

## **Appendix C**

### **Natural Disaster Mitigation**

# Appendix C

## Natural Disaster Mitigation

### Table of Contents

	Page
<b>1        NATURAL DISASTER MITIGATION .....</b>	<b>C-1</b>
1.1    Disaster Emergency Response Plan-Thua Thien-Hue Province .....	C-1
1.2    Flood Inundation Maps.....	C-3
1.3    Field Benchmark Network .....	C-3
1.4    Resettlement Areas/Two-Story Buildings & Red Cross Housing Frames .....	C-4
1.5    Dam Remedial Works-Phu Bai Reservoir .....	C-6
1.6    Huong River Basin Catchment.....	C-6
1.7    Lagoon and Coastal Areas.....	C-7
 <b>2        AVAILABLE DATA AND INFORMATION .....</b>	 <b>C-16</b>
2.1    Natural Disaster Mitigation .....	C-16
 <b>3        FORESTATION PLAN.....</b>	 <b>C-23</b>
3.1    General .....	C-23
3.2    Objectives .....	C-23
3.3    Present Condition of Huong River Basin .....	C-23
3.4    Organization and Management.....	C-25
3.5    Past Executed Forest Project .....	C-25
3.6    Existing Scheme .....	C-26
3.7    Recommendation.....	C-27
3.8    Future Subject.....	C-27

## List of Tables

		Page
Table C.1	Statistic data of capital forest and bare land in Thua Thien Hue province in 2001 .....	CT-1
Table C.2	Principle for Forest Sector Co-operation including Partnership (signed on 12th November 2001) .....	CT-2
Table C.3	Trees planed in Hue province .....	CT-3
Table C.4	Sample of planted tree in Vietnam (decision 03/2001/QD-TT dated 5/1/2001).....	CT-3

## List of Figures

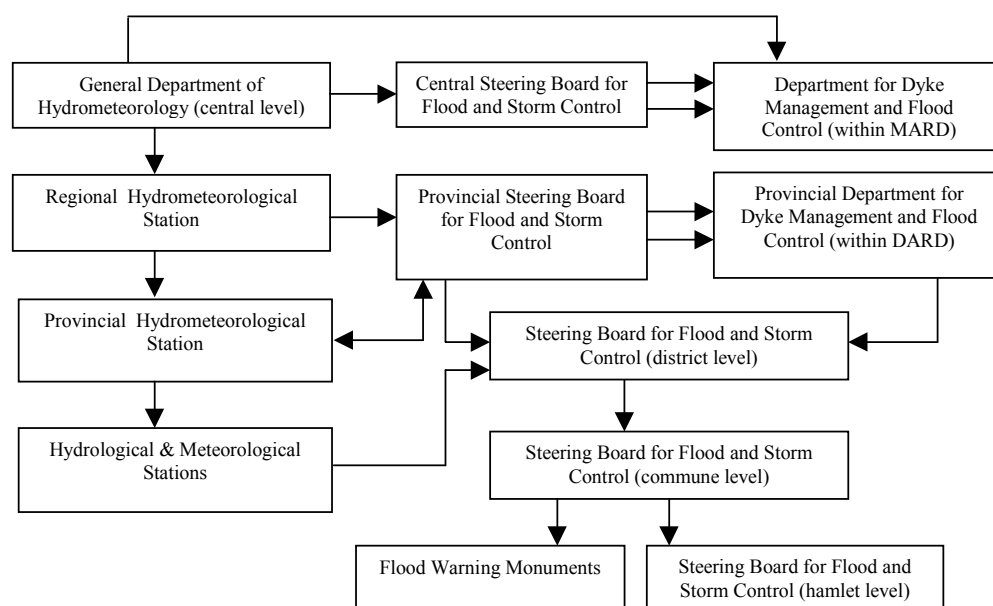
		Page
Figure C.1	Huong River Basin.....	CF-1
Figure C.2	Cross Section of Huong River Basin .....	CF-1
Figure C.3	Satellite Image of Huong River Basin on Jan.1989 .....	CF-2
Figure C.4	Vegetation Map of Huong River Basin on 1969 and 2000 .....	CF-3
Figure C.5	Usage of Chemical Weapon during the War .....	CF-4
Figure C.6	Current Condition of Ta Tarach River Basin and Bo River Basin .....	CF-5
Figure C.7	Forest Map in 1999 .....	CF-6
Figure C.8	Zoning of Climate .....	CF-7
Figure C.9	Forestry Organization Chart.....	CF-8
Figure C.10	Forest Farm in Thua Tien Hue Province .....	CF-9
Figure C.11	Forest Management Map and List .....	CF-10
Figure C.12	Existing Scheme Related Forestry .....	CF-11
Figure C.13	Proposed Reforest Area.....	CF-12

