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FIJI METEOROLOGICAL SERVICE

TROPICAL CYCLONE REPORT 92/1

TROPICAL CYCLONE KINA

26 December 1992 to 5 January 1993

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Tropical Cyclone Reports are intended to be quickly available, preliminary descriptive reports for public use. Their early issue means that details may be subject to subsequent correction.

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INTRODUCTION

Kina was the second tropical cyclone to occur in the area of responsibility of the Nadi Tropical Cyclone Warning Centre (TCWC) during the 1992/1993 Southwest Pacific Tropical Cyclone Season. It was also the second to hit Fiji within a month, causing one of the most severe devastations in recent times.

Originating from a tropical depression just east of Solomons on 26 December, Kina initially moved very slowly in the general direction of Fiji as it developed steadily. It reached peak intensity by late on the 29th with estimated maximum average winds of 75 to 80 knots and momentary gusts of 120 knots close to its centre. It maintained this intensity for nearly half of a total lifespan of about 9 days as a tropical cyclone.

Embedded in a changing upper-level environment and influenced by other weather systems existing in the area at that time including tropical cyclone Nina which formed in the Australian Gulf of Carpentaria and moved rapidly eastwards across the Coral Sea, Kina followed a rather distinct and erratic path that resulted in the cyclone centre passing between Fiji's two main islands of Viti Levu and Vanua Levu, and directly over the old capital of Levuka on Ovalau during the night of 2nd January. The cyclone later crossed Southern Lau and also threatened Southern Tonga, passing about 60 miles southwest of Nukualofa at its closest proximity.

Fiji suffered its greatest ever financial loss due to a tropical cyclone with destruction or damage to houses, property, infrastructure and crops valued at nearly \$F170 million (\$US110 million). 23 human deaths occurred, several others were reported missing and there was an unaccountable loss of livestock. Prolonged heavy rainfall brought by Kina, with a combination of other factors including high tides and heavy seas which basically blocked the mouths of major rivers, caused the worst flooding experienced in over sixty years, accounting for much of the loss. Heavy damage was also sustained in Tonga where at least three human lives were lost.

HISTORY

Though a tropical depression had existed in the area near Solomon Islands for some days, it was not until 26 December when the system gained enough organization to warrant issue of warnings. The first international marine warning on the depression was issued at 1200 UTC* on the 26th indicating average winds close to the centre to gradually increase to 35 knots (gale force). After showing rapid organization initially, and then

*UTC - Universal Co-ordinated Time (same as GMT)
Add 12 hours for Fiji Standard (local) Time.

slight relaxation for about 12 hours, the system began to steadily develop from about 1200 UTC on the 27th. It was designated a tropical cyclone and code-named "Kina" by the Nadi TCWC at about 1900 UTC on the 27th.

Kina initially moved towards southeast at about 5 knots but turned southwards soon after 1800 UTC on the 28th and became slow-moving approximately 300 miles northwest of Nadi for about two days from early on the 29th. Meanwhile the system developed to peak intensity with maximum average winds estimated at 75 to 80 knots and momentary gusts to about 120 knots. Destructive to very destructive winds were expected within about 60 miles of the centre and damaging gales out to about 120 miles from the centre initially, and to a much wider area later as the cyclone expanded and started interacting with other neighbouring weather systems.

Between 0600 and 1800 on 31st December Kina made a curvature towards east and started heading for the Yasawa Group in Fiji at about 05 knots again. As the system approached Northern Yasawas, it turned sharply towards southeast, meanwhile accelerating to about 15 knots, and tracked between the two main islands of Viti Levu and Vanua Levu. The island of Yasawa experienced the passage of the southern portion of Kina's very large and ill-defined "eye" in the afternoon of 2nd January (Fiji time) with the "lull" lasting about 4 hours. The effect of the "eye" was also felt over Viti Levu's northern town of Rakiraki around midnight (Fiji time) on 2nd January and over Ovalau (on which the old capital Levuka is situated) during early hours of 3rd January. After crossing Ovalau the cyclone turned east-southeast for a while, but then again curved southeast and moved across Southern Lau, its centre passing close to the island of Fulaga, Kabara, Ogealevu, Vanua Vatu, Moala and Vatoa.

