

**OCD MANUAL ON MUD AND  
DEBRIS FLOW FORECASTING  
AND WARNING**

OCD

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FORECASTING AND WARNING**

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## **1. INTRODUCTION**

Mayon Volcano, the most active volcano in the Philippines, lies in the Southeast Luzon in the province of Albay.

Mayon reaches up to around 2,462 m above sea level and covers an area of 250 sq. kms. It is surrounded by eight (8) municipalities and one (1) city that covers an area of 1,261.4 sq. kms., with a total population of 638,696 people (1995 NCSO).

Mayon volcano's recorded activities since the 17th century had brought about considerable losses in lives and properties.

Volcanic hazard in Mayon vary greatly in type, aerial extent, duration and destructive potential. These hazards are a consequence of Mayon's three (3) different eruption types. ( Strombolian, Vulcanian, Plinian).

Lahars, a flowing mixture of volcanic debris and water are one of the most persistent and destructive hazard posed by Mayon volcano. It is sometimes called mudflow or volcanic debris flow.

Lahars from Mayon volcano originate from the upper and middle slopes of the volcano. Lava and pyroclastic materials perched on the steep slopes are eroded and then mobilized by heavy rains, thus causing a debris-wet mixture to cascade and flow downslope of the volcano. It usually follow pre-existing gullies and ravines. Upon reaching the lower slopes, it spreads out and leave thick and wide spread deposits which span a wide range of velocities and dimensions.

Lahar with an speed of 36 to 144 km per hour forcibly destroy buildings and infrastructures, and bury low lying areas with boulders, sand and mud. They oftentimes block drainage channels, raise river beds and cause flooding of extensive areas at the base of the volcano. (attachment A)

## **2. AREAS TO BE AFFECTED BY MUD AND DEBRIS FLOW**

The pyroclastic materials deposited on the steep slope of Mayon Volcano during the last eruption pose hazards to 30 barangays of 5 municipalities and 1 city at the foot of the Mayon Volcano with a total population of 64,700. When strong rains/typhoons occurs. The mud and debris flow usually passed thru 8 channels of which 4 are ective high risk and 4 active moderate risk. (attachment B).

The municipalities of Daraga and Sto. Domingo and the city of Legazpi will be affected by the mud and debris flow from the active high risk channels of Budiao, Bafiadero, Mabinit, Buyuan and Basud channel. (attachment B-1&2)

The municipalities of Tabaco, Guinobatan and Ligao will be affected by the mud and debris flow from the active moderate channels of San Vicente, Buang, Maninila and Nasisi. (attachment B-3&4)

### 3. FACILITIES AND EQUIPMENT

In 1996, Japan International Cooperation Agency (JICA) installed facilities and equipment for monitoring lahars and debris flow as a part of telemetry network system to the Philippine Government through NDCC and OCD Region 5 (attachment C) in strategic location in the active risk channel and moderate risk channel of Mayon Volcano in the Province of Albay, for the issuance of timely warning to the barangay (s) at risk and give them sufficient lead time to effect evacuation. (attachment D&E)

These facilities and equipment are as follows:

- Lahar Warning System (Six station)
- Rain Gauge (Five station)
- Central Telemeter Station (One station)
- Repeater Telemeter Station (One station)

**Lahar Warning Station** - there are six (6) station which are expensive to maintain for every occurrence of strong typhoon, the terminal pole and wire sensor are destroyed by strong current of water and mud flow and spareparts are to be imported from Japan.

**Rain Gauge Station** - there are five (5) rain gauge station which the rain gauge recorded rainfall and rain intensity and the data is transmitted to Central Monitoring Station by a radio transmitter and repeater station.

**The monitoring station** - records data transmitted by the different rain gauge station in the field. The data are processed and the data are printed out in a screen, the status of volume of water received by each station.

By operation of the monitoring station equipment, rainfall data are displayed by station or standard warning, evacuation rainfall level and current warning condition as “rainfall judgement graph” are displayed by each station.

In the graph displayed in the monitor wherein the intensity of total rainfall in millimeter per hour and accumulated effective rainfall in mm are the two factors to consider as basis on the issuance of different level at lahar warning to PDCC, MDCC, CDCC up to Barangay Captain concerned.