## Appendix C Natural Disaster Mitigation

### 1 NATURAL DISASTER MITIGATION

#### 1.1 Disaster Emergency Response Plan - Thua Thien-Hue Province

Following initial meetings with both the Provincial People's Committee (PPC) and the Department of Agriculture and Rural Development (DARD) of Thua Thien-Hue province, a presentation of the Province's Disaster Emergency Response Plan for the year 2001 was given by senior members of the Provincial Flood and Storm Control (FSC) Committee. The presentation gave an overview of the extent and nature of the plan and what actions were taken in 2001, in regard to disaster mitigation. The presentation noted the province is subjected annually to flooding and as such any emergency response plan should make allowance for at least the worst case scenario, that being the flood of 1999 occurring again in any given year. It noted that every household should have their own flood emergency contingency plans. The lines of communication and procedures for flood warning within Thua Thien-Hue province, given by the presentation, are depicted schematically on the following diagram.



**Organisation Chart for Flood Warning Procedures – Thua Thien-Hue Province**

The 2001 Disaster Emergency Response Plan presented, contained the following five major components:

- Preparation of Equipment, Materials & Facilities for 2001 Flood.

- Prevention & Limitation of Flood Damage in Villages & Communes.
- Protection of Reservoirs.
- Preparation Before Flood Season.
- Provincial Flood and Storm Control (FSC) Committee.

(1) Preparation of Equipment, Materials and Facilities for 2001 Flood

The first component of the Emergency Response plan consisted of aspects relating to flood warning systems; communication systems; high rise buildings for evacuation during flooding; equipment and human resources for rescue activities; remedial works for coastal and river bank erosion and resettlement.

It was reported that of 1248 households planned for resettlement as a result of the 1999 floods, 645 households (52%) had to date resettled. The plan noted the limited funds available during the year to provide basic infrastructure to these resettlement areas.

(2) Prevention and Limitation of Flood Damage in Communes and Villages

The second component of the Disaster Emergency Response Plan detailed the actions that would be taken during floods to safe guard life and property in communes and villages. These actions would include:

- Informing local people of the flood and storm situation through mass media in regard to what measures are to be taken during the flood. Specific tasks would be assigned to the corresponding levels within the village and communes.
- Require people living in the lagoon area to find shelter as soon as they receive the warning from the flood and storm control board.
- Help poor households residing in flood-prone areas to reinforce their houses, store food and possessions and evacuate people as required.
- Ensure local people stock sufficient food to be used in emergency situations and the majority have access to rescue equipment including boats, canoes, rafts, ropes and life buoys, when needed.
- Evacuate people in areas where landslides, due to rainfall and flooding may potentially occur.

(3) Protection of Reservoirs

The third component of the response plan concerned protection of reservoirs and noted that only Truoi and Hoa My reservoirs in Thua Thien-Hue province are under the management of the Provincial Flood and Storm Control Steering Committee

(FSC). There are FSC steering boards for each reservoir. The People's Committee in each district are responsible for reservoirs in their area. During times of floods the FSC at district level will send guards to the site of each reservoir for 24-hour surveillance and to ensure communications with relevant authorities are maintained at all times.