After crossing Fiji Kina threatened the Southern Tonga Group causing destructive winds over Tongatapu and nearby smaller islands between 1200 UTC on the 3rd and 0000 UTC on the 4th. The cyclone centre passed about 60 miles southwest of Nukualofa.

WARNINGS AND ADVISORIES

The Nadi Tropical Cyclone Warning Centre (TCWC) had the primary responsibility for monitoring and issuing marine, aviation and public warnings on Kina for most of its lifespan. Besides Nadi several centres from both within and outside the region issued regular warnings and advisories on the cyclone. These included the Brisbane TCWC, the Joint Typhoon Warning Centre in Guam, the Honolulu Weather Service, the Offutt Air Force Base in USA and the global forecast centre in Bracknell, United Kingdom.

The advisories and guidance received from the various centres were very useful for determining the intensity and forecasting the track of Kina by Nadi.

i) International Marine Warnings

The first warning was issued by the Nadi TCWC at 1315 UTC on 26 December when the system was still a depression about 650 miles to the northwest of Fiji and 500 miles to the north of Port Vila in Vanuatu. Winds close to centre were estimated to be 30 knots but were expected to

increase to 35 knots in the next 12 to 18 hours. Subsequent gale warnings on the depression were issued every six hours. It was not until 30 hours later that the system acquired tropical cyclone characteristics. Subsequently, the Nadi TCWC upgraded the system and issued the first storm warning on KINA at 1915 UTC on the 27th with estimated average winds of 40 knots close to centre, increasing to 50 knots in the next 12 hours. As the environmental conditions became more favourable, Kina began to develop further and winds close to centre were progressively increased.

Enhanced satellite imagery later on the 28th indicated a warm spot to be appearing at the centre of the cyclone. Based on this and anticipated further development, warnings on Kina were upgraded to hurricane category from 1915 UTC on that day. Destructive to very destructive winds over 50 knots were initially forecast within 30 miles of centre and later increased to about 60 miles as the system intensified and expanded further. Similarly, the radius of gales was extended from 120 miles when Kina initially acquired hurricane intensity to about 400 miles in the northern semicircle at one stage as the system expanded itself and started to interact with other neighbouring weather systems.

After maintaining peak intensity for about 4 days Kina began losing intensity from about 0600 UTC on the 3rd, as it encountered strong vertical windshear and entered into cooler sea waters. Warnings were downgraded accordingly as the winds associated with the cyclone gradually decreased. The Nadi TCWC issued a final warning (storm warning) at 0600 UTC on the 4th following which Wellington assumed responsibility to issue further warnings on Kina. The cyclone was estimated to have 60 knots close to centre at that time. 18 hours later, and after several issues of the warnings by Wellington, a visible satellite imagery indicated Kina to be located further north still in Nadi's area of responsibility. The Nadi TCWC therefore resumed issuing warnings on it, soon downgrading it to a tropical depression and issuing the final warning at 1915 UTC on the 5th of January by when gales were no longer associated with the system.

ii) Special Weather Bulletins for Fiji

The first SWB for Fiji was issued at 1045 hours FST* when Kina was located about 360 miles northwest of Nadi and was moving southeast, towards the Group, at about 05 knots. The whole country was placed on a tropical cyclone alert. This was some four days before the tropical cyclone started to have its direct impact on Fiji. Soon after the first alert was issued, Kina began to curve southwards and became slow-moving about 300 miles northwest of Nadi for over two days. Meanwhile an alert was maintained for the whole Group in seventeen SWBs issued at 4 to 6 hourly intervals during the period.

