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GOVERNMENT OF WESTERN SAMOA

PRELIMINARY
DAMAGE ASSESSMENT REPORT
FOR CYCLONE VAL

6 - 9 DECEMBER 1991

Prepared by
National Disaster Council


Signed by:.....
Hon. Tuilaepa S. Malielegaoi
CHAIRMAN

APIA 13th December 1991

I N T R O D U C T I O N

Early on Friday, 6 December 1991, the first storm warning for Western Samoa was received. Soon after, it was up-graded to a hurricane warning - the highest wind warning - and on Friday evening, Cyclone Val began its assault on the Western Samoa islands. This onslaught continued unabated for four days until the early hours of Tuesday, 10 February 1991. In the evening of the same day the hurricane warning was cancelled for the Western Samoa Group.

Tropical Cyclone Val was the most destructive hurricane to strike Western Samoa in the last 100 years. The Cyclone Val system was extraordinary for its intensity and its irregular path and shifting speed particularly in the vicinity of the Samoa Group.

Cyclone Val generated average sustained winds of 90 knots or 104 miles per hour gusting up to 130 knots or 150 miles per hour over four consecutive days.

As Cyclone Val approached Samoa, it was travelling at 10 knots or 12 miles per hour moving steadily on a South-East course. But on nearing Savaii it slowed to a speed of 5 knots or 6 miles per hour and changed to a South-West course, as it passed over Savaii. It then changed course again, curving northwards and remained stationary for about 6 hours before it finally moved away south east of the Samoa Group.

We were grateful for the weather forecasts on Cyclone Val provided by the Fiji meteorological service. Some of the information received in the latter stages of the passage of Cyclone Val through the country might have caused our people to relax their vigilance somewhat prematurely.

Twice on Sunday evening, 8 December 1991, the weather forecast was for "winds decreasing from tomorrow morning". This forecast was repeated in the early hours of Monday, 9 December 1991. The effect of this information on people who have endured three harrowing days of devastation was dramatic. People went outside on Monday morning and started clearing up and repairing damaged houses. During this Monday and continuing into early Tuesday, 10 December 1991, Upolu was struck by the strongest and most destructive winds, unleashed by Cyclone Val.

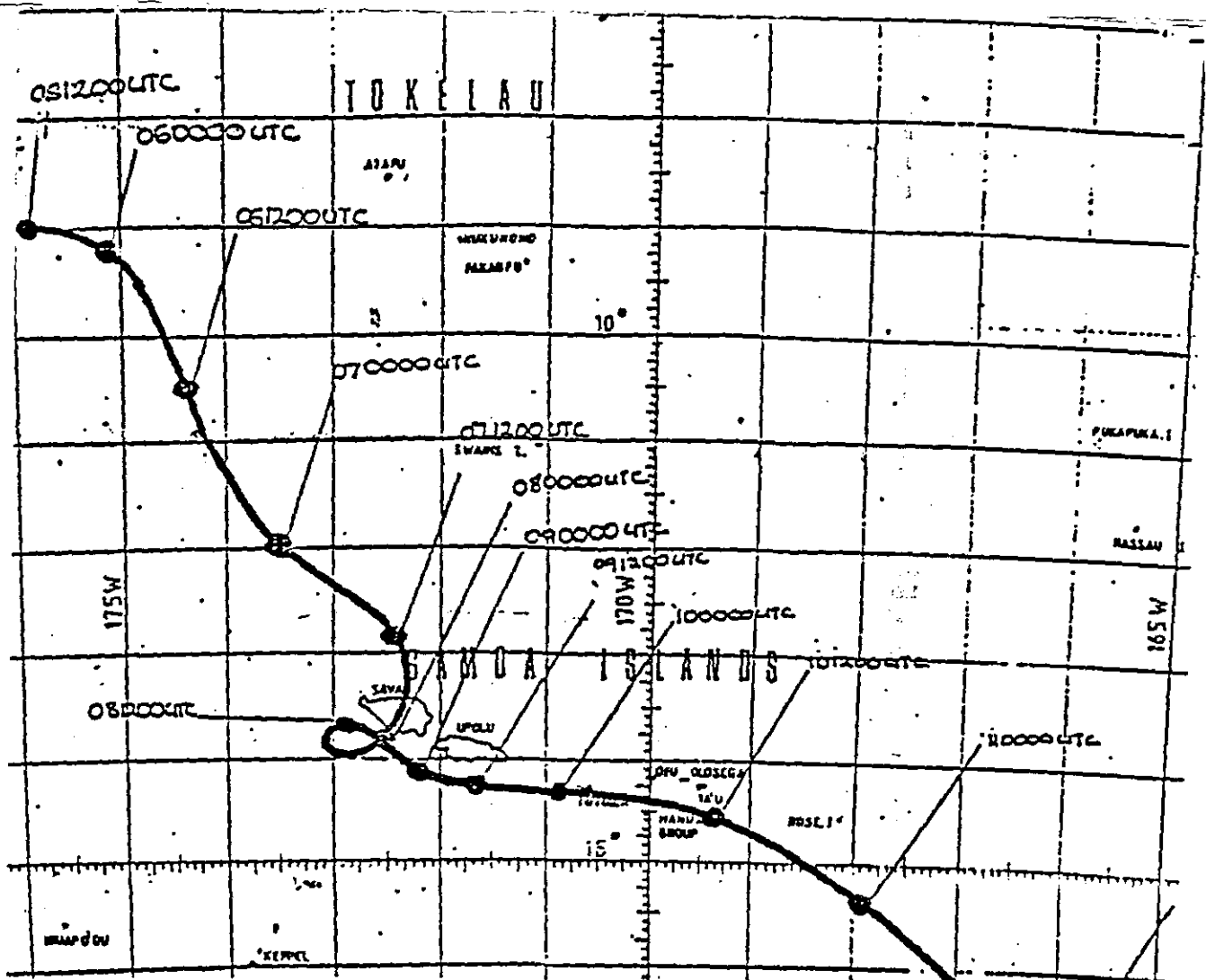
Given the frequency of cyclones in this part of the South Pacific, Western Samoa must quickly up-grade the Apia Observatory so that it is able to provide reliable weather information in a timely manner.