#### (4) Preparation Before Flood Season

The fourth component of the Emergency Response Plan detailed the actions that were taken in 2001 before the onset of the flood season.

#### (5) Provincial Flood and Storm Control (FSC) Committee

The final component of the 2001 Disaster Emergency Response Plan defined the twenty activities and related responsibilities necessary to carry out the plan, which was later successfully executed by the Provincial Flood and Storm Control (FSC) Committee of Thua Thien-Hue province. The activities defined were later delegated to the various members making up the FSC Committee, which consisted of the directors of the majority of local government departments and agency's.

### **1.2 Flood Inundation Maps**

Flood inundation maps have been prepared for the flood-affected areas downstream of the Huong river in Thua Thien-Hue province by the Hydrometeorological Centre of the Central Region in Hue, during the period September 2000 to March 2001. Three series of maps were produced, corresponding to flood probabilities of 1 in 10 years ( $P=10\%$ ), 1 in 20 years ( $P=5\%$ ) and the 1999 flood which was estimated to be the 1 in 67 year flood ( $P=1.5\%$ ). For each of these probabilities, flood inundation maps were prepared, each drawn to a scale of 1:10,000. Indicated on the maps are those areas inundated by flood waters in the depth ranges 0-1m, 1-2m, 2-3m and those areas where the depth of flood inundation is greater than 3m. The direction of flood flow and location of surveyed flood marks are also indicated. The maps used as a basis the 20 primary flood warning monuments and 18 secondary monuments surveyed and installed following the 1999 floods.

Following the presentation of the 2001 Disaster Emergency Response Plan, outlined previously, an inspection of the complete set of 1:10,000 inundation maps for the 1999 flood was made at the headquarters of DARD in Hue.

### **1.3 Field Benchmark Network**

As part of the program to produce flood inundation maps for the Thua Thien-Hue province, the Hydrometeorological Centre of the Central Region installed a series of flood warning monuments within the flood-affected districts of the province. In

total 20 primary flood level warning monuments, indicated in the following table and 18 secondary flood level warning monuments were installed in the districts of Hue, Phu Vang, Quang Dien, Huong Tra, and Huong Thuy.

On each of the primary flood level warning monuments are markings giving the 1995 and 1999 flood levels and Flood Level Warning III.

In regard to the secondary flood level warning monument network, each benchmark is associated with a corresponding benchmark in the primary network, both having the approximate same geographic location, with the secondary monuments generally being associated with some ones house or public building in the area. The 1999 flood level and Flood Level Warning III are also indicated on the secondary monuments.

The combined primary and secondary flood level warning monuments to be used in conjunction with the flood inundation maps, make up the current field benchmark network for the Thua Thien-Hue province. During the site visit to the province several primary and secondary flood level warning monuments were inspected.

