Chapter 2. GIS Database Development

CHAPTER 2. GIS DATABASE DEVELOPMENT

2.1 Purpose of the Development of the Database

Geographic Information System (GIS) has emerged as one of the most powerful tools in decision making and planning in the past 20 years. It can handle large volumes of map and attribute data simultaneously. It has a wide range of data analysis functions such as overlay, buffer and attribute manipulation. Because of these capabilities, GIS has been used extensively for urban/regional planning, environmental or natural resource management, tax mapping and facilities management.

After several big earthquake disasters around the world, researchers, experts and local government administrators have turned to GIS help them analyze these phenomena and reduce the destructive impact of these catastrophes. For MMEIRS, a multi-purpose GIS was developed that can be used for not only for seismic damage estimation but also for other applications such as planning and management of cities and municipalities. GIS techniques were used extensively by experts to study existing conditions of Metropolitan Manila and simulate various earthquake scenarios. The project also produced a new large scale topographic map at scale 1:5,000 based on new aerial photography. This new base map reflects the current state of development of Metropolitan Manila. Accurate and updated information are vital in the course of the study.

Geographic data pertaining to Metropolitan Manila's existing natural and social conditions, infrastructure, public facilities and lifeline data were also being collected for the project. These data were analyzed and combined with each other to provide new and more insight on Metropolitan Manila in order to assess it's vulnerability to earthquake. This involved collection of data both in hardcopy and digital forms and then processing them to formats usable in GIS analyses.

2.2 Design of the Geographic Database

The design of the geographic database involved several steps. The steps involved 1) assessment data requirements of the study, 2) determining availability and collection of data 3) establishing mapping conventions, and 4) standardizing data inputs.

Assessment of data requirements of the study involved interviewing other members of the study team specializing in different fields such as geology, infrastructures, health, emergency and social studies. Previous earthquake related studies were also examined in order for the GIS specialist to get a better understanding of the data requirements. This step is important so that the GIS databases developed will be able to support the various queries and analyses that were done by the other members of the study team.

After the assessment of data requirements of the study was done, a determination of data availability was conducted. MMDA, Phivolcs, LGU's and other agencies were visited to determine what data are available. Special attention was given to readily available digital data. Where digital data are not available hardcopies were collected for digitization or encoding.

Mapping conventions were then established. As expected, map data collected from the various agencies visited were plotted using different coordinate systems. In establishing mapping conventions, the coordinate system to be used was decided. PTM III was selected for all map data for the project. The project involved the creation of a new 1:5000 base map for Metropolitan Manila based on new aerial photography. PTM III is appropriate for mapping at scales 1:5000 and larger. This selection was arrived at in consultation with NAMRIA and the project mapping consultants.

Geographic data collected for the study were then standardized to prepare them for GIS analyses. This involved establishing database structures, designing the feature types to be used to represent the different map features and establishing map layouts for all map outputs.

The data requirements of the experts involved in the study determined the database structures to be used. The data were structured in a format that made it possible to be queried and analyzed by experts using the GIS. For example, standard codes were established to represent the different administrative units of Metropolitan Manila such as cities/municipalities and barangays. To facilitate linkages to other government databases pertaining to LGU's and barangay, the coding system of NSO was adopted.

GIS feature types such as Point, Line, Polygons to be used to represent the different map features were also standardized. For example, Point feature type was used to plot locations of important public facilities such as police stations, fire stations and other landmarks. Lines were used to represent road centerlines, polygons were used to represent administrative areas such as LGU's and barangay.

The basic map layout for all map outputs was also designed. The layouts were designed for plot-out in A0, A3 and A4 paper sizes. The layout included spaces for title blocks, legend, scales, data frame and other map data.

2.3 Data Collection and Input

Data collection involved visiting all 17 local government units in Metropolitan Manila, coordinating with counterpart agencies, MMDA and Phivolcs, visiting relevant government agencies and private companies.

The following describe the results of data collection.

2.4 Census Data

Census data relevant to the project were obtained from NSO. The Data Kit of Official Philippine Statistics (DATOS) and Public Use Files of the 2000 Census of Population and Housing (Census 2000) were purchased for the study.

1) Data Kit of Official Philippine Statistics (DATOS)

Datos is a collection of statistics for all regions, provinces, cities, municipalities and barangays. The data kit also include digital maps showing approximate administrative boundaries at the regional, provincial, city, municipal and barangay level. The format of the digital maps is Arcview shapefile.

2) Public Use Files of the 2000 Census of Population and Housing (Census 2000)

The Public Use Files of the Census 2000 was especially prepared by NSO for MMEIRS. The data file received contains the raw data collected in Census 2000. The files received basically contained two types of records: Population Data and Housing Data.

(1) Population Data

The census of population is a complete count of all residents, both Filipinos and foreigners, in the Philippines including overseas workers as of May 1, 2000. It also gathers basic characteristics of each individual such as age, sex, marital status, education, disability, ethnicity, occupation, and fertility.

