduction zone, the main interface or zone of contact between the plates, and an inner zone of intraplate activity in the overriding Caribbean Plate. The level of seismic activity and tsunami potential in each of these zones is influenced by the presence of aseismic ridges on the down going plate. Ridges may increase the probability of tsunami or slow earthquakes, by reactivating thrust faults in the accretionary prism. The north-

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eastern corner of the Caribbean Plate margin has a smooth transition from the relatively simple subduction zone in the Northern Lesser Antilles into a region of oblique convergence"

(WILLIAM R. MCCANN, Earth Scientific Consultants, Westminster, CO 80021, USA)

Tidal Waves or Tsunami are unlikely to affect directly the main population centers of Saba and St. Eustatius as they are situated well above sea level. However, the tourism industry (hotels, restaurants and dive shops) as well as the Electricity and Water Company, harbor and a gasoline station will be severely affected on St. Eustatius as they are located along the coast. On Saba it would affect the harbor. Also the accessibility of the harbors will be affected as on both islands there is only one access road. When a Tidal Wave comes from the South East of St. Eustatius, the airport, the population of Lynch, Zeelandia could be affected. The hazard should be considered low in terms of probability, and medium in in terms of impact.

HURRICANE

The number of hurricanes in the Caribbean and Gulf of Mexico has been on a rise and experts say that this trend will continue for at least the following 15 years. Given that many people head to the tropical climates of Central America where life takes on slower pace temperature remains summer like year round, it is no wonder that everyone wants to make sure their vacation will not be spoiled by a vicious hurricane. Sadly, some of the most popular Caribbean islands are located within the Caribbean Hurricane Belt which makes them prone to hurricanes during the Atlantic Hurricane Season which extends from June 1st to November 30th.

Caribbean Hurricane Belt is an area in the Atlantic, including the Caribbean Sea and Gulf of Mexico that has a high level tendency to get hit by a hurricane.

Saba and St Eustatius are located within the hurricane belt and have been exposed to numerous tropical storms and hurricanes, the most significant in recent times being Hugo in 1989 and Luis in 1995. The greatest of all Hurricanes occurred from October 10 - 16, 1780.

This storm hit virtually every island from Tobago in the south east through the Leeward Islands across to Hispaniola. The death toll was 4,500 in Barbados, 9,000 in Martinique and at. St. Eustatius, the losses were very great. Between 4000 and 5000 persons are said to have lost their lives. [Source: Disaster Mitigation Guidelines by PAHO] .

The hurricane developed in the Atlantic possibly in the vicinity of 12°N and 38°W. It moved westward very slowly at little more than 6 nautical miles per hour. When its center was about 120 nautical miles east of Barbados, it began to curve and move between West by North and West-Northwest. After crossing a very short distance north of Barbados, it took a more North-Westerly track passing East of St. Lucia, Southwest of

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St. Kitts, South of Puerto Rico changing course for Mona Island, re-curving and passing East of the Turks Islands, re-curving to pass South East of Bermuda, moving North-East. Hurricanes list as highest risk in respect to probability and impact.

Read how to prepare for an hurricane here.

AIRPORT ACCIDENTS

Both islands have airports with regular flights, mainly to and from St. Maarten. Under regular wind conditions, due to the size of the airplanes and the direction of the runways (not in direction of populated areas) the number of casualties is not expected to be in excess of 50 persons. The St. Eustatius Red Cross Branch states however, that under different wind circumstances, when the aircraft is required to fly over the populated areas of Princess / Lodi and Golden Rock, should the aircraft encounter problems the casualty count will be higher (population count in Princess / Lodi 50 homes, population count in Golden Rock 80 homes).

In the case of Saba, in the event of high winds or cross winds, no planes can land or leave.

On both islands impact and probability is estimated to be medium

HARBOR ACCIDENTS

Both islands have a harbor where also crucial activities such as electricity production and desalination of water (Water Plant) are taking place. The existing port on St Eustatius was built in 1993 and consists of an 80 meters long breakwater with a harbor light. The pier is 8 meters wide, 60 meters long with a Ro-Ro accommodation of 15 meters wide. The harbors of Saba and St Eustatius are only accessible by a one way road which could cause difficulties for evacuation when an incident occurs; especially disaster tourism could affect evacuation efforts. With high waves, no boats can dock.