On the morning of 1st January, 1993 it became apparent that Kina would move closer and start to have its effects on Fiji in the next 24 hours. Subsequently, a gale warning was issued for Yasawa and Mamanuca Groups and Northwestern Viti Levu in SWB number eighteen compiled at 1100 hours FST on that day. Winds in these areas were forecast to become strong overnight and increase to damaging gale force from the next

* Fiji Standard (or local) Time

morning. It was also indicated that winds may become more destructive in these areas later in the day. The rest of Fiji was still placed under an alert. The next three SWBs, issued 4 hours apart, carried similar warning messages. In SWB number twenty-two compiled at 0300 hours FST on 2nd January, a storm warning was issued for the Yasawas and a gale warning maintained for Mamanuca Group and northwestern Viti Levu, west of a line from Rakiraki to Sigatoka. With more eastward movement of Kina, the gale warning was extended to cover the whole of Vanua Levu in the next SWB issued at 0700 hours on that day. SWBs were issued at 3 hourly intervals thereafter. In SWB number twenty-five Yasawa Group was placed under a hurricane warning. By then Kina was located about 80 miles west-northwest of Yasawa.

With Kina's persistent movement on a fairly easterly path towards Vanua Levu at about 05 knots, though the system was expected to curve east-southeast later, the whole of Vanua Levu, Taveuni and Northern Lau were placed under storm warning in SWB Number twenty-six issued at 1600 hours FST. In the next SWB the western half of Vanua Levu was brought under hurricane warning along with some islands in Lomaiviti and Lau Groups. The storm warning was extended to include the areas of Tavua, Rakiraki and Tailevu in Viti Levu. Meanwhile Kina turned southeast and was accelerating. Consequently, areas of Viti Levu from Ba, eastwards through Rakiraki, all the way to Navua and the whole of Lomaiviti Group were warned to expect very destructive hurricane force winds. Warnings were adjusted accordingly as the cyclone centre passed close to Rakiraki, which experienced the southwest edge of Kina's large eye, over Ovalau and close to or over several islands in Southern Lau Group.

Altogether thirty-eight SWBs were issued for Fiji on Kina, twenty-one of which carried specific warnings. The whole country was warned, at one stage or another, to expect damaging gales or destructive to very destructive winds storm to hurricane force winds and heavy rain with expected occurrence of flooding including sea flooding of low-lying coastal areas from the tropical cyclone. The final SWB for Fiji was issued at midday on 3rd January by when Kina had passed Southern Lau and was accelerating southeast, towards Southern Tonga.

iii) Special Weather Bulletins for Tonga

The first Special Weather Bulletin (SWB) containing an alert for Southern Tonga was issued at 1645 UTC on the 2nd when it was anticipated that Kina would head towards the Group. The cyclone was estimated to have peak winds of 75-80 knots and momentary gusts up to 120 knots at that time. Kina began to accelerate towards the southeast at about 15 knots. Six hours later a gale warning was issued for Southern Tonga while the cyclone was located some 300 miles to the northwest of Nukualofa. Winds were expected to increase to 40 knots with gusts to 60 knots during the evening of the 3rd. Bulletins were issued every 3 hours thereafter. At 0530 UTC on the 3rd, as Kina curved more towards the south-southeast, the warning for Tongatapu Group was upgraded to a storm with a forecast maximum average winds of 60 knots and gusts to 90 knots. The centre of the cyclone was anticipated to pass within 40 miles of Tongatapu Group within the next 7 hours. A gale warning was maintained for the rest of Southern Tonga.

As Kina got closer to the Group, (about 80 miles northwest of Nukualofa at 1200 UTC on the 3rd), the warning for Tongatapu Group was further upgraded to a hurricane with expected average winds of 70 knots. Similarly, warning for Ha'apai was upgraded to a storm while Vava'u was still under gale warning. As the cyclone moved rapidly away from the Group towards the south, warnings were downgraded accordingly. SWB Number 10 issued at 2100 UTC on the 3rd contained a gale warning for the whole of Southern Tonga as Kina was located about 70 miles south of Nukualofa.