(2) Housing Data

The census of housing is a complete enumeration of all housing units in the country whether occupied or vacant at the time of the census. Structures which are not conventional housing units such as caves, trailers, abandoned railroad coaches, etc., but used as living quarters at the time of census are also included. Physical characteristics of building where housing units are found including housing facilities and services are also gathered. The data files received included information on the following:

- Construction materials of the outer wall such as
    - Concrete/brick/stone
    - Wood
    - Half concrete/brick/stone and half wood
    - Others – Asbestos, Glass, Bamboo, Makeshift etc
- Construction materials of the roof
- Year the building was constructed
- Building type,
- State of repair,

- Approximate floor area

These data were processed to produce new insights as to the current conditions of structures in Metropolitan Manila. Thematic maps showing building counts per barangay, building density were produced. Sample maps produced from these data are shown in this report.

2.5 Major Facilities

1) Schools

The study team was able to collect a digital school location map from MMDA but this did not include all schools in Metropolitan Manila. To update the public primary and secondary school map, the study team visited the Department of Education (DepEd) offices at the National and NCR levels. A meeting of physical facilities officers and planners coming from the 14 division offices of DepEd in Metropolitan Manila was organized by with the help of the DepEd NCR office. In the meeting, the 14 division offices were provided with base maps and questionnaires by the study team for them to plot public primary and secondary schools in their areas of responsibilities.

To update the map showing the private primary and secondary schools, the Master list of private schools for school year 2002-2003 was downloaded from the DepEd website. The master list contains the schools' addresses and telephone numbers. Using the schools' addresses, the schools were plotted on the Metro Manila base map. Schools that could not be readily located using addresses were contacted through telephone and were asked for directions. About half or 474 schools were plotted out of a total of 861 schools were located.

To update the map showing tertiary institutions, the Commission on Higher Education (CHED) was contacted. CHED was able to provide a digital map showing tertiary institutions in Metropolitan Manila. The locations of these tertiary institutions were either located using GPS or eyeballed on the map.

2) Hospitals

The study team was able to collect hospital location map from MMDA but this is not complete. To update the hospital map, the Department of Health (DOH) was visited. DOH was able to provide an updated directory of hospitals in Metropolitan Manila. Using the directory, the team was able to plot the locations of the hospitals.

3) Police Stations

The Operations Department of NCR Police Office (NCRPO) in Bicutan is the primary source of information for police stations. The study team provided the NCRPO with a hardcopy base map of Metropolitan Manila where they plotted all the police station locations. The NCRPO also

provided the study team a directory of the police stations with attributes such as personnel and vehicle information. The study team then had the locations digitized and the attributes encoded.

4) Fire Fighting Stations

The Department of Interior and Local Government was able to provide a digital map of Fire Fighting Stations in Metropolitan Manila. The format of the data is MapInfo and was converted by the study team to Arcview shape file format. The study team was also able to obtain attribute information about the fire stations such as personnel and equipment information.

5) Governmental Facilities

Locations of governmental agencies were collected by field verification. The locations of these facilities were plotted on the new topographical map created.

6) Land Use

A new land use map based on recent aerial photography was created in cooperation with NAMRIA. The new land use map contains detailed classifications of residential, industrial and other land use.

7) Water Supply and Sewer

The Metropolitan Waterworks and Sewerage System (MWSS) is the primary source of information for water and sewer facilities. In 1997, two private companies were granted long term concessions to provide water supply and sewerage disposal in Metropolitan Manila. They are Manila Water Company, Inc (MWCI) for the East Zone, and Maynilad Water Services Inc. (MWSI) for the West Zone of Metropolitan Manila. Through MWSS, the study team was able to acquire digital maps of MWSI's water supply and sewer system in AutoCAD format. The AutoCAD drawing was then processed for use in GIS. For the east sector covered by MWCI, a harcopy water distribution map was provided by MWSS. The study team had this digitized and coverted to Arcview shape format.

8) Power Facilities

The main source of power facilities data are Meralco and National Power Corporation (NPC). NPC provided a harcopy map showing their main distribution lines and substations in Metropilitan Manila. This was digitized and converted to Arcview shape format. Meralco provided a digital map showing their distribution lines and substations in AutoCAD format. This was then processed and converted into Arcview shape format.

9) Telecommunications

In coordination with the National Telecommunications Commission (NTC), the study team met with the 6 main telecommunications providers in Metropolitan Manila. They are :

- PLDT
- Bayantel
- Globe
- Digitel
- Eastern Telecoms
- Smart

Resistance was encountered when the study team asked for facilities data to be provided by the telecommunications companies because the field of telecommunications is highly competitive. Finally, a hardcopy map showing PLDT's primary cable and exchange locations was obtained. This was digitized and converted to Arcview shape format.

10) Port Facilities

The Philippine Ports Authority (PPA) was the primary source of port facility information. According to PPA, there are three main port facilities in Metropolitan Manila. They are :

Table 2.1 List of Port Facilities

Port	Operator	Main Activity
North Harbor	PPA	Domestic container, non-container Passenger
Manila International Container Terminal	International Container Services Inc.	International cargo Break bulk cargo
South Harbor	Asian Terminals Inc.	International cargo & containers

The members of the study team were able to get digital maps in AutoCAD format of the three port facilities. The operators of the ports also provided answers to questionnaires that were provided.

11) Bridges

The Department of Public Works and Highways was able to provide the study team with a bridge inventory database that they conducted in 1995. The team was also able to obtain bridge location map from MMDA. These data are were verified by field survey conducted by the study team.

2.6 General Characteristics of Existing Data

Data collected for use in the different analyses in the project came from varied sources. As can be expected, differences in locational accuracy and formats were encountered. The following describe the general characteristics of existing data collected:

- A general lack of digital map data was observed. A large portion of collected data from LGU and various government agencies were in the form of hardcopy maps. These hardcopy maps were then digitized to make them ready for analyses using GIS techniques.