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By comparison, Cyclone Ofa which struck the Samoa Group in February 1990 buffeted Western Samoa for a period of three days with winds gusting up to 130 miles per hour and moving at a steady speed of 12 knots or 14 miles per hour in a straight south east path.

This preliminary damage assessment report will form the basis of discussions with the donor community for assistance in rehabilitating Western Samoa and its economy from the devastation wrought by Cyclone Val. A more comprehensive report will be issued when detailed surveys and assessments of the damages are completed.

PATH OF CYCLONE VAL



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PREFACE:

This preliminary report has been prepared for the National Disaster Council as a matter of urgency, and is based on a series of ground and aerial observations, most of which have been of a cursory nature. Detailed surveys will be made in due course, and a further report will then be prepared. The observations have nevertheless been undertaken with the help of available professional personnel, and may be taken as reliable preliminary findings.

The report deals with the following items:

- * Section 1 - Roads
- * Section 2 - Major Bridges
- * Section 3 - Water supply
- * Section 4 - Apia Surface Drainage Project
- * Section 5 - Coastal Protection Works
- * Section 6 - Buildings and Dwellings
- * Section 7 - Airports
- * Section 8 - Ports
- * Section 9 - Sea Transport
- * Section 10 - Power Supply
- * Section 11 - Postal and Telecommunications
- * Section 12 - Primary Industry (Agriculture)
- * Section 13 - Education
- * Section 14 - Health
- * Section 15 - Fire Services

Damage estimates in this Report have been made on the basis of reports by Public Works Department (PWD) and other Government agencies, with assistance provided by consulting engineers, as listed hereunder:

Roads:Upolu:

- . East Coast Road - PWD/Cardno and Davies (C&D)
- . Lemafa Pass - Richardson Road - Beca Worley
- . South Coast Road - Peseta Luaiufi Tone (PLT) Consultants
- . Cross-island Road - PWD
- . West Coast Road - PWD/C&D
- . Aleisa Road - PWD/C&D
- . Quarry Operations - PWD
- . Apia Town Streets - PWD

Savaii

- . North Coast Road (incl. SR-1, SR-2 contracts) - PWD/Snowy Mountain Engineering Corporation (SMEC)
- . Minor Roads - PWD

Buildings:

- . Government Office Buildings - PWD
- . Private housing - PWD
- . Government Residences - Department of Lands and Environment (L&E)

Bridges:

- . Major bridges (Upolu and Savaii) - Tinai, Gordon Consultants (T&G)

Ports:

- . Apia Port Works and other port related facilities - Ministry of Transport (MOT), Nippon Tetrapod, Rinkai Construction and Beca Worley International (BWI)

Airports:

- . Faleolo International - SMEC, Airport Authority
- . Fagalii Domestic - PWD
- . Maota Domestic - PWD/SMEC

Drainage:

- . Apia Surface Drainage Project - PWD.