Primary Flood Level Warning Monuments - Thua Thien-Hue Province						
<u>Code No.</u>	<u>Location</u>	<u>District</u>	<u>Elevation of Base of National Grid</u>	<u>Flood Warning Level III</u>	<u>1995 Flood Level</u>	<u>1999 Flood Level</u>
H01	Dong Ba Market	Hue City	2423	*	0.79	1.61
H02	Phan Chu Trinh Str.	Hue City	2159	0.8	1.3	2.18
H03	Phu Hau Ward	Hue City	1536	0.52	1.64	2.45
H04	Dap Da Bridge	Hue City	1722	0.48	1.68	2.55
PV01	Phu Vang Post Office	Phu Vang	1785	0.05	1.24	2.02
PV02	Phu Mau Commune	Phu Vang	2604	*	0.72	1.58
PV03	Phu Xuan Commune	Phu Vang	1519	0.4	1.53	2.33
PV04	Phu Thanh Commune	Phu Vang	1112	0.5	1.37	2.01
PV05	Phu Xuan Commune	Phu Vang	930	1.07	1.86	2.34
QD01	Quang An Commune	Quang Dien	1259	2.04	2.92	3.65
QD02	Quang Dien Commune	Quang Dien	1937	*	3.21	3.89
QD03	An Gia-Tan Lap Town	Quang Dien	478	1.34	2.08	2.61
HT01	Huong Toan Commune	Huong Tra	2312	*	2.31	3.82
HT02	Huong Guan Commune	Huong Tra	3384	3.73	4.38	4.93
HT03	Huong Vinh Commune	Huong Tra	1586	3.12	4.01	4.75
HT04	Huong Ho Commune	Huong Tra	4561	*	5.58	7.20
HT05	Huong Phong Commune	Huong Tra	2125	*	3.09	3.81
HT06	Thuy Thanh Commune	Huong Thuy	880	*	2.08	2.97
HT07	Thuy Bang Commune	Huong Thuy	7004	*	8.40	11.23
HT08	Thuy Luong Commune	Huong Thuy	1318	0.62	1.68	2.44

Note: \* Flood Level Warning III below base of Flood Warning Monument

#### 1.4 Resettlement Areas/Two-Storey Buildings & Red Cross Housing Frames

According to the site visits, to several commune resettlement areas in the districts of Huong Tra, Phu Loc and Phu Vang. It was clear from these visits that people now

living in the resettled communes, which had all been created as a result of the 1999 floods, were living in much safer environments.

Although the provision of infrastructure is planned for all resettlement areas, those visited were found to be lacking basic infrastructure relating to drinking water supply systems, drainage and sewerage systems, road networks and electrical supply. The site visit confirmed what had been noted in the province's 2001 Disaster Emergency Response Plan, that currently only limited funds are available for the provision of infrastructure to resettlement areas.

Site visits were also made to the flood-prone areas in the districts of Huong Tra, Huong Thuy, Phu Vang and Phu Loc. It was observed during these visits the preponderance of newly constructed two-storey schools and clinics and the large number of buildings recently constructed using Red Cross housing frames.

Because these flood-prone areas are flat and low lying the two-storey buildings dominated the landscape and were visible for some distance. Interviews with local residence confirmed their satisfaction with the newly constructed buildings within their community. The majority understood the secondary function of the buildings in providing safe havens for both themselves and their families, if required during periods of flooding. For the local residence, it was added reassurance that the buildings were easily accessible and within a short distance of their respective homes.

Red Cross housing frames currently consist of two functional models, a 4 column unit (*Hue Model*) and a 6 column unit (*ABC Model*). Both are based on the same principle they are cheap, strong and easy to erect and provide a static core that will remain standing under severe weather conditions. The idea being local inhabitants can add extensions to the core by use of local materials. During storms and floods these extensions would be swept away but the core would remain. The Red Cross have reported that houses using their frames withstanding the November 1999 floods, with only one house failing out of a total of 2,450 constructed in the Central Provinces prior to the floods. To date a total of 4,724 frames (excluding resettlement areas) have been provided for in Thua Thien-Hue province.

During visits to the flood-prone areas it was also observed the majority of communes equipped with public address systems which consisted in the main of loudspeakers attached to telephone/electrical street poles. The system would be used by the FSC at the commune level, to inform local residents of any impending floods and other danger warnings and as a means of keeping in contact with the local inhabitants during floods.



### **1.5 Dam Remedial Works – Phu Bai Reservoir**

The rehabilitation of existing reservoirs and dams are important structural measures for natural disaster mitigation. As Phu Bai Reservoir was one of the major reservoirs in Thua Thien-Hue province to sustain damage during the 1999 floods, a visit to the dam site was made. Construction was in progress at the time of the visit. Remedial works include the complete refurbishing of the upstream face of the dam with stone pitching; construction of a grid system of concrete open channel drains on the downstream slope of the dam; installation of sluice gates on existing spillway outlet and construction of new irrigation channel from the dam outlet.