- Coordinates systems used in the various maps differ. The common systems encountered were UTM, PTM and Geographic coordinates. Some problems were encountered due to non-standard coordinate systems used. For MMEIRS, PTM III was adopted as the standard coordinate system. The Philippine Transverse Mercator (PTM) is the official coordinate system for surveying and mapping in the Philippines. It is an adaptation of the Universal Transverse Mercator (UTM) Grid System for latitudes 4° to 22°N and longitudes 117° to 125°E, based on the Transverse Mercator projection. PTM is further divided into five zones. Metropolitan Manila is covered by PTM zone III or PTM III.
- Digital map data collected were in different formats. Arcview, Arc /Info, MapInfo and AutoCAD were encountered. Some data were in raster formats such as jpeg and tiff. Using different techniques these digital data were converted to Arcview shapefile format. The standard adopted by MMEIRS.
- Map data collected were compiled at different scales. The most common scale used was 1:10,000. Some maps collected from LGU's do not indicate scale. Digital maps collected from NAMRIA is at scale 1:5,000. The new base map being created for the project is at scale 1:5,000. At this scale, most building and house footprints can be distinguished.

2.7 Data Analysis Unit

Two basic units of analysis were used, grid cells and administrative boundaries.

For analyses pertaining to urban/regional planning, administrative boundaries were used. The main sources for administrative boundary information used were digital maps in ArcView shapefile format provided by MMDA and acquired from NSO. Differences between the MMDA and NSO versions were observed. The boundaries used for the GIS analyses were mostly boundaries taken from the MMDA map and updated in some portions guided by the NSO map. The barangay boundaries were edited to account for differences resulting from barangays that were merged, deleted or boundaries moved.

Two types of administrative boundaries were used, LGU and barangay boundaries. This is also the census units used by NSO. A total of 17 LGU boundaries were used to reflect the limits of the 17 cities and municipalities included in Metropolitan Manila. According to data acquired from NSO, a total of 1694 barangays comprise Metropolitan Manila. Some barangays especially in the City of Manila comprise only of one or two street blocks and cover only a small area. For convenience, the barangays in the City of Manila were grouped together into districts.

For analyses pertaining to natural conditions, grid cells of 500 m x 500 m size and 50 m x 50 m size were used. To create the grid network, a rectangular area was established, with origin at 1584500 m northing and 488000 m easting, such that it covers the entire Metropolitan Manila with a buffer of about 200 m from the limits of the boundary. The grid cells falling outside the

boundary limits of Metropolitan Manila plus a buffer zone of 200 m were then deleted. Each grid was then assigned an ID number that reflects its geographical position.

2.8 Data Processing

Based on the geographic database, spatial characteristics of natural and social conditions of the study area were analyzed. After the completion of GIS database development, digitized maps were combined and overlaid with each other to evaluate the spatial/regional distribution of constraints or vulnerability for seismic disaster. The data analysis process consists of four stages: primary analysis, secondary analysis, tertiary analysis and evaluation/recommendation.

In the primary data analysis stage, simple calculation or overlay analysis were conducted to show the existing conditions of the study area both social and natural.

For the secondary data analysis stage, primarily processed data items were combined and overlaid. For example, slope and geological data will be overlaid to come up with slope stability analysis.

The following describes the primary and secondary analyses made on the data collected:

GIS Analyses

Type of Analysis	Description	Data Required	Output	Process
Gross Population Density per City/Municipality	Calculate population densities per City/Mun based on 2000 NSO census 2000. Unit used is Person/Ha	NSO Census 2000 City Boundary Map (S_CityBnd.shp)	S_CityBnd.shp with additional Pop Gross Density field	To calculate gross population density per city/mun, the NSO Census 2000 Table showing the population counts per city/mun was linked with the City Boundary map using "Geocode" as relate key. The area for each city is then derived using the boundary map. The Population density is calculated as PopDen = (Population per city) / (Area per city)
Gross Population Density per Barangay	Calculate population densities per barangay based on 2000 NSO census 2000. Unit used is Person/Ha	NSO Census 2000 Barangay Boundary Map (S_BgyBnd.shp)	S_BgyBnd.shp with additional Pop Gross Density field	To calculate gross population density per barangay, the NSO Census 2000 Table showing the population counts per barangay was linked with the Barangay Boundary map using "Geocode" as relate key. The area for each barangay is then derived using the boundary map. The Population density is calculated as PopDen = (Population per Barangay) / (Area per Barangay)
Road Length per City/Municipality	Determine existing road length per City/Mun based on MMEIRS 2003 base maps. Unit used is m/Ha.	Road Centerline Map (I_RoadCenter2003.shp) City Boundary Map (S_CityBnd.shp)	Road Length per city data in J:¥Database¥Excel¥QuckTables¥City Data2003.xls	To determine road length per city, the road centerline map is overlayed with the city boundary map to come up with a road length per city map. The road lengths are then recalculated in the resulting map. The total road length per city is then summarized by dissolving the resulting map using city code as the dissolve key.
Road Area per City/Municipality	Calculate Road Area Density per city/Mun. Unit used is %	Road Centerline Map (I_RoadCenter2003.shp) City Boundary Map (S_CityBnd.shp)	Road Area per city data in J:¥Database¥Excel¥QuckTables¥City Data2003.xls	To determine road area per city, the road width data extracted from the MMEIRS 2003 base maps are used. The road centerline map is then overlayed with the city boundary map to come up with a road area per city map. The road areas are then calculated in the resulting map as road length multiplied by road width.

