= Cyclone Waka =

Severe Tropical Cyclone Waka (Fiji Meteorological Service designation : 03F , Joint Typhoon Warning Center designation : 07P) was one of the most destructive tropical cyclones ever to affect the South Pacific Kingdom of Tonga . Waka originated within the near @-@ equatorial trough in mid @-@ December 2001 , although the system remained disorganized for more than a week . The storm gradually matured and attained tropical cyclone status on December 29 . Subsequently , Waka underwent rapid intensification in which it attained its peak intensity as a Category 4 severe tropical cyclone (Australian tropical cyclone intensity scale) on December 31 , with winds of 185 km / h (115 mph) . Shortly thereafter , it passed directly over Vava 'u , Tonga , resulting in widespread damage . By January 1 , 2002 , the cyclone began to weaken as it underwent an extratropical transition . The remnants of Waka persisted for several more days and were last observed near the Southern Ocean on January 6 .

Although the storm affected several countries along its path , Waka left the most significant losses in Tonga , where it killed one person and wrought 104 @.@ 2 million pa?anga ($ 51 @.@ 3 million USD) in damage . Hundreds of structures , including 200 in the island 's largest city , and much of the nation 's agriculture were destroyed . Winds in excess of 185 km / h (115 mph) battered Vava 'u , defoliating nearly every tree on the island . In addition to infrastructural and public losses , the environment was also severely affected ; a native species of bat lost roughly 80 % of its population due to the lack of fruit . Following the storm , Tonga requested international aid to cope with the scale of damage . Due to the severity of damage , the name Waka was later retired and replaced with Wiki . According to a study by Janet Franklin et al . , storms similar in intensity to Waka , on average , strike Tonga once every 33 years .

= = Meteorological history = =

In mid @-@ December 2001 , at the end of a Madden ? Julian oscillation pulse , twin equatorial monsoonal troughs developed in the Northern and Southern Hemispheres . Although warm sea surface temperatures of 30 ° C (86 ° F) in the region favored development of a tropical cyclone , the southern trough developed substantially slower than the northern one . On December 19 , the southern component was classified as Tropical Depression 03F by the Regional Specialized Meteorological Center in Nadi , Fiji (Fiji Meteorological Service) ; at this time the depression was situated just east of the Solomon Islands . The northern component eventually developed into Typhoon Faxai , an extremely powerful Category 5 equivalent cyclone . Unlike Faxai , the precursor to Cyclone Waka developed slowly , mainly because of moderate wind shear in the region . Moving southeastward , the system gradually became more organized . On two occasions , the Joint Typhoon Warning Center (JTWC) issued a Tropical Cyclone Formation Alert ; however , the agency later canceled them both times . By December 27 , the depression had entered a region of lesser shear , favoring significant development of the system . The following day , the JTWC classified the system as Tropical Depression 07P , when the storm was situated roughly 640 km (400 mi) northwest of Pago Pago , American Samoa .

Tracking towards the southwest in response to a mid @-@ level ridge to the southeast , the depression quickly intensified , attaining gale @-@ force winds on December 29 . Upon doing so , it was upgraded to a tropical cyclone and given the name Waka . Shortly thereafter , the storm underwent rapid intensification ; roughly 24 hours after being named , Waka attained sustained winds of 120 km / h (75 mph) . During December 30 , the center of the storm brushed Wallis Island before turning towards the southeast and accelerating due to an approaching trough from the northwest . Continuing to intensify , Waka passed directly over Niuafo 'ou on December 31 with winds of 150 km / h (90 mph) . Later that day , the cyclone attained its peak intensity as a Category 4 severe tropical cyclone with ten @-@ minute sustained winds of 185 km / h (115 km / h) and a barometric pressure of 930 mbar (hPa ; 27 @.@ 46 inHg) . The JTWC assessed the storm to have attained similar one @-@ minute sustained winds upon peaking ; however , this was due to discrepancies between the two warning centers . At this time , Waka displayed a well @-@ defined ,

circular eye roughly 60 km (37 mi) in diameter . Shortly after attaining its peak intensity , the center of Waka passed over Vava 'u .