In addition to the city pier, as the main pier is called, STNV has a terminal as well, which is located near Tumble Down Dick Bay on the western side of the island of St. Eustatius. STNV's crude oil facility consists of onshore and offshore elements.

The terminal pier's location is approximately 1.5 miles (2.41 kilometers) northwest of the Government Pier. Their facilities include:

1. A Single Point Mooring located in approximately 210 feet (64 meters) of water, approximately 6000 feet (1830 meters) offshore

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2. Floating Hose Station #1 for bunker barges located in approximately 30 feet water (9 meters), approximately 1260 feet (385 meters) offshore
3. Floating Hose Station #2 with 2 berths: east berth for small vessels and barges, and the west berth for large vessel located approximately in 52 feet water (16 meters), approximately 1610 feet (490 meters) offshore.
4. The Finger Jetty (920 meters long) consists of 2 berths. Berth No. 1 located on the south face of the jetty and Berth No. 2 is on the north face. Minimum depth is 62 feet at MD-I. At Seaward Dolphin (MD-4) depth is +/- 30 meters. The water inshore along the jetty shoals gradually. The barge dock is at the shoreward end of the jetty in approximately 26 feet (8 meters) of water accommodating tugs and bunker barges. Barge dock +/- 8 meters depth. Tug dock (not in use any more) has a depth of +/- 4½ meters.

Generally; tanker mooring and hook-up can be conducted in significant seas of up to six (6) feet. Significant seas in excess of six (6) feet will cause the activity to be reviewed by the Terminal Manager.

Although safety is high priority oil spillage is a risk as well as fire and seepage of toxic gasses.

WATER SHORTAGES

The main annual rainfall on Saba is approximately 1,000 mm. The dry season is normally between December and July and precipitation varies depending on altitude and exposure to the Eastern Trade winds. Annual rainfall has been known to exceed 1,920 mm on the higher Windward slopes and the summit of the island. Data collected from January 1992 through December 1995 shows an average rainfall of 776.8 mm. This is far below the earlier figures and is an indication of the serious drought that occurred in Saba in 1994. Variation in rainfall intensity over the small area and different elevations of the island may partly account for the low readings. Most inhabitants of Saba practice rain water harvesting (cisterns) as an additional source. The dry season is normally between February to July. Light constant northeast trade winds keep the average temperature at a cool 27 degrees. However data collected shows that the rainfall for the past three years has decreased, which has caused a drought on the Island, which was felt during the years 2008 and 2009, in 2010, the dry period was not as hard felt. The entire population of St. Eustatius collects rain water in their cisterns, however, with the arrival of the water production, which uses the method of desalination of seawater, which is partially operational, the community can purchase water, that is then delivered by water trucks to their homes. In 2008, 2009 the demand for water was so great that the Statia Oil Terminals (Nu Star

Energy) was allowed to sell water as well. In 2009 the Dutch Royal Navy delivered 60.000 bottles of water to Saba. In 2013 more than 70.000 bottles of water have been delivered.

FIRE

Possibility of brush fire in the dry period is a threat for St. Eustatius. As well as the threat of a fire at NuStar Energy, although this is less likely due to their high standards of security.

EXPLOSION

Although there are no oil refineries as such on St. Eustatius, NuStar Energy stores LPN, LGN and other highly flammable gasses and chemicals. In addition there are various offshore businesses that carry out tests on the items coming in via NuStar Energy. The location of NuStar Energy, although relatively far from the populated area, is however very close to: a sand storage company, a school, two labs that test among others, oil and oil products, a gasoline depot , two car garages and body shops (that include welding) as well as the Red Cross Building and the airport. An additional reason fire and explosions are of concern is because there are no provisions on the island to deal with burn victims. These will have to be evacuated (flown out) to Guadeloupe, Curacao or Colombia.

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