				The total road area per city is then summarized by dissolving the resulting map using city code as the dissolve key.
Narrow Road Length per City/Mun	Calculate Narrow Road Length per city/mun. Narrow Roads are defined as roads that are less than 6m. Unit used is m/Ha.	Road Centerline Map (I_RoadCenter.shp) City Boundary Map (S_CityBnd.shp)	Narrow Road Length per city data in J:¥Database¥Excel ¥QuckTables¥City Data2003.xls	To determine narrow road length per city, the road width data extracted from the MMEIRS 2003 base maps are used. A Narrow Road Map is then created by extracting roads less than 6m from the road centerline map. The Narrow Road Map is then overlayed with the city boundary map to come up with a narrow road area per city map. The road length are then recalculated in the resulting map. The total narrow road length per city is then summarized by dissolving the resulting map using city code as the dissolve key.
Narrow Road Ratio per Total City Road	Calculate Narrow Road Length per total city/mun roads . Narrow Roads are defined as roads that are less than 6m. Unit used is m/m.	Road Centerline Map (I_RoadCenter.shp) City Boundary Map (S_CityBnd.shp)	Narrow Road Ratio per city data in J:¥Database¥Excel ¥QuckTables¥City Data2003.xls	To determine narrow road leghth per total city roads, a Narrow Road Map is then created by extracting roads less than 6m from the road centerline map. The Narrow Road Map is then overlayed with the city boundary map to come up with a narrow road area per city map. The road length are then recalculated in the resulting map. The total narrow road ratio per Total City roads is calculated as narrow road lengths per city divided by total city road length.
Open Area per City/Municipality	Determine amount of open area available per City/Mun based on the MMEIRS Land Use Map.	Open Area Map (S_Vege-86.shp) City Boundary Map (S_CityBnd.shp)	Open Area per city data in J:¥Database¥Excel ¥QuckTables¥City Data2003.xls	To determine open area per city, open areas are extracted from the MMEIRS land use map. The open areas are overlayed with the city boundary map to come up with an open area per city map. The open areas are then recalculated in the resulting map. The total open area per city are then summarized by dissolving the resulting map

				using city name as the dissolve key.
Industrial Area per City/Municipality	Calculate Industrial Areas per City/Mun using the MMEIRS Land Use Map.	MMEIRS Land Use Map (S_LandUse2003.shp) City Boundary Map (S_CityBnd.shp)	Industrial Area per city data in J:¥Database¥Excel ¥QuckTables¥City Data2003.xls	To determine industrial area per city, industrial areas are extracted from the MMEIRS land use map. The industrial areas are overlayed with the city boundary map to come up with an industrial area per city map. The industrial areas are then recalculated in the resulting map. The total industrial area per city are then summarized by dissolving the resulting map using city name as the dissolve key.
Subdivision Area per City/Municipality	Calculate Subdivision Area per City/Mun.	S_Subdivision.shp City Boundary Map (S_CityBnd.shp)	Subdivision Area per city data in J:¥Database¥Excel ¥QuckTables¥City Data2003.xls	The subdivision areas are overlayed with the city boundary map to come up with an subdivision area per city map. The subdivision areas are then recalculated in the resulting map. The total subdivision area per city are then summarized by dissolving the resulting map using city name as the dissolve key.
Built-up (Residential) Area per City	Calculate Built-up Areas per City/Mun using the MMEIRS Land Use Map.	MMEIRS Land Use Map (S_LandUse2003.shp) City Boundary Map (S_CityBnd.shp)	Built-up Area per city data in J:¥Database¥Excel ¥QuckTables¥City Data2003.xls	To determine built-up area per city, built-up areas are extracted from the MMEIRS land use map. The built-up areas are overlayed with the city boundary map to come up with an built-up area per city map. The built-up areas are then recalculated in the resulting map. The total built-up area per city are then summarized by dissolving the resulting map using city name as the dissolve key.
Rate of Moderately Damaged Bldg (Model 08)	Calculate Rate of Moderately Damaged Bldg. Unit used is %	D_Building_Dam_08_ Region	D_Building_Dam_ 08_Region (P_Pct)	Create the ff. fields: P_Pct = P_Total/Total
Rate of Seriously Damaged Bldg (Model 08)	Calculate Rate of Seriously Damaged Bldg. Unit used is %	D_Building_Dam_08_ Region	D_Building_Dam_ 08_Region (H_Pct)	Create the ff. fields: H_Pct = H_Total/Total