Coastal Protection Works:

- . Public Works Department.

Water Supply:

- . Public Works Department.

Power Supply:

- . Electric Power Corporation

Education Facilities

- . Education Department

Health Facilities

- . Health Department

Primary Industry (Agriculture):

- . Department of Agriculture, Forests and Fisheries

Telecommunication:

- . Department of Post Office and Telecommunications

Cost estimates quoted in this Report are to be regarded as preliminary only. They will be confirmed and/or revised as more detailed damage assessments become available.

This Report does not include any estimate of damages to the tourism infrastructure or financial losses likely to be incurred as a result of Cyclone Val. Neither does it attempt

to estimate the damages to private property (other than housing) or damages and losses in the business community. The estimates relate only to those items specifically dealt with under the various Section headings.

The estimates are generally based on current contract rates. Where contract rates are not readily available, rates used in recent project feasibility studies are employed.

On 1st February, 1990, Western Samoa was struck by Cyclone Ofa, which lasted for three days and caused severe damage to buildings, air-fields and the coastal road system. Ofa was considered a rare event. Although wind speeds were comparatively low, seas were very high with extraordinary wave regimes. The recurrence frequency of Ofa was put at between 2% and 1.25% (1:50-80 years).

Cyclone Val struck Western Samoa on Friday, 6 December 1991, and by comparison with the Ofa reports and by general account, it was significantly more severe than Ofa. Cyclone Val lasted four days, and caused the most devastation on Monday evening, 9 December 1991. Maximum wind gusts were reportedly 260km per hour which were far in excess of wind strengths during Ofa.

It is estimated that about 90% of all buildings on Savaii suffered major damage (50% roof loss or more damage), and about 80% on Upolu. It is estimated that some 50% of all Government buildings on Upolu sustained substantial damage. Many of the older, colonial-style buildings will need major reconstruction.

Ongoing roading and bridgeworks have been seriously disrupted. Contract works in general would need to be extended by up to 2 months. Vast quantities of catchment trash and debris have been washed down, causing severe blockages at many bridges, with resultant overwash and scour. Structural damage has occurred at some bridges.

Damage Assessment and Cost Estimates by Sector or Sub-sector:

SECTION 1 - Roads

Main Roads - Upolu

East Coast Road: Apia to Falevao (includes EC-1 contract.).

Access over the full road length has not been possible. A section of the road which had been reconstructed under the EC1 contract has remained generally intact, although it has sustained substantial damage to the running surface. The engineered and constructed coastal protection works withstood Cyclone Val well, with loss only of the Type E protection.

This should be revised to embrace larger rock units at time of reinstatement. A major realignment is also clearly indicated at about 12km chainage.

There was extensive destruction of the road in the vicinity of Solosolo village.

It is estimated that an extension of Contract Completion time of 2½ months will be needed to repair and realign the East Coast Road.

Estimated cyclone damage costs
(including WST\$ 1.0m for deviation)

= WST\$ 4.250m
=====

Lemafa Pass/Richardson Road:

These roads are currently under contract C1. Roads generally stood up well. Some minor slips and washouts accrued. Repair works have started and would take approximately three weeks to complete.

Estimated cyclone damage costs

= WST\$ 0.120m
=====

South Coast Road - (Leulumoega to Samusu).

Overall, this road stood up well, particularly the first section down to Fusi village. The newly sealed sections have generally remained undamaged. Pot-holing and some pavement break-up have occurred between Fusi and Salani. This road was cut at Vavau and the section between Vavau and Lalomanu (about 12km), through Aleipata, has been completely destroyed and will need total reconstruction. Carefully engineered coastal protection works along this road would be necessary.