#### 4. INTERPRETATION OF DATA

In the interpretation of data two factors are to be considered: accumulated effective rainfall in mm with a graduation from 60 to 280 mm and intensity of rainfall in mm/hour from 0 to 14. (attachment F)

<b>Level of Warning</b>	<b>Lead Time</b>	<b>Criteria</b>
Lahar Warning No.1	4 hours	The graph showing that accumulated effective rainfall slightly below intensity rainfall 2
Lahar Warning No.2	3 hours	accumulated effective rainfall reaches rainfall intensity 2 or slightly above
Lahar Warning No.3	2 hours	accumulated effective rainfall reaches about or above rainfall intensity

If the accumulated effective rainfall is more than 220 mm regardless of rainfall intensity lahar flow will triggered.

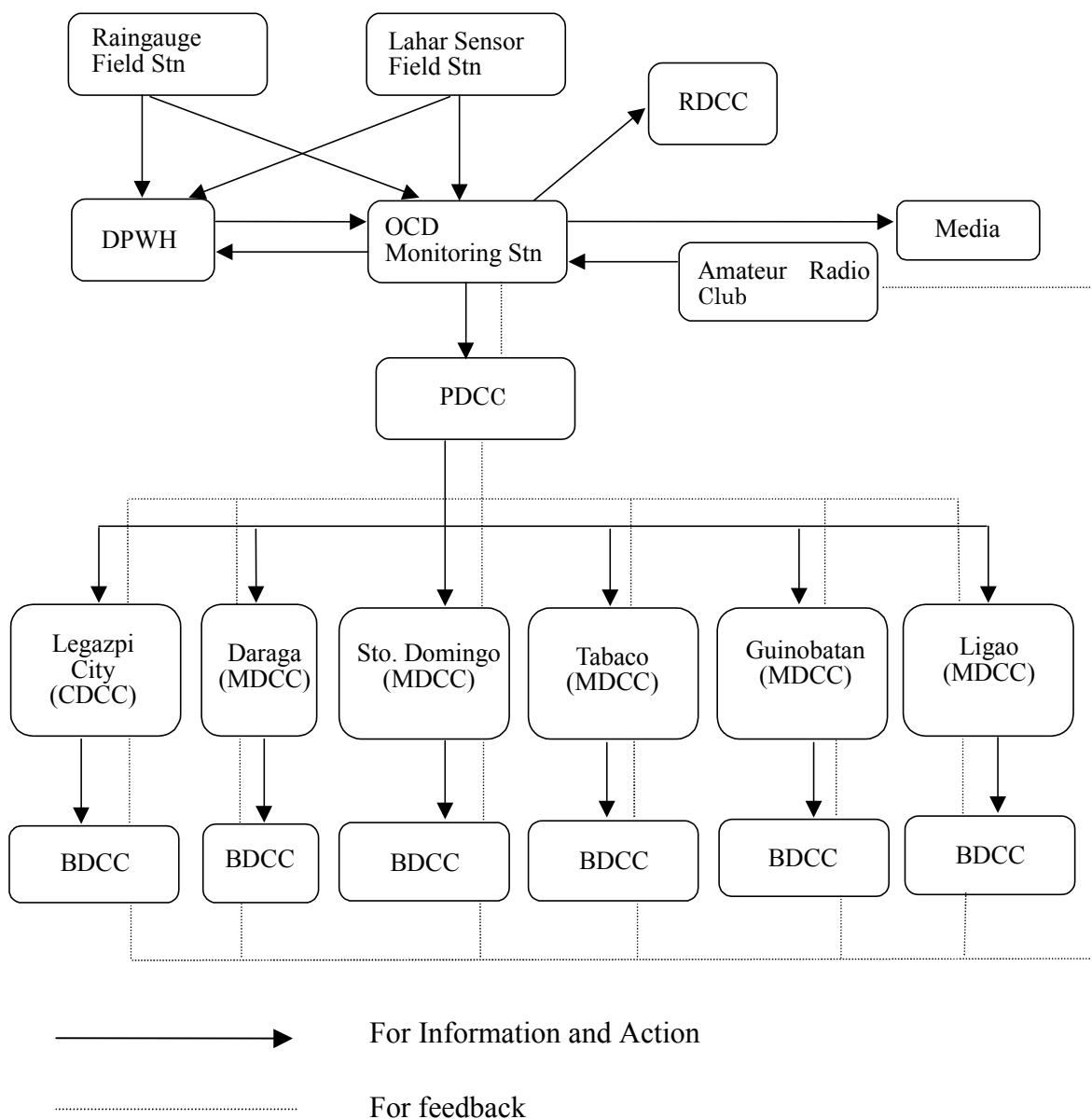
**5. MUD & DEBRIS FLOW WARNING ALERT LEVEL**