Building Collapse Risk (Model 08)	Calculate Building Collapse Risk	D_Building_Dam_08_ Region	D_Building_Dam_ 08_Region (FinWtRec)	Create the ff. fields: H_Weight = Rating of H_Total P_Weight = Rating of P_Total FinalWt = (H_Weight + P_Weight) / 2 FinWtRec = Reclass of FinalWt
Flammable Area	Score Flammable Areas	G_Grid500 Flood4Fire_Grid_regi on	Flammable.dbf (FlameWt)	Create FlameWt with the ff. values: Ratio2 <= 30% → Score 1 For Ratio2 > 30%, with Wood Building Ratio (Ratio0) 0-10 → Score 2 10-20 → Score 3 20-30 → Score 4 30+ → Score 5
Rate of Areas Affected by Explosions	Assign Weights to Areas affected by Explosion	G_Grid500 H_HazFacilities H_GasSta	ExplosionGridRisk. dbf (ExpWt)	Buffer H_GasSta with 0.3 km Buffer H_HazFacilities with the ff. buffer distance: LPG & Gas Tanks → 2 km Acetylene & Oxygen → 0.3 km LPG → 2 km Petroleum → 0.5 km Power Generation → 0.5 km Chemicals → 1 km Oil → 0.5 km Union of both buffered Areas Intersect with G_Grid500 Calculate NewArea of Grids affected by explosions Calculate Percentage AreaPct = NewArea/GridArea For values of AreaPct, score ExpWt with, 0-20 → Score 1 20-40 → Score 2 40-60 → Score 3

				60-80 → Score 4 80-100 → Score 5
Flammable Risk	Calcilate Flammable Risk	G_Grid500 Flammable.dbf , ExplosionGridRisk.dbf (FlamWt, ExpWt)	FinalFlammable.dbf (FinalWt)	Use FlamWt of Flammable.dbf Use ExpWt of ExplosionGridRisk.dbf Ave = (FlamWt +ExpWt) / 2 FinalWt = reclassification of Ave
Evacuation Difficulty (Model 08)	Score Areas with evacuation difficulty	G_Grid500 D_Building_Dam_08_Region (H_Total) I_RoadCenter (RdWidthCal)	RdLengthTotal.dbf (BlockRisk)	Intersect Layers of H_Total <= 150 and RdWidthCal < 6 Calculate Roadlength1 Intersect Layers of H_Total > 150 and RdWidthCal < 8 Calculate Roadlength2 Calculate Sum of Roadlength1 and Roadlength2 Calculate BlockRisk on the reclassification of the sum based on the following: > 4000 → Score 1 3000 – 4000 → Score 2 2000 – 3000 → Score 3 1000 – 2000 → Score 4 0 – 1000 → Score 5
Evacuation Difficulty and Flammable Area	Assign weights to evacuation difficulty areas and flammable areas	G_Grid500 Flammable.dbf RDLengthTotal.dbf	Export_Output.dbf FinalWt	In Export_Output.dbf, join Flammable.dbf and RDLengthTotal to get the values of FlameWt and BlockRisk respectively. Add field AveWt and FinalWt Calculate AveWt = (FlameWt+BlockRisk)/2 Reclass FinalWt based on values of AveWt
Regional Risk Map	Calculate regional risk	G_Grid500 TotalRisk.dbf FinalFlammable.dbf		Show only the High Regional Risk, High Flammable Risk and High Evacuation Difficulty

		RdLengthTotal.dbf		
Service Area Density of Hospitals	Determine service area density of hospitals	G_Grid500 P_Hospital	AllGridHospBuff.dbf HospArWt	Add Buffer field in Hospital for different types as follows: Tertiary = 2 km Secondary = 1 km Primary = 0.5 km Buffer the Hospital but don't dissolve the buffered areas. Calculate NewArea of each Grid Summarize on GridID on the Sum of NewArea Create HospArWt with the ff: on AreaPct Values: 0 –100 → Score 5 100 – 200 → Score 4 200 – 300 → Score 3 300 – 400 → Score 2 > 400 → Score 1
Hospital Service Shortage Risk	Calculate hospital service shortage risk	G_Grid500 D_Building_Dam_08_Region (H_Total)	AllGridHospBuff.dbf HospWt	Join D_Building_Dam_08_Region and get values of H_Total Recalculate HospWt: For H_Total 1, 2 → Score 1 For H_Total 3,4,5 → Average values (Ave) with HospArWt Ave = (H_total+HospArWt)/2 Reclass Ave into 5 values and store to HospWt
Service Area Density of Public Schools	Determine service area density of public schools	G_Grid500 P_School_DepEd	AllSchGrid.dbf (AreaPctWt)	Assign the following buffer to each school type: College → 2 km Secondary → 1 km Elementary → 0.5 km

		P_School_CHED		Buffer both P_School_CHED and P_School_DepEd without dissolving buffer areas. Intersect CHED buffer with Grid and DepEd buffer with Grid. Add field, Newarea, in each table and calculate for the area. Summarize by Grid on the sum of NewArea on both tables. Create a table AllSchGrid containing the fields of the sum of newarea in both tables (by joining). Calc AreaPct = (SumArea + SumArea1)/GridArea Create AreaPctWt with the ff: on AreaPct Values: 0 –100 → Score 5 100 – 200 → Score 4 200 – 300 → Score 3 300 – 400 → Score 2 > 400 → Score 1
Evacuation Facility Shortage Risk	Calculate evacuation facility shortage risk	G_Grid500 D_Building_Dam_08_ Region	AllSchGrid.dbf NewSchWt	Join D_Building_Dam_08_Region and get values of H_Total Recalculate NewSchWt: For H_Total 1 → Score 1 For H_Total 2,3,4,5 → Average values (AveDamAr) with AreaPctWt AveDamAr = (H_total+AreaPctWt)/2