Estimated cyclone damage costs

= WST\$ 10.050m
=====

Cross-island Road:

Generally in good condition except for two major washouts, and longitudinal edge-erosion. Two major culverts are needed and sub-surface drainage works should be done, but these lie outside "cyclone damage" parameters.

Estimated cyclone damage costs

= WST\$ 0.085m
=====

West Coast Road (Apia to Falelatai):

This road suffered substantial loss of shoulder material, sealing and some pavement damage. A number of culverts need reinstatement. The recently constructed, but non-engineered, seawall suffered damages and carefully engineered coastal protection must be incorporated into the reconstruction of this important road.

Estimated cyclone damage costs
(including coastal protection) _____

= WST\$ 2.850m
=====

Aleisa Road:

No major damage to pavement occurred. A clean-up task, with emphasis on opening and re-defining drainage facilities is needed.

Estimated cyclone damage costs _____

= WST\$ 0.010m
=====

Quarry Operations:

This section includes damage costs to the crushing plants and buildings at Alafua and Olo quarries and supply of suitable repair and/or reconstruction materials (fastenings etc.), for all the works indicated in this report.

The Alafua crusher sustained damage to one conveyor system, rendering it inoperable, and similar damage occurred at Olo, but less severe. The Alafua access Road was washed out and a major culvert or small bridge is now needed.

Estimated cyclone damage cost _____

= WST\$ 0.800m
=====

Apia Town Streets:

Major sections of the streets system have suffered severe break-down of seal with consequent pavement damage, especially along Beach Road and its major inter-sections. Mulivai Bridge approaches have been completely under-washed and reconstruction appears necessary.

Estimated cyclone damage cost _____

= WST\$ 0.300m
=====

Savaii:North Coast Road:

This includes the present North Coast Road contracts SR1 and SR2. Savaii appears to have sustained more damages than Upolu. Substantial lengths of washouts and general pavement damage have been sighted. Some 10km of road around Tuasivi has been lost completely and total reconstruction is required.

Large areas of the South Coast Road need reconstruction, and coastal protection works are required at Salailua. The engineered coastal protection work along SR2 performed well and remain substantially intact. The SR1 pavement has generally held up well and only minor work is required, although the recently primed length has lost its seal.

Estimated cyclone damage costs _____
 = WST\$ 4.100m
 =====

MINOR ROADS: (Including secondary, rural and plantation roads):

General washout of pavements due to heavy rain and some minor slips have occurred. Extensive clearing of drains is required and some culverts need replacement. Severe pavement damage on Savaii occurred.

Estimated cyclone damage costs _____
 = WST\$ 2.100m
 =====

SECTION 2 - MAJOR BRIDGES

No detailed assessment reports have been received at time of compilation of this report. However, a cursory inspection of some of the Upolu bridges by the Public Works Department suggests major undermining at several bridges and possible impact damage due to massive debris jams. Some stream realignments are also required to improve the flow regime and to protect the outer embankments. This is particularly necessary at Sinamoga (Leele Stream) and Vaisigano (Vaisigano River). It is also suspected that Mulivai Bridge has been undermined and grouting will be needed. Major revetment works are required at Falevao and invert control will be needed at Lepea. Extrapolation of local bridge performance has enabled an estimate for the major bridges generally to be prepared.

Estimated cyclone damage costs _____
 = WST\$ 3.200m
 =====

SECTION 3 - WATER SUPPLY:

In the Apia area, there is damage to the treatment plants and intakes, transmission mains and reticulation pipe-work. The Fuluasou plant is operating at full capacity, Vaisigano at about 50% capacity, and Malololelei is not contributing due to blockages. It is expected that most rural intakes have been damaged together with pipelines. Roads adjacent to these intakes have been disrupted as the formation has washed out or slipped.

The Public Works Department will carry out the rehabilitation work wherever possible. That arrangement will substantially decrease the cost estimate given below to \$3.9 million. The cost assessments include professional advice, labour, vehicle hire, equipment and plant hire and consumable items.

Estimated cyclone damage costs

= WST\$11.600m
=====

SECTION 4 - APIA SURFACE DRAINAGE PROJECT:

The contract drainage works have survived the cyclone very well, despite the channels being incomplete and some confluences and rock revetment work yet to be finalised. A major effort to clear all constructed canals is needed, and where some new channels were blocked and over-topped, back-scour to a minor degree has occurred. Filling and shaping is needed.