The final Special Weather Bulletin for Southern Tonga was issued at 0000 UTC on the 4th, as the system moved away and winds were expected to rapidly decrease to below gale.

In total 11 SWBs were issued for Tonga on Kina between 1645 UTC on the 2nd and 0000 UTC on the 4th.

iv) Special Advisories for Vanuatu

Special Advisories for Vanuatu were started in the very early stages when the system was only a depression located north of the Group and appeared to be moving south-southeast. With a possible curvature towards south, or southwest, the system had the potential to directly threaten Vanuatu. A total of eight Special Advisories were issued at six hourly intervals starting from 0300 UTC on 27 December. They were tailored to meet the needs of the Vanuatu Meteorological Service, particularly in compilation of alert or warning bulletins. The final Special Advisory was issued at 2000 UTC on the 28th when it was clear that Kina would move away and no longer pose a threat to the Group.

v) Tropical Disturbance Advisories

Nadi issued 12 hourly Tropical Disturbance Advisories on the system from the time the depression was first located until Kina dissipated completely as a tropical cyclone within its area of responsibility. The advisories were for general information purposes and were addressed to all national meteorological services within the region, and beyond. They contained information on the location, movement and intensity of the system, plus expected changes within the next 24 hours.

EFFECTS

The rather peculiar path of Kina led to the cyclone causing severe effects over Fiji, parts of which experienced the full brunt of a cyclone for the first time in over 20 years, and moderate damage over Southern Tonga.

i) Fiji Group

Rainbands from Kina had already started to affect Fiji from 28 December causing some heavy rainfall in the interior and eastern parts of its main islands. Winds in most of the Group became strong from late on 1st January and gradually increased to damaging gale force in the morning of the 2nd over Yasawa and Mamanuca Groups, and from later that afternoon in rest of the Western and Northern Divisions. Rain also became frequent and heavy. As Kina approached and passed overhead or close to Yasawas, Northern and Eastern Viti Levu, Southwestern Vanua Levu, and Lomaiviti and Lau Groups between the night of 2nd and afternoon of 3rd January (refer to attached track), winds became destructive to very destructive and rain became torrential.

Kina's path virtually across the middle of the Fiji Group resulted in most parts of the Group suffering moderate to severe damage. The country was battered by winds averaging up to about 80 knots and momentary gusts to 120 knots. Prolonged heavy rain and resultant massive overflow of the country's major rivers caused extensive flooding, which in some cases was the worst experienced in over sixty years. This was notably the major cause of loss of lives and destruction. The northern and eastern parts of Viti Levu and some islands in the Lomaiviti Group and Southern Lau were declared the worst hit.

Major disruption was caused to transportation between the Eastern and the Western Divisions as the two main-road bridges at Ba and Sigatoka broke under the pressure of the torrential currents and accumulated debris in these flooded rivers.

A number of landslides especially about the interior of Viti Levu cut the road access to settlements inland.

Crop damage especially in the Sigatoka and Navua/Nausori areas was severe with almost total losses. In some cases all farm machineries and equipment were washed away. Loss to livestock especially in the eastern parts of Viti Levu was significant enough to threaten the dairy and meat industries.

Infrastructure suffered badly with houses close to flooded river banks being swept totally off from their foundations while other sustaining severe damage from high winds.

In total 23 lives were lost mostly as a result of drowning and being struck by flying objects.

Preliminary cost of damage has been estimated at nearly \$F170 million.

ii) Tonga

Major damages were confined to the Tongatapu Group, the southern-most islands of Tonga as Kina passed closest to these islands. Three lives were lost in Nuku'alofa, two by drowning and one as a result of electrocution. Damage to food crops, especially bananas and breadfruit, on Tongatapu was severe while that to dwellings was minimal. Electricity and communications were also disrupted.