				Reclass AveDamAr into 5 values and store to NewSchWt
Service Area Density of Fire Stations	Determine service area density of fire stations	G_Grid500 P_FireStations	GridFSArea2.dbf (AreaPct)	Assign the following buffer to each Fire station class: Substation→ 2 km Station → 4 km Buffer the layer without dissolving the buffer area. Intersect Fire Station buffer with Grid. Add field, Newarea, in the table and calculate for the area. Summarize by Grid on the sum of NewArea on the table. Create a table GridFSArea2 containing the fields of the sum of newarea (by joining). Calc AreaPct = Sum_Area/GridArea Create AreaWt with the ff: on AreaPct Values: 0 –100 → Score 5 100 – 200 → Score 4 200 – 300 → Score 3 300 – 400 → Score 2 > 400 → Score 1
Fire Extinguish Service Shortage Risk	Calculate fire fighting shortage risk	G_Grid500 FinalFlammable.dbf RdLengthTotal.dbf	GridFSArea4.dbf	Add AccessWt and FlameWt fields from RdLengthTotal and FinalFlammable respectively. Add field AveWt and ExtWt2. Calculate AveWt = (AreaWt + AccessWt + FlameWt) / 3

				Reclass ExtWt2 based on values of AveWt
Service Area Density of Parks and Open Spaces	Determine service area density of parks and open spaces	G_Grid500 Parks_OpenSpaces	AllGridPOSBuff.dbf POSAreaWt	Buffer 2 km on the existing Parks and Open Spaces without dissolving buffer areas. Intersect G_Grid500 with the buffered areas. Create a new field AREA and calculate the area in each grid. Summarize by Grid ID and getting the Sum of the AREA. Add fields AreaPct and POSAreaWt. Calculate AreaPct = (SumArea/GridArea) Calculate POSAreaWt with the ff: on AreaPct Values: 0 –100 → Score 5 100 – 200 → Score 4 200 – 300 → Score 3 300 – 400 → Score 2 > 400 → Score 1
Evacuation Area Shortage Risk	Calculate evacuation area shortage risk	G_Grid500 D_Building_Dam_08_Region	AllGridPOSBuff.dbf FinalWt	Join D_Building_Dam_08_Region and get the H_Total field and rename it as Dam08Val field. Transfer the values. Create a field Dam08, AveWt and FinalWt. On Values of Dam08Val, recalculate Dam08 based on the ff: 0 – 50 → Score 1 50 – 100 → Score 2 100 – 150 → Score 3 150 – 200 → Score 4 > 200 → Score 5 Calculate AveWt = (Dam08+POSAreaWt)/2

				Reclass FinalWt based on values of AveWt
Total Regional Risk (Model 08)	Calculate total regional risk	G_Grid500 FinalFlammable.dbf D_Building_Dam_08_Region RdLengthTotal.dbf	TotalRisk.dbf	Add FlamRisk, Model08 and EvacRisk fields from FinalFlammable, D_Building_Dam_08_Region and RdLengthTotal respectively. Add field AveRisk08 and calculate as AveRisk08 = (FlamRisk + Model08 + EvacRisk) / 3 Reclass Risk08b based on values of AveRisk08

Supporting Report
Part VI Appendices

1. City Ordinance of Earthquake Disaster Management

CITY ORDINANCE ON DISASTER MANAGEMENT

Section 1. Title and Purpose

This is the Disaster Management Ordinance of the city of _____. An ordinance to authorize a program for pre-disaster mitigation; to provide for the direction and coordination of disaster preparations, response, and recovery; to streamline the administration of disaster relief; to appropriate and or control the city costs of disaster assistance and for other purposes.

Section 2. Definition of Disaster

Disaster is defined under this section to mean the actual or threatened existence of conditions of extreme peril to the safety of persons and property caused by natural or manmade events such as attacks, terrorism, chemical or oil spills or other environmental contaminations, fires, floods, storms and other hazards such as earthquakes. Disaster may include any occurrence, which by reason of its magnitude is or is likely to become beyond the control of the normal services, personnel, equipment and facilities of the departments of the city government.

Section 3. City Policies on Disaster Management

The policy of the city in disaster management is to take all action possible to the extent that it aims to prevent disaster, to reduce the vulnerability of city residents to any disaster that may strike, to establish capabilities for protecting citizens from adverse effects of disasters, to respond effectively to actual occurrence of disasters and other risks, and to provide for recovery in the aftermath of any emergency involving extensive damage or other debilitating influence on the normal pattern of life in the community.

Section 4. City Disaster Management Organization

There is hereby created the City Disaster Management Organization. This Organization shall constitute the forces and resources necessary to meet the conditions of a disaster and shall be composed of the various city personnel, services, and resources controlled by or otherwise available to the Mayor.

The primary city office for disaster management is the office of the Mayor with the assistance of the City Disaster Coordinating Officer. The Mayor is the Director of the City Disaster Management Organization.

The City Disaster Coordinating Council is a collegial body for coordinating disaster plans and programs during pre-disaster, disaster, and post-disaster conditions, operating under the supervision of the City Mayor.

The Mayor together with the City Disaster Coordinating Council and City Department heads shall have joint responsibility for: integrated emergency management planning, coordination of emergency management, resource management and training of department heads as well as communication and warning systems.

Section 5. Disaster Management Plans and Programs

The disaster plan of the city shall provide a blue print for the city's prevention, preparedness and response arrangements in the event of a disaster. The focus of the plan is to minimize the destructive effects of disasters within the city.