<b>ALERT LEVEL</b>	<b>CRITERIA</b>	<b>ACTION TO BE TAKEN</b>
<b>Alert I</b>	Accumulated rainfall and intensity exceeds the designated value (WL-1)	OCD & DPWH staff watch and wait for further development
<b>Alert II</b>	Accumulated rainfall and intensity exceed the designated value (WL-2)	Release warning to the public thru media. Advise PDCC to start preparation for evacuation. DPWH term start to execute their standard operation procedure (SOP)
<b>Alert III</b>	Occurrence of hazard is convinced because accumulated rainfall intensity exceeds the designated value (WL-3)	PDCC & CDCC advise the residents to go to designated pick-up point for immediate evacuation. CDCC diapatch evacuation vehicle and receive evacuees in the evacuation center. DPWH execute their plan (SOP) corresponding to this stage.
<b>Alert IV</b>	Hazard is confirmed not to occur anymore because rainfall subsides and weather forecast do not indicates additional heavy rainfall in near future	Evacuees to be send back to their barangays. PDCC, CDCC & DPWH start their post-disaster activities/

**6. Standard Action for Mud and Debris Flow (ROCD)**

- WL-1** - Report to the office as soon as possible
- Establishment observing term (24 hours / d)
  - Confirm PAGASA's Weather Forecast
  - Identify the Municipality / city to be warned
  - Confirm the situation to Regional DPWH
- WL-2** - Confirm the situation with RDPWH
- Confirm availability of warning equipment
  - Confirm PAGASA's weather forecast
  - Inform the situation with RDPWH
  - Confirm the PDCC and MDCC / CDCC's receive of the warning
  - Receive information on the condition of rivers and roads from DPWH
  - Log and record the conditions of rivers and roads
  - Watch the movement of snake curves
  - monitor the snake curves of other stations
- WL-3** - Confirm the situation with RDPWH
- Confirm PAGASA's weather forecast
  - Inform level 3 warning to \_\_\_\_\_
  - Confirm the receive
  - Receive information from relevant MDCC / CDCC and assess them
  - Inform the situation to PDCC
  - Monitor the snake curves and other stations
- WL-4** - Confirm the situation with RDPWH
- Confirm PAGASA's weather forecast
  - Watch snake curves
  - Inform release to PDCC
  - Continue monitoring the snake curve for 3 hours including one of other stations

**7. COMMUNICATION FLOW CHART**





## **COMMUNICATION FLOW SYSTEM**

The OCD and DPWH monitor in their respective monitoring system and closely watch the further development of accumulated rainfall and rain intensity brought by the occurrence of weather disturbances using the raingauge field stations. They compare their findings and decide the issuance of different level of copy furnish the RDCC Chairman for information and Guidance.

The Bulletin is transmitted to PDCC thru fax and / or telephone or courier. The contents of the bulletin are : bulletin No./Time/Date monitored parameter indicating observation time accumulated effective rainfall (mm), total rainfall intensity in mm/hr., the raingauge station where the data originates, area at risk, alert status and recommendation.

The bulletin transmitted to PDCC thru telephone will be dictated to the receiver. The receiver read back the dictated data for any correction. The bulletin concerned MDCC down to the barangay.

Media will be utilized for widest dissemination for the information especially in warning level 3.

The amateur radio clubs may help in gathering information and situation in the area at risk for information of the concerned DCC's.

The BDCCs will report to the PDCC on their situation and needs thru higher DCCs for information and guidance.