### **1.6 Huong River Basin Catchment**

At the site of the proposed Ta Trach dam the vegetation coverage was found only to be bush and scrub at no more than waist height and extending for an area as far as the eye could see.

Landslides, direct results of the combined effect of deforestation and flooding were sighted at various locations adjacent to roads and the remedial protective works, local authorities had constructed were observed.

One aspect, which was not anticipated and observed during the site visits to the Huong River Basin catchment and worthy of further consideration was the potential for forest fires. In those parts of the catchment where deforestation had not taken place there was thick dense vegetation. The potential for forest fires in these area would be extremely high, particularly during the dry season when the undergrowth would be dry and highly susceptible to fire.

Any natural disaster mitigation plan to be incorporated into a comprehensive master plan for a river basin, which is the subject of this current study, should take cognisance of the potential dangers of forest fires, if such a threat exists.

Taking this into consideration and following recommendations from DARD, a meeting was arranged with the Forestry Department of Phu Loc District, which has the reputation of being one of the most efficient and best organised forestry departments within Thua Thien-Hue province.

Areas of Phu Loc district form integral parts of the Huong River Basin catchment. The district has the highest forest coverage (57%) in the province with 45,000ha of forest. Prior to 1990 in excess of 40ha of forest were being destroyed annually by forest fires. The main cause of fires was the high temperatures, reaching as high as 40 degrees centigrade for ten consecutive days. Other causes related to unexploded ordnance (UXO), people's negligence and electrical storms.

As a direct result of a well orchestrated and planned forest fire prevention plan commenced in 1991, forest fires in the district were drastically reduced. In 2001 less than 1ha of forest was destroyed by fire. The forest fire mitigation plan, which was so successful, consisted of both structural (construction of look-out towers, fire-breaks and erection of warning signs) and non-structural components (public awareness programs and establishing local fire control boards). Some of the lessons learnt from the implementation of this plan could possibly be used for the implementation of similar plans for flood disaster mitigation.

### **1.7 Lagoon and Coastal Areas**

In the course of addressing natural disaster mitigation in the context of preparing a comprehensive master plan for the Huong River Basin, the important aspects of coastal erosion and the breaching of the lagoon were taken into consideration. As part of that exercise site visits were made to the Tam Giang lagoon, the estuaries of Thuan An (sea outlet to the Huong river) and Tu Hien and the adjoining sandbar and coastline where extensive coastal erosion was observed. Currently an internationally funded project entitled *Integrated Coastal Zone Management* is addressing these issues.

Prior to the floods of 1999 there existed only one opening to the sea of the Tam Giang lagoon located in the vicinity of the Thao Lang Barrage. The lagoon is an important economic asset to Vietnam as it is the place for the cultivation of shrimps and seaweed, both large foreign currency earners. However, their cultivation is very much dependant on an optimum salinity of the water being maintained at all times, this being best controlled if there is only one opening of the lagoon to the sea. As a result of the floods of 1999 the sandbar separating the lagoon from the sea was breached at three locations, in addition to the southern opening of the lagoon, the former Tu Hien estuary, being reformed. Two of the openings closed naturally by lateral drift and the 3<sup>rd</sup> one was closed by relevant authorities constructing a road to rejoin the sandbar with the mainland. Dredging is now currently taking place on the landward side to restore the integrity of the lagoon to its natural state before the floods of 1999.