The disaster plan shall be developed by the appropriate city officials with the participation of the City Disaster Coordinating Council. The City Disaster Coordinating Council under the supervision of the Mayor and with the assistance and coordination of the City Disaster Management Coordinating Officer shall be responsible in integrating the disaster plan.

In implementing this specific section of this ordinance, the City Mayor and the City Disaster Coordinating Council shall update any existing disaster management or risk mitigation plan of the city, outline the current disaster management system that is in place including any propose enhanced system in the future and define the responsibilities of individual employees and organizations at each level of the system which consists of the Regional and Local Disaster Coordinating Councils.

The updated city disaster plan should provide for the coordination of disaster related planning, preparedness, response and recovery by relevant city departments and agencies and specify the disaster management roles and responsibilities of city and other government agencies including non-government organizations and the private sector.

Section 6. Duties and Powers of the Mayor in Disaster Management

The Mayor or Local Chief Executive is the Director of the City Disaster Management Organization.

The Mayor holds primary responsibility for directing and controlling all disaster related planning, preparedness, response and recovery by relevant city departments and agencies. The Mayor is also responsible for ensuring that proper coordination is carried out with the MMDCC, other cities, other levels of government, and non-governmental organizations. The Mayor shall also keep the City Council fully advised as to the status of disaster plans and operations.

In the event of sickness, absence from the city, or disability rendering the Mayor unable to act as Director of the City Disaster Management Organization, for purposes of this ordinance the powers of the Mayor provided herein shall be exercised by the Vice Mayor.

Section 7. Duties and Powers of the City Disaster Coordinating Officer

The primary responsibility of the City Disaster Coordinating Officer is to coordinate city emergency management activities, both internally with the city officials, agencies, barangay leaders, etc., and externally with those of the Metro Manila Disaster Coordinating Council and adjacent jurisdictions.

Section 8. Functions and Powers of the City Disaster Coordinating Council

It shall be the function of the City Disaster Coordinating Council to develop and recommend for adoption by the Mayor and City Council emergency and mutual aid plans and agreements and such resolutions and procedures as are necessary to implement such plans and agreements.

The Disaster Coordinating Council shall be composed of such members as specified in PD1566 including those designated by the Mayor and City Council in the exercise of such powers under the Local Government Code.

The Disaster Coordinating Council shall meet upon call of the Mayor and no less than 3 times annually.

Section 9. Duties and Powers of Departments and other Offices

Each city department is responsible for developing and maintaining its own operational plans and emergency management procedures. Specific responsibilities are to be outlined in each department's individual key actions checklists which are to be developed in each city department under the guidance and supervision of the City Disaster Coordinating Officer.

Responsibilities of city offices and other organizations that are not defined in any sections of this ordinance shall be defined in an Executive Order and will be included in the overall city disaster management plan.

Additionally, each city department, officer and employee shall render all possible assistance in carrying out the provisions of this ordinance.

Section 10. Lead Responsibilities of City Departments

The City Mayor shall provide the overall leadership necessary in the overall planning for disaster mitigation. City Departments shall likewise assume specific responsibilities for disaster mitigation, which are closely related to their official mandates.

a. City Engineering Office shall inventory the road network in the city and maintain city roads and streets properly. It will also identify alternate roads necessary to transport materials and supplies into the city in case regular routes are impassable.

b. City Fire Department shall make ready at all times fire apparatus, equipment, and personnel to be able to respond quickly and effectively during an emergency.

c. City Social Welfare Office shall develop an action plan how to provide relief effectively to victims of disasters and monitor situations in disaster areas.

d. City Health Department shall be responsible for the planning as well as delivering of emergency health services including triage and handling of mass casualty situations.

e. City Education Department shall be responsible for providing public education at the community level on how to prevent major damages and casualties in the event of an emergency.

f. City Treasury Department shall inventory and monitor its finances and other resources so that what the city has planned for disaster mitigation is implementable.

The disaster management functions of other city departments not mentioned herein shall be defined by the City Mayor in an Executive Order as provided for in Section 9.

Section 11. Disaster Management Training Programs and Policies

It shall be the policy of the city to formulate an annual disaster management training program for all city personnel. It shall further be the policy of the city to implement regularly the disaster management training plans with the aim of upgrading the response capabilities of the city in the event of a disaster.

Section 12. Disaster Alert Program

It is imperative that the public be kept informed of potential disasters about to occur and of the developments during an emergency or disaster. In the event

of a major disaster, the Mayor or the City Disaster Coordinating Officer will request the assistance of the Police Department and/or other agencies as appropriate in the establishment of a command center. The command center should develop a sustained disaster alert mechanism for people to monitor and as basis for their response to an emergency. The media should be kept apprised of information regarding the event. Factual information, i.e. casualties, damages, and incident locations may be given to the public provided that the information before it is released is appropriately cleared and reviewed by the competent authority in order to avoid conflicts and inaccuracies.

Section 13. Declaration and Termination of Local Disaster [or Emergency]

The Mayor is hereby empowered to declare the existence of a local disaster [or emergency] in the event of circumstances outlined in Section 2. The declaration shall be in writing and shall take effect immediately. The declaration shall be transmitted immediately to the MMDCC, the City Council, the public, and others as appropriate through the most appropriate means.

This section also requires that the appropriate city authorities also shall terminate the proclamation of emergency when the conditions warrant.