**DIRECTORY**

<b>GOV'T AGENCY</b>	<b>TEL/ NOS.</b>	<b>FAX NOS</b>
OCD/RDCC	481-50-31/2455107/2455132	481-50-31
DPWH	482-06-49/482-03-59	
PHIVOLCS	483-27-29	483-27-29
PAGASA	481-02-14/2143238	481-02-14

<b>DCC'S</b>	<b>TEL. NOS.</b>	<b>FAX NOS.</b>
ALBAY PDCC/PDMO	481-24-42	
LEGAZPI CITY	820-35-26	481-25-75
DARAGA	483-35-60/483-35-62	483-35-61
STO. DOMINGO		
TABACO	487-52-38	
GUINOBATAN	484-63-33	
LIGAO	485-11-15	

<b>RADIO STATION</b>	<b>TEL. NOS.</b>	<b>FAX NOS</b>
DZGB	480-55-08	
DWZR	480-88-20	
RADIO BOMBO	481-38-70	
ABS-CBN	480-10-01	
DWBS	481-20-73	

### **SPEED OF LAHAR**

Persons (Walking)		4 km/hr	
Car		40 km/hr	
Lava Flow	1 --	36 km/hr	
Debris Flow	18 --	72 km/hr	
Lahar	36 --	144 km/hr	(10 m/s – 40 m/s)
Pyroclastic Flow	36 --	360 km/hr	

**SUMMARY OF AREAS TO BE  
AFFECTED BY LAHAR  
(Active High Risk)**

<b>CHANNEL</b>	<b>NO. OF BARYS.</b>	<b>TOTAL POP.</b>	<b>NO. OF HHOLD</b>
1. Budiao/Bañadero Channel a. Daraga b. Legazpi	9	19,863	3,764
2. Mabinit Channel a. Legazpi City	3	6,193	1,149
3. Buyuan Channel a. Legazpi City	3	9,048	1,658
4. Basud Channel a. Sto. Domingo	4	7,716	1,351
<b>TOTAL</b>	<b>19</b>	<b>42,820</b>	<b>7,922</b>

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**PROVINCE OF ALBAY  
SUMMARY OF AREAS TO BE  
AFFECTED BY LAHAR**

	NO. OF CHANNEL	NO. OF MUN.	NO. OF BRGYS	TOT. POP.	NO. OF HHOLD
Active High Risk	4	3	19	42,820	7,922
Active Moderate Risk	4	3	11	21,880	4,151
<b>Total</b>	<b>8</b>	<b>6</b>	<b>30</b>	<b>64,700</b>	<b>12,073</b>

MayonDat. doc/hts'99

**SUMMARY OF AREAS TO BE  
AFFECTED BY LAHAR  
(Active Moderate)**

<b>CHANNEL</b>	<b>NO. OF BARYS.</b>	<b>TOTAL POP.</b>	<b>NO. OF HHOLD</b>
1. San Vicente Channel a. Tabaco	2	5,979	1,156
2. Buang Channel a. Tabaco	1	2,046	369
3. Maninila Channel a. Guinobatan	5	10,441	1,974
4. Nasisi Channel a. Ligao	3	3,414	652
<b>TOTAL</b>	<b>11</b>	<b>42,820</b>	<b>4,151</b>

**AREAS TO BE AFFECTED BY LAHAR  
ACTIVE HIGH RISK CHANNEL**

MUN/BRGY	TOTAL POPULATION	NO. OF HOUSEHOLD
1. <u>Budiao/Bañadero Channel</u>		
Daraga:		
Budiao	1,470	290
Bañadero	1,457	275
busay	1,857	358
Culliat	1,153	208
Bañag	2,697	518
Bagumbayan	2,294	431
Malobago	858	172
Tagas	<u>5,595</u>	<u>1,035</u>
	<b>17,381</b>	<b>3,287</b>
Legazpi City:		
Bogtong	<u>2,482</u>	<u>477</u>
<b>TOTAL</b>	<b>19,863</b>	<b>3,764</b>
2. <u>Mabinit Channel</u>		
Legazpi City:		
Mabinit	916	172
Pawa	2,587	477
Bonga	<u>2,690</u>	<u>500</u>
<b>TOTAL</b>	<b>6,193</b>	<b>1,149</b>
3. <u>Buyuan Channel</u>		
Legazpi City:		
Buyuan	2,746	485
Bigaa	4,415	842
Padang	<u>1,887</u>	<u>331</u>
<b>TOTAL</b>	<b>9,048</b>	<b>1,658</b>
4. <u>Basud Channel</u>		
Sto. Domingo:		
Sta. Mesirecordia	2,037	349
Fidel Surtida	1,857	303
Lidong	2,136	385
San Isidro	<u>1,716</u>	<u>314</u>
<b>TOTAL</b>	<b>7,716</b>	<b>1,351</b>