CONCLUSION

Despite some very irregular features of Kina, its rather unique and erratic path, and the various problems and disruptions encountered by the Nadi TCWC, the cyclone was well handled. Warnings and advisories issued on the system were reasonably accurate and timely. It is a pity that the cyclone could not be located by radar as it approached Fiji, which would have helped track the system much more precisely. This in turn would have allowed the public to be warned slightly earlier of changes in the path of the cyclone and the resultant threat.

Kina will go on record as one of the most destructive tropical cyclones in Fiji's recent history. It will be particularly notable for the very severe nature of floods that resulted, which was no doubt the major cause of death and destruction.

TABLE 1 WINDS AND PRESSURES RECORDED AT METEOROLOGICAL STATIONS IN FIJI AND TONGA DURING PASSAGE OF KINA

Station	Winds (Knots) (dir&spd/gust)	Time (UTC)*	Lowest Pressure (HPa)	Time (UTC)
<u>FIJI</u>				
Nadi Airport	18052 / 79	021153**	968.8	020920
Nausori Airport	18060 / 88	021600	964.9	021600
Nabouwalu	32090+ / 110	021330	970.2	021500
Ono-i-lau	10040 / 75	030900	978.0	030600
Laucala Bay	14049 / 77	021200	972.3	021600
Lakeba	27020+ / 50	030400	970.7	030200
Matuku	18065+ / 110	030030-030315	977.2	030000
Viwa	12080 / 110	020900	955.9	021200
Udu Point	30035 / 62	030000	984.8	021630
Vanua Balavu	35040 / 50	030019	980.2	030100
Vunisea	11037 / 50	021200	986.3	021600
Yasawa-i-Rara	06090+ / 120	020400	949.5	020600
<u>TONGA</u>				
Vavau	23037	040400	993.3	031800
Ha'apai	36040	032000	990.2	031800
Fua'amotu	03050 / 76	031833	971.0	032000
Nuku'alofa	03038-03058+ (unable to estimate gusts)	031600-031900	971.5	032000

* UTC = Universal Co-ordinated Time (same as GMT)
For Fiji Standard Time add 12 hours.

** 021153 = 1153 hours UTC on 2/1/93 (2353 FST).

+ indicates that winds were manually estimated.