Continuing into the new year , Waka gradually weakened on January 1 , 2002 as it entered a less favorable region for tropical cyclones . As a result , wind shear displaced convection from the center and its eyewall broke apart . Moving over decreasing sea surface temperatures , Waka began to undergo an extratropical transition , which it completed on January 2 . Tracking southeastward , the remnant cyclone briefly slowed over open waters before again accelerating . Over the following few days , the system gradually weakened , with sustained winds decreasing below gale @-@ force by January 5 . The storm was last noted on January 6 near the Southern Ocean , about 2 @,@ 200 km (1 @,@ 400 mi) north @-@ northwest of Antarctica , at which time it had a pressure of 972 mbar (hPa ; 28 @.@ 7 inHg) .

= = Preparations and impact = =

= = = Tonga = = =

On December 30 , just a day before Waka passed through Tonga , warnings were issued for numerous islands , including parts of Fiji and Samoa . Forecasts showed the storm passing directly over the low @-@ lying Tongan capital of Nuku 'alofa as a Category 3 cyclone . Owing to warnings from local media , all New Year 's Eve celebrations were canceled as residents and tourists boarded up their homes . All airports in the region were shut down and ferry service was suspended . Many residents on the small island of Niuafo 'ou , about 35 km2 (13 @.@ 5 mi2) in size , evacuated to other islands prior to Waka 's arrival .

When the storm was moving through the islands of Tonga at peak strength , a few islands recorded hurricane @-@ force winds ; the city of Neiafu measured the strongest winds , peaking at 185 km / h (115 mph) . In the southern islands , wind gusts up to 250 km / h (155 mph) affected isolated areas . In the Ha?apai islands , sustained winds reached 100 km / h (65 mph) and gusted to 140 km / h (85 mph) . Heavy rains also fell during Waka 's passage , amounting to over 200 mm (7 @.@ 9 in) in Ha?apai .

Initial reports from Nuku?alofa on December 31 indicated severe agricultural damage but few infrastructural losses . Following the passage of Waka , communication with Niuas and Vava 'u were lost . According to local reports , high winds sandblasted Neiafu and downed nearly every tree . Surveys by the Red Cross revealed that roughly 200 homes in the city were severely damaged or destroyed and those left standing lost their roofs . Vava 'u lost roughly 90 % of its crops , including essential food crops such as taro , yams and bananas . In Ha 'apai , one person died from cardiac arrest brought on by the storm . Fallen trees blocked numerous roads ; power and water supplies were also interrupted to most residents . Severe damage also took place on Niuatoputapu where coastal homes were impacted by Waka 's storm surge and several structures lost their roofs . In one instance , a yacht was brought onshore by the surge and crashed into a restaurant , destroying both .

According to damage surveys , 13 of the country 's islands sustained damage ; 470 homes and 6 schools were destroyed and hundreds more damaged . Damage throughout Tonga amounted to 104 @.@ 2 million pa?anga ($ 51 @.@ 3 million USD) . In addition to infrastructural and public damage , the environment sustained catastrophic losses on Tonga . The Insular Flying Fox (Pteropus tonganus) , a native species of bat , suffered great losses from Waka . Compared to pre @-@ cyclone population levels , 79 @.@ 8 % (± 9 @.@ 9 %) of the species was killed across six islands . This was due to widespread destruction of their natural food source , which decreased by 85 % (± 11 @.@ 8 %) following Waka . Trees across Vava 'u were completely defoliated , although only 6 @.@ 6 % were killed , leaving no food for the bats . The greatest decline in bats was on Utula 'aina Island at 95 @.@ 7 % ; A 'a Island sustained a complete loss of food @-@ bearing plants . Six months after the storm , the bat population in Vava 'u was still only 20 % of the pre @-@ storm level .