**Photo 1 : Huong South (North-Western Part), Nov. 2001**

(1) Main Canal / Drain, (2) Hue,  
(3) Huong River, (4) Highway No.1



**Photo 2 : Downstream Slope of Truoi Dam, Nov. 2001  
(Centre: Truoi River, Right: Irrigation Canal)**



**Photo 3 : Main Canal / Drain, Nov. 2001**  
**(Huong North, Halfway Between Phu Cam Intake and Cong Quan Outlet)**  
(1) Hue, (2) Phu Cam Intake, (3) Cong Quan Outlet



**Photo 4 : Phu Cam Intake, Nov. 2001**  
(1) Huong River Side



**Photo 5 : Cong Quan Outlet, Nov. 2001**

(1) Main Canal / Drain, (2) Lagoon



**Photo 6 : Pumping Station, Nov. 2001  
(Drainage Pumps Near Cong Quan Outlet)**

(1) Power Supply Line, (2) Farm Land, (3) Lagoon



**Photo 7 : Lagoon Dike, Nov. 2001**  
**(Near Cong Quan Outlet)**  
(1) Farm Land, (2) Lagoon



**Photo 8 : Fishing Nets in the Lagoon, Nov. 2001**  
**(Near Lagoon Bridge to Thuan An Outlet)**  
(1) Sea Side, (2) Land Side



Photo 9 : Phu Vang District – Two storey primary school (recently constructed) in centre of flood-prone area.



Photo 10 : Phu Loc District – Roadside sign indicating fires strictly forbidden.



Photo 12 : Phu Vang District – Public address (PA) system to warn local inhabitants of impending floods.



Photo 11 : Nam Dong District – Sign indicating level of danger for forest fires ranging from low risk (I) to extreme risk (V).





Photo 13 : Flood inundation mapping  
Thua Thien-Hue Province.

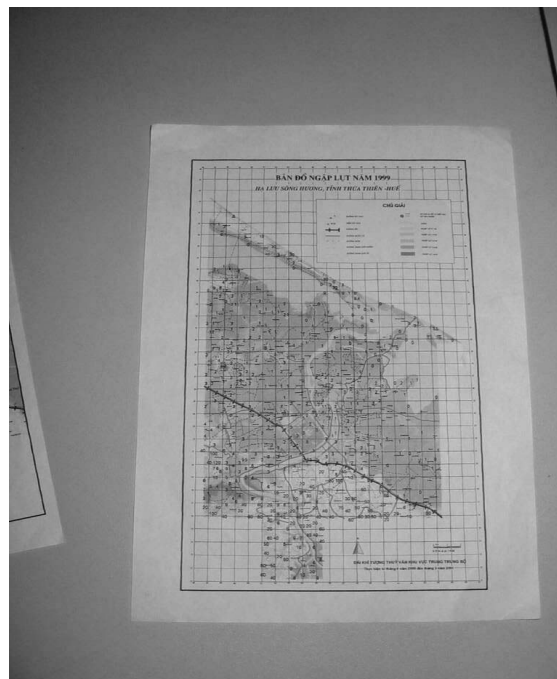


Photo 14 : Flood inundation mapping  
Thua Thien-Hue Province.



Photo 15 : Flood level warning  
monument H04 – Hue Thua Thien-Hue



Photo 16 : Flood level warning monument  
H04 – Hue Thua Thien-Hue Province.





Photo 17 : Phu Bai Reservoir, Huong Thuy District - Dam remedial works.



Photo 18 : Phu Bai Reservoir, Huong Thuy District - Dam remedial works.



Photo 19 : Road Construction and Protection of Cutting Slope – Huong Tra District



Photo 20 : Phu Vang District – Red Cross Housing Frame (ABC Model).



Photo 21 : Huong Tra District – Red Cross Housing Frame (Hue model).



Photo 22 : Phu Loc District – Red Cross Housing Frame (ABC model).



Photo 23: Deforestation – Huong Tra District



Photo 24 : A Luoi Meteorological Station.



Photo 25 : Thuong Nhat Hydrological Station in Nam Dong District.



Photo 26 : Coastal erosion of sandbar adjacent to Thuan An estuary.



Photo 27 : Dredging of Tam Giang Lagoon



Photo 28 : Nam Dong Meteorological Station.