Estimated cyclone damage costs

= WST\$ 0.049m
=====

SECTION 5 - COASTAL PROTECTION WORKS:

The engineered protection works that form part of the present road reconstruction contracts EC-1 and SR-2 (refer), performed well and require little repair expenditure. However, the seawall at Vaiala Beach (Apia) and the dumped rock foreshore protection around Apia harbour, which were not designed according to any engineering specifications were substantially destroyed. However these seawalls had provided some protection in minimising damages to areas which would otherwise have sustained greater damages.

Apia harbour needs properly-designed coastal protection, extending from the new ferry terminal, along Beach Road and the Reclaimed Area to the Tusitala Hotel, a distance of some 2.5km.

Due to the low-lying nature of the Vaiala Beach esplanade area, which is well populated, a properly-designed and re-

built seawall would be essential. It would protect both the village people and the esplanade area, and should be considered as cyclone damage works. Cyclone Ofa also seriously damaged this area, and it will happen again, if proper coastal protection measures are not undertaken now.

The harbour protection work could cost WST\$3.75m and the Vaiala seawall could cost WST\$ 0.9m.

Estimated cyclone damage costs	_____
=	WST\$ 4.650m
	=====

SECTION 6 * BUILDINGS AND DWELLINGS

Cyclone Val generated extraordinary, high-velocity wind gusts which caused major damage to buildings. The main problems included complete roofs being uplifted and roof leakages that led to damages been sustained on electrical wiring and interior of houses. In many instances, the old structural framing and wiring are no longer suitable for repair. It is recommended that these be demolished and completely reconstructed.

Damages caused to private dwellings (which cover private residential housing, community halls, churches, village committee halls, factories and private business buildings) were extensive.

A quick assessment of damages to government buildings was also undertaken. These buildings include government offices, government residential houses and the Apia Park Sports complex.

Estimated cost to Private Dwellings	WST\$320.100m
Estimated cost to Government Bldgs	WST\$ 16.100m
Estimated cyclone damage costs	_____
=	WST\$336.200m
	=====

SECTION 7 - AIRPORTS

Faleolo International Airport

Some minor damages occurred to the runway and taxiway. The tarmac was undamaged but the terminal building roof did suffer some damages and leakages. The control tower suffered serious damage to the windows and communication equipment was lost. Other equipment also experienced major damages. The small plane hangar has been substantially damaged. Expert advice suggests some coastal protection works to the site would be worthwhile. An allowance for some repairs to the runway seal has been made.

Estimated cost for Faleolo is WST\$ 2.35m.

Fagalii Airstrip (Upolu)

The terminal building has suffered total loss. No damage to the runway has occurred.

Estimated cost for Fagalii is WST\$ 0.2m.

Maota Airstrip (Savaii)

Half of the building is destroyed and most of the roofing has blown away. Estimated cost of repairs is WS\$8,000.

Estimated total cyclone damage
costs to Airports

= WST\$ 2.558m
=====

SECTION 8 - PORTS:

No substantial damage to the new container park at Apia harbour occurred. However, the outer breakwater, new ferry terminal building and various transit sheds, stores and warehouses have sustained roof and/or wall damage.

Estimated cyclone damage costs

= WST\$10.900m
=====

SECTION 9 - SEA TRANSPORT:

All inter-island vessels escaped major damages. Minor damages were reported at the engineering workshop of the Western Samoa Shipping Corporation, the Corporation office building and vehicles.

Estimated Loss

= WST 1.050m
=====

SECTION 10 - POWER SUPPLY

The national power system sustained major damages both in Savaii and Upolu. Damages to diesel based power stations, hydro stations, headponds, penstocks, distribution lines, equipment, access roads, buildings and staff houses were reported by the Electric Power Corporation.

Total Replacement Costs = WST\$19.500m
=====

SECTION 11 - POSTAL AND TELECOMMUNICATIONS

The main damages on Postal and Telecommunication Services were on the buildings. Almost all of the buildings accomodating Postal Services around the country have been damaged in some ways.

On the telecommunications side extensive damages have been caused by the cyclone to Microwave link equipments, Satellite Earth Station equipment and Telephone Lines and Poles.