= = = Elsewhere = = =

During the cyclone 's formative stages , it brought significant winds and swells to Tokelau , resulting in localized flooding and crop damage . American Samoa also experienced heavy rains , amounting to 56 @.@ 9 mm (2 @.@ 24 in) , and gusts up to 90 km / h (56 mph) . The winds downed a few trees and caused minor crop damage , with losses amounting to US $ 120 @,@ 000 . Large swells affected the island for roughly a week as the storm developed and moved away from the region . Cyclone Waka also affected Wallis and Futuna , prompting tropical cyclone watches and warnings from December 28 to 31 , and later impacted Niue , prompting warnings there from December 30 to January 1 . On Wallis Island , one home was destroyed and 50 % of the banana crop was lost . A maximum of 112 mm (4 @.@ 4 in) of rain fell in Hihifo during the passage of Waka . A wind gust of 126 km / h (78 mph) and swells up to 7 m (23 ft) were recorded in Wallis . Niue received more significant damage , experiencing a storm surge of up to 8 m (26 ft) and sea spray up to 100 m (330 ft) inland . Numerous fallen trees and power lines blocked roads and left southern areas of the island without power for roughly six hours . Damage in Niue amounted to US $ 10 @,@ 000 .

After moving through the Tongan islands , the remnants of Waka brought large swells , estimated up to 2 @.@ 5 m (8 @.@ 2 ft) , to the North Island of New Zealand . Thousands of residents and tourists were in the region following the New Year 's holiday . Meteorologists warned that the oceans would be increasingly dangerous and advised people not to venture into the water . Every lifeguard in Whangamata , as well as former lifeguards , were called in to assist in keeping an estimated 8 @,@ 000 people out of the water . Although most people stayed within a designated swimming area , several rescues had to be made . Rip currents also pulled 38 people out to sea in Mount Maunganui Main Beach ; all were quickly rescued by lifeguards .

= = Aftermath = =

Within a day of Cyclone Waka 's passage in Tonga , the Government of New Zealand deployed an aircraft to survey the scale of damage and reestablish contact with the Tongan Islands . This aircraft was sent in accordance with the FRANZ Agreement , enacted in 1992 , which states that assests from one country would be used in relief operations . On January 2 , the head of Tonga 's Disaster Office announced that they would likely need international assistance to recover from the storm . Due to the substantial damage to agriculture , food shortages were expected to impact the region over the following months . By January 7 , the Red Cross began sending supplies to Tonga . Hundreds of tents and tarpaulins were brought in by an Australian AC @-@ 130 to help with the recovery process . On January 12 , a New Zealand Lockheed C @-@ 130 Hercules carrying US $ 700 @,@ 000 worth of supplies flew to the area to deliver aid . An additional US $ 700 @,@ 000 was given in relief funds to repair damage wrought by the storm . Of this , US $ 500 @,@ 000 would be used to repair schools that were damaged or destroyed and the remaining US $ 200 @,@ 000 would be used for emergency lighting , cooking and food supply recovery .

Further funds came from the United States Agency for International Development , which offered US $ 25 @,@ 000 by mid @-@ January . The French Polynesian assembly in Tahiti also provided US $ 770 @,@ 000 worth of relief supplies and aid . The main industry of Tonga , tourism , was devastated by the storm as no tourists were allowed to travel to the region for at least two weeks after Waka 's passage . The Government of Tonga requested a total of US $ 39 @.@ 2 million in international aid , most of which was dedicated to rehabilitation of infrastructure . Medical supplies and personnel were later deployed by the World Health Organization . In early March , a relief fund based on donations was set up by the United Methodist Committee on Relief to provide US $ 210 @,@ 000 for 30 families impacted by the storm . About 180 people were given assistance in rebuilding their homes by the Church World Service later that month . As food shortages became severe in April , emergency supplies were sent to the outlying Niuas islands of Tonga . In May , US $ 5 @.@ 85 million was approved for emergency funds by the World Bank to assist in infrastructural rehabilitation .

Vava 'u suffered a tremendous decrease in agricultural exports due to Waka , dropping 86 @.@ 5 % from the previous year . Despite substantial agricultural losses , the sector ended up expanding roughly 2 % by the end of 2002 and the overall economy grew by 2 @.@ 9 % . Owing to the severity of damage wrought by the cyclone , the World Meteorological Organization retired the name Waka following its using and replaced it with Wiki .