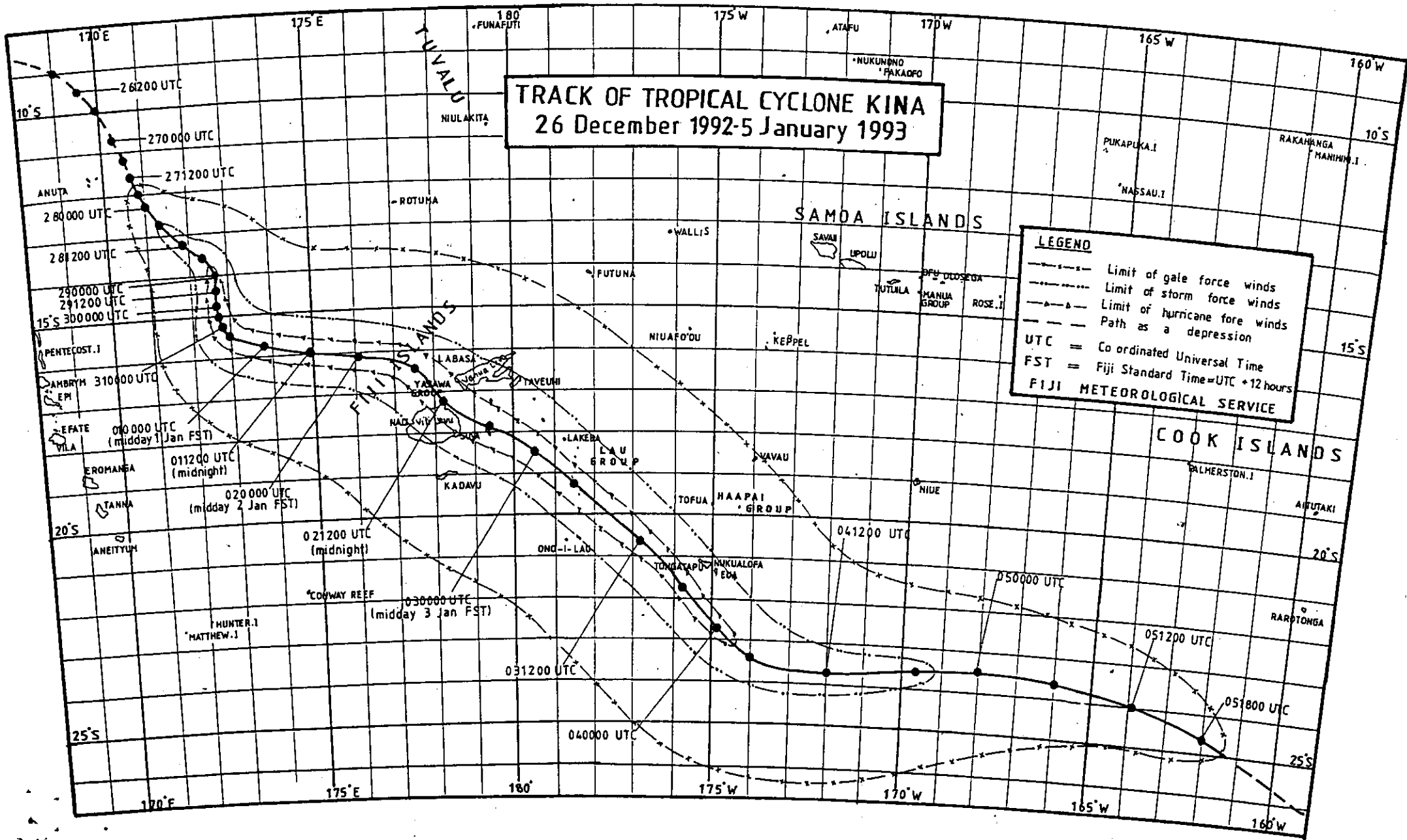
TABLE 2 RAINFALL RECORDED AT STATIONS OVER FIJI DURING PASSAGE OF CYCLONE KINA.

	Nadi	Suva	Sgtka	Monasavu	Labasa	Ba	Lakeba	Koro-O	Savusavu	Nausori	Navua	Levuka	Ltka	Penang
28 Dec	Tce	1	nil	16	8	nil	1	nil	nil	1	1	2	nil	4
29 Dec	4	87	13	145	23	2	4	8	19	48	48	10	1	15
30 Dec	26	24	4	112	6	5	24	22	1	26	30	22	nil	40
31 Dec	4	88	22	73	2	9	35	20	nil	28	221	11	7	19
1 Jan	13	9	-	23	15	11	17	12	34	7	-	4	17	55
2 Jan	1	62	-	104	20	6	11	19	14	70	-	41	8	68
3 Jan	143	-	-	550	-	-	23	295+	89	260	-	-	212*	295+
4 Jan	2	12	-	17	nil	-	-	7	3	-	-	-	212*	3
TOTAL	193	283	39	1040	74	83	115	383	160	440	300	90	245	499

Note: * denotes accumulated rainfall for period 9 am 2 Jan (Sat.) to 9 am 4 Jan (Mon.).

+ denotes actual rainfall to have exceeded this amount as the raingauge over-spilled.