An estimated cost of damages is

= WST\$ 2.800m
=====

SECTION 12 - PRIMARY INDUSTRY (AGRICULTURE)

1. Food Crops : Damage to bananas, taro, breadfruit, vegetables and other root crops is estimated at 100%. Present supply of food crops could last from 2-4 weeks. A f t e r t h i s t i m e t h e situation would be critical for a period of about 6 months.

(Damage Estimate: \$44.2 million).

2. Tree Crops: Damage to tree crops is estimated at 90-100%. It would take several years for most tree crops to grow to fruit bearing stage.

(Damage Estimate: \$29.00 million)

3. Livestock: Livestock is estimated at 50% loss and replacement for infrastructure is estimated at 80%.

(Stock Replacement Estimate: \$12.5million)

4. Fisheries: Damage to fishing boats, equipment, and infrastructure estimated at \$1.2 million.

5. Forestry: The loss of forest plantations is estimated at \$6.1 million while the loss of native forest (timber) is estimated at \$100.1 million.

6. Others: Severe damage was also sustained by Office and accomodation buildings, laboratories, equipment, nurseries, experimental farms, and by the Apia Observatory.

(Estimated Cyclone Damage: WST8.1m)

Estimated Total Cyclone Damage: WST201.2m

=====

SECTION 13 - EDUCATION

Extensive damage was sustained by schools both public and private owned, throughout the whole country. Books, teaching materials, equipment such as typewriters and duplicating machines, desks, chairs, blackboards, and teaching aids have been largely destroyed.

The major damages sustained in the education sector were school buildings. Many have been demolished and virtually all school buildings in the country suffered some damage and would require major re-building to restore them to a functional state. Some of the buildings damaged in 1990 by Cyclone Ofā and subsequently rebuilt with external assistance have again been destroyed.

About 80% of the books at the Public Library were damaged by rain water following structural damage to the building.

Estimated Cyclone damage Costs	WST\$21.000m
	=====

SECTION 14 - HEALTH

The damage and devastation to health facilities and services including medical equipment and medical supplies is estimated at WST\$21.2 million. This estimate is based on an initial aerial inspection of health facilities in both Savaii and Upolu. A more detailed assessment will be done when road access to all parts of the country is restored.

Estimated Cyclone Damaged	_____
	WST\$21.200m
	=====

SECTION 15 - FIRE SERVICES

The Fire Brigade has lost its building with various equipment, tools and consumables damaged. One of the Fire engine was written off after the cyclone. The remaining equipment were damaged by seawater.

Estimated cyclone damage costs	_____
	= WST\$ 1.500m
	=====

SUMMARY OF COSTS

SECTION		COST (WST\$m)
1	- Roads	24.665
2	- Major Bridges	3.200
3	- Water Supply	11.600
4	- Apia Surface Drainage Project	0.049
5	- Coastal Projection Works	4.650
6	- Buildings and Dwellings	336.200
7	- Airports	2.558
8	- Ports	10.900
9	- Sea Transport	1.050
10	- Power Supply	19.500
11	- Postal and Telecommunications	2.800
12	- Primary Industry (Agriculture)	201.200
13	- Education	21.000
14	- Health	21.200
15	- Fire Services	1.500
TOTAL		= \$ 662.072m

Note: Using the exchange rate of USD\$1.0 = WST\$2.0, the total preliminary estimated cost of damages identified in this report is about US\$331.0 million.

EXERCISE - ASSESSMENT - EXERCISE - ASSESSMENT - EXERCISE**MOZAMBIQUE CYCLONE**

Initial situation: Date of disaster: Saturday, 25 March
 Arrival of DHA Team in Maputo: 29 March, 8:00hrs

 The Team has had a first briefing with the DHA Coordinator
 (UNDP Res. Rep.) (see attached note). It is scheduled to
 leave for a field trip within the next few hours.

Composition: Team leader
 4 Team members
 1 Communications officer

Equipment: Personal equipment, as specified in UNDAG handbook
 "personal preparedness checklist"
 Communications equipment:
 - 1 Inmarsat M (voice communications capability, no fax/tlx)
 - 1 Inmarsat C (fax/tlx transmission capability, no voice)

Time available: 5 days

Other information: See attachments