**AREAS MODERATE RISK CHANNEL  
AREAS TO BE AFFECTED BY LAHAR**

MUN/BRGY	TOTAL POPULATION	NO. OF HOUSEHOLD
1. <u>San Vicente Channel</u> Tabaco:		
San Vicente	2,834	514
Mariroc	<u>3,145</u>	<u>642</u>
<b>TOTAL</b>	<b>5,979</b>	<b>1,156</b>
2. <u>Buang Channel</u> Tabaco		
Buang	<u>2,046</u>	<u>369</u>
<b>TOTAL</b>	<b>2,046</b>	<b>369</b>
3. <u>Maninila Channel</u> Guinobatan		
Maninila	1,378	247
Masarawag	3,246	631
San Rafael	2,771	527
Tandarora	1,366	250
Maipon	<u>1,680</u>	<u>319</u>
<b>TOTAL</b>	<b>10,441</b>	<b>1,974</b>
4. <u>Nasisi Channel</u> Ligao		
Nasisi	963	195
Baligang	1,182	207
Basag	<u>1,269</u>	<u>250</u>
<b>TOTAL</b>	<b>3,414</b>	<b>652</b>

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## **INFORMATION ABOUT OCD, N/RDCC & P/M/C/BDCCs**

The Filipino has always endured the hardships of a hostile environment. He has continually sought survival against typhoons, floods, earthquakes, epidemics, fires and other calamities. Experts tell us calamity will happen anywhere and anytime. Destructive capacity can be enormous and the problem is made more difficult by absence of warning. Planned arrangements must be made available to:

1. Prevent loss of life
2. Prevent needless suffering of the people
3. Protect property, and
4. Minimize damages during disasters and calamities.

The concept therefore is one of SELF-HELP and Mutual Assistance. It is expected that each political and administrative subdivision of the country shall utilize all available resources in the immediate area before asking for assistance from neighboring entities or higher authority.

### **THE ORGANIZATION**

#### **National Level**

The Philippine Government fully supports the need for an effective civil defense organization and Republic Act 1190, otherwise known as the Civil Defense Act of 1954, and the Presidential Decree 1 as implemented by Letter of Instruction No. 19 gave effect to this. Republic Act 1190 of 1954 was further re-enforced by Presidential Decree 1566 of June 11, 1978. This decree strengthened the Philippine Disaster Control Capability by establishing the National Program on Community Disaster Preparedness.

#### **THE FUNCTIONS OF THE OFFICE OF CIVIL DEFENSE ARE:**

- a) To establish and administer a comprehensive national civil defense and civil assistance program.
- b) To formulate plans and policies for the protection and welfare of the civilian population in time of war directly involving the Philippines or other national emergencies of equally grave in character.

- c) To estimate total material, manpower and fiscal requirements for carrying out of the civil defense programs, and allocate to the provinces, cities, municipalities and barangays such aid in facilities, materials, and funds as may be available from the national government
- d) To develop and coordinate a program for informing, educating and training the general public, members of the disaster coordinating councils and disaster control groups on civil defense and civil assistance measures.
- e) To furnish guidance to the various provinces, cities, municipalities and barangays in the planning, organization and operation of their civil defense organization.
- f) To advise the Secretary of National Defense on matters concerning civil defense and make recommendations from time to time as may be deemed appropriate or as the Secretary may require, and
- g) To perform such other duties as may be directed by higher authority or provided by law.

### **NATIONAL DISASTER COORDINATING COUNCIL**

The National Disaster Coordinating Council (NDCC), which is the highest policy determining body for major disaster, is composed of almost all members of the cabinet under the chairmanship of the Secretary of National Defense.