TRACK OF TROPICAL CYCLONE KINA 26 December 1992-5 January 1993

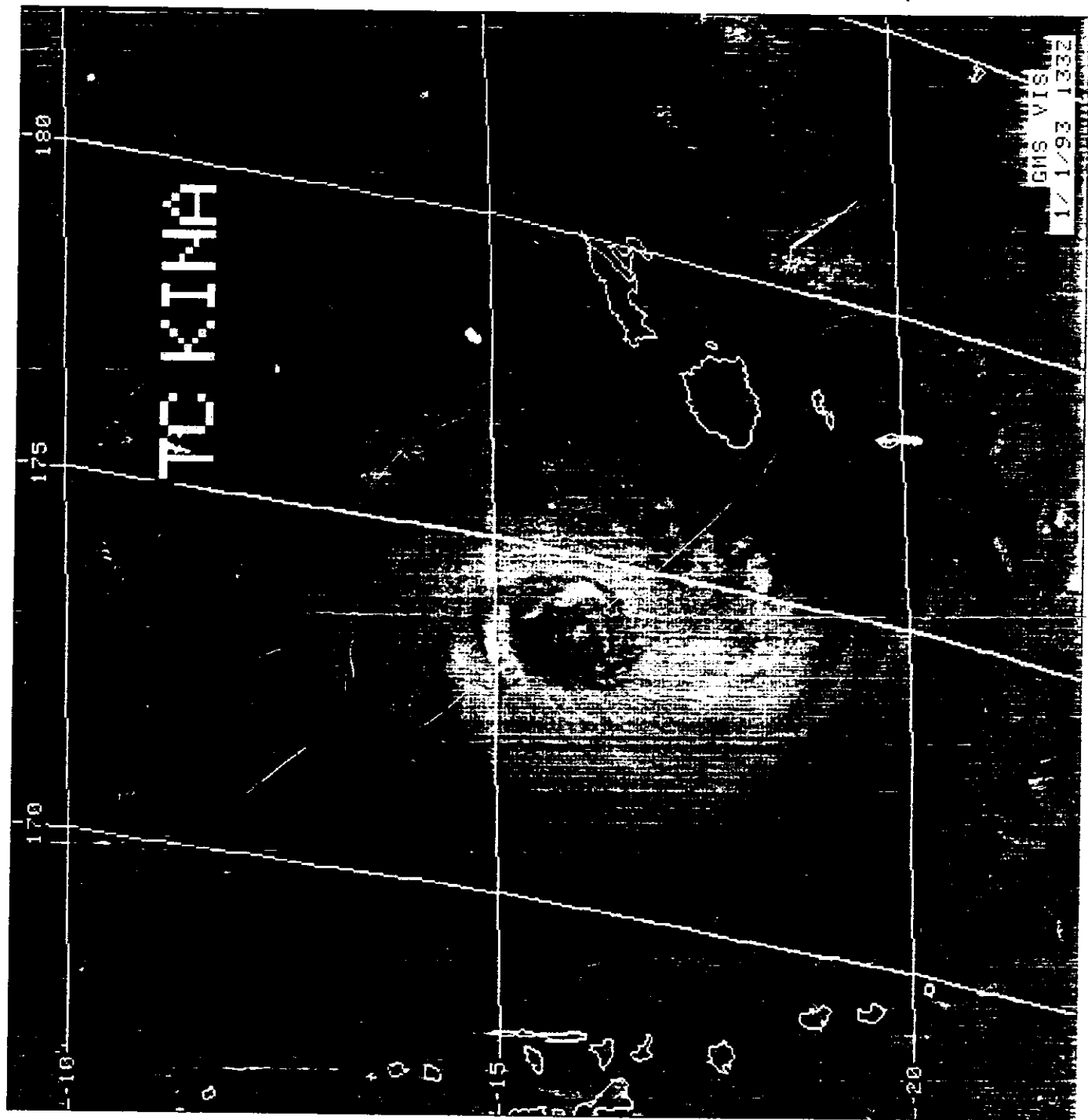


LEGEND

- x--- Limit of gale force winds
- Limit of storm force winds
- - - - - Limit of hurricane force winds
- Path as a depression

UTC = Co ordinated Universal Time
 FST = Fiji Standard Time = UTC + 12 hours

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