The NDCC whose main function is to advise the President on the status of the national disaster preparedness program, disaster operations and rehabilitation efforts undertaken by the government and the private sector, utilizes the facilities and services of the Office of Civil Defense in Camp Aguinaldo, Quezon City. All the members of the council contribute their manpower, facilities and expertise to effectively carry out the functions of the NDCC.

#### **Local Level**

### **REGIONAL DISASTER COORDINATING COUNCIL**

The Regional Disaster Coordinating Council (RDCC) shall be responsible for the regional preparedness programs, disaster operations and rehabilitation activities by the government and the private sector and advise the National Disaster Coordinating Council through the Office of Civil Defense on the status of disaster preparedness and operations in the region.

## **LOCAL DISASTER COORDINATING COUNCIL**

Legislative makes it compulsory for the local government from the provincial, city, municipal and barangay levels to:

- a) ***Health Service*** - involves the medical services and first aid.
- b) ***Auxiliary Fire Service*** - helps the existing fire departments in operating fire departments in operating fire engines, putting out fires and organizing fire brigades.
- c) ***Police Service*** - helps the Philippine National Police in enforcing traffic regulations, prevention of looting and other acts of lawlessness.
- d) ***Emergency Transportation Service*** - operates trucks, buses, and other means of transportation for hauling supplies, civil defense workers, injured persons and evacuees to dm designated places.
- e) ***Communication and Warning Service*** - provides, operates and maintains continuous and reliable communications and adequate warning system throughout the period of impending and or existing disasters and calamities.
- f) ***Public Information Service*** - provides accurate information and instructions to the civilian population during emergencies.
- g) ***Rescue and Engineering Service*** - provides teams to save lives and quickly getting people out of damaged buildings, and freeing the trapped or isolated.
- h) ***Evacuation Service*** - evacuates the populace and properties systematically if an emergency or calamity arises.

## **HOW CIVIL DEFENSE WORKS**

When a disaster hits the country and a state of emergency is declared the President upon the recommendation of NDCC, the Office of Civil Defense-National Disaster Management Center shall perform the following tasks:

- a) Process warning information received from warning agencies and other sources and disseminate alert notices to the cooperating/implementing agencies and Civil Defense Regional Offices and the general public.

- b) Activate the Emergency Broad cast System, if and when necessary.
- c) Monitor preparations for and actions taken by cooperating/implementing agencies on requirements obtained from the disaster-stricken areas and coordinate their activities and functions and those of the private sector to maximize the utilization of the nation's resources for the protection and preservation of the civilian population and properties during disasters or emergencies.
- d) Issue requests to cooperating/implementing agencies on additional requirements for mitigating the effects of disasters.
- e) Prepare continuing reports and assessments for the President and Secretary of National Defense and other NDCC members.

**COOPERATING/IMPLEMENTING AGENCIES SHALL PERFORM THE FOLLOWING:**

- a) Upon receipt of warning information from OCD and other sources, implement their respective action plans pursuant to the National Calamities and Disaster Preparedness Plan.
- b) Monitor actions taken by their respective field units.
- c) Recommend actions to be taken by other cooperating/implementing agencies in the mitigation of disaster on requirements of disaster stricken areas beyond their capability tasks.
- d) Submit reports as obtained from the field.
- e) Effect lateral coordination with other cooperating/implementing agencies and the local government to maximize assistance to the distressed community.

The direction and control of disaster operations of the national level shall be exercised by the National Disaster Coordinating Council through the facilities of the Office of Civil Defense. Direction and control at all other levels shall be exercised through their respective disaster operation centers.

## **MAYON LAHAR WARNING STATION**

### **RAINFALL STATION**

- STN:No. 01 - (Site A) Maninila, Guinobatan, Albay  
02 - (Site B) Mabinit, Lrgazpi City  
03 - (Site C) Buyuan, Legazpi  
04 - (Site D) Sta. Mesirecordia, Sto. Domingo, Albay  
05 - (Site E) Mayon Vista Lodge, Tabaco, Albay

### **MUDEFLOW SENSOR STATION**

- 06 - (Site F) Miisi/Budiao, Daraga, Albay  
07 - (Site G) Mabinit, Legazpi City  
08 - (Site H) Buyuan, Legazpi City  
09 - (Site I) Sta. Mesirecordia, Sto. Domingo, Albay  
16 - Repeater Station – Hill 27, Paulog, ligao, Albay  
\*Monitoring Station – RDMD, OCD, CAMP Gen.

Simeon A. Ola, Legazpi City

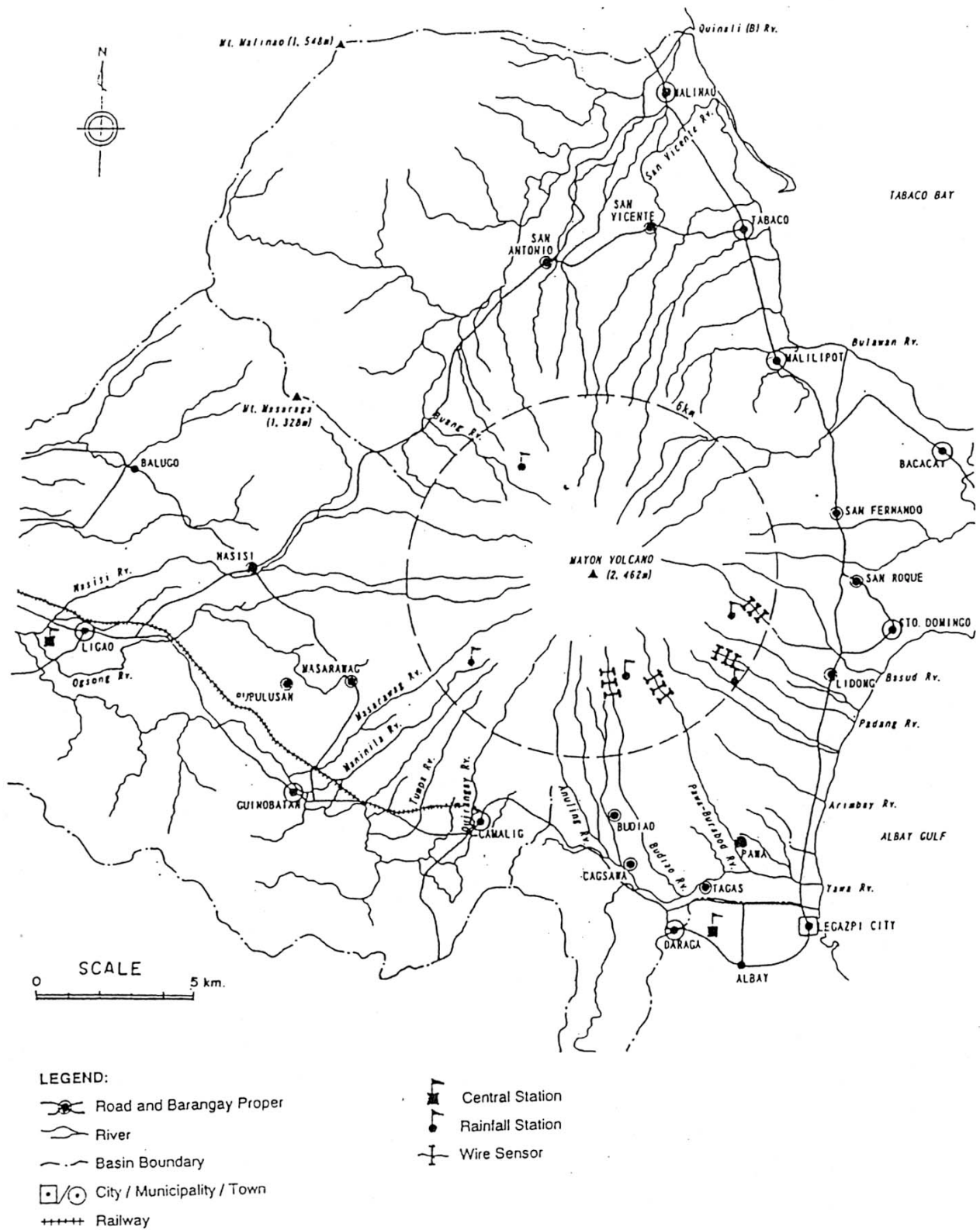


Figure G - 3 Existing Telemetered Rainfall Gauging Station Site