Section 14. Disaster Evacuation Plan

The Mayor may direct and compel the evacuation of all or part of the city population through prescribed routes and modes of transportation to appropriate evacuation destinations and control ingress and egress to a disaster area. The movement of persons within the area and the occupancy of the premises therein shall be strictly monitored. Details of the evacuation procedures may be set forth either in the manual for disaster management to be formulated under Section 16 of this ordinance or a specific evacuation plan may be prepared by the City Mayor or the Disaster Coordinating Officer.

Section 15. Disaster Recovery Plan

In support of Section 13 of this ordinance, the city in formulating its overall disaster management plan shall highlight as a major component of the overall disaster plan, a recovery plan to rehabilitate damaged properties and social and economic disruption in the aftermath of the occurrence of a disaster. The recovery plan shall define the city offices involved with their responsibilities predetermined.

Section 16. Disaster Management Reporting System

It shall be the joint responsibility of the City Disaster Coordinating Officer and City Disaster Coordinating Council under the supervision of the City Mayor to

formulate and implement a disaster management reporting system. The city reporting system on disaster management shall be installed in the city government and all responsibilities of the appropriate city officials properly defined and disseminated for the guidance and information of all concerned.

Section 17. Public Education and Community Awareness

To protect lives and properties, it is essential to alert the community to local hazards and provide information on preparedness and risk reduction strategies. The City Government shall:

a) Conduct public awareness programs advising the community about local characteristics of potential hazards and possible impacts;

b) Provide public education on how individuals can prepare themselves for disaster events;

c) Have an information dissemination plan; and

d) Allow and encourage public access to the local mitigation and counter disaster response and recovery plans.

Section 18. Disaster Management and Information Technology

To support the provisions of Section 12 and Section 13 of this ordinance, the city government shall adopt modern techniques in managing disasters. The city shall improve its applications of information technology in order to manage effectively disasters and their destructive consequences.

Section 19. Manual on Disaster Management

It is hereby made mandatory that the city government shall formulate and complete a Manual on Disaster Management within a period of one year immediately after the approval of this ordinance by the City Council.

Section 20. Budget for Disaster Management

The City Council shall appropriate disaster contingency funds, as necessary, for the protection of the inhabitants and property of the city from disaster. Such funds are to be sourced from any local fund as augmentation or as additional funds to the mandatory five percent calamity appropriation from the total budget of the city.

Section 21. Disaster Management Performance Audit

The city shall endeavor to establish standards of performance in disaster mitigation. The procedure outlining how performance audits may be used in disaster management shall be contained in the Manual for Disaster Management, the formulation of which is mandated under Section 16 of this ordinance.

Section 22. Miscellaneous Provision (Inter-local cooperation)

a. The city shall immediately contact the MMDCC, the Philippine National Red Cross, and other pertinent agencies during a disaster.

b. The city shall provide a temporary site for the city government whenever a disaster will destroy city government facilities and infrastructure in order to continue city government operations.

c. The city shall encourage inter-local cooperation among adjacent local governments in the event of the occurrence of a disaster.

d. The city shall coordinate and work with the Metro Manila Disaster Coordinating Council in the organization of zones where a cluster of cities may be grouped together for better coordination during a disaster like earthquakes.

Section 23. Private Liability

It shall be unlawful for any person who will fully obstruct, hinder or delay any emergency services, enforcement of any rule or regulation issued pursuant to this ordinance, or to perform any act forbidden by any rule or regulation under this ordinance.

It shall likewise be unlawful for any person to wear, carry or display an emblem, insignia or other means of identification as a member of any city emergency services groups unless authority to do so has been granted by the proper officials of the city. Violations of these provisions are subject to fines, penalties or imprisonment as may be provided by law.

Section 24. Penalty

Any person who will intentionally or willfully violate any provisions of this ordinance shall be punished with a fine to be determined or at the discretion of the City Council.

Section 25. Mandatory Review

It shall be mandatory for the legislative Council of the city to review this ordinance five years after its approval, in order to evaluate its relevance and propose any appropriate changes.

Section 26. Separability Clause

If, for any reason or reasons any part or provision of this ordinance shall be held to be unconstitutional or invalid, other parts or provisions hereof which are not affected thereby shall continue to be in full force and effect.

Section 27. Effectivity Clause

This ordinance shall take effect one month after its approval by the Sangguniang Panlungsod unless otherwise provided herein, after its posting in conspicuous places in the city and or after its complete publication in at least one (1) newspaper of general circulation.

2. Earthquake Disaster Mitigation Handbook

Table of Contents

Chapter I Introduction **1-1**

Chapter II Legal and Institutional Arrangements **2-1**

Chapter III Earthquake **3-1**

Chapter IV Earthquake Effects and Potential Earthquake Scenarios for Metro Manila Area **4-1**

Chapter V Strategies on Earthquake Mitigation **5-1**

Chapter VI Existing Resource Agencies in Metro Manila **6-1**

Chapter VII Capacity Building and Training Courses in Earthquake Disaster Mitigation **7-1**

Chapter VIII Community Based Disaster Mitigation **8-1**

Chapter I

INTRODUCTION

Chapter I
Introduction

AIMS AND PURPOSES OF THE HANDBOOK

This Handbook on Earthquake Mitigation is an attempt to predetermine to the extent possible, actions to be taken by the cities and municipalities in Metro Manila and by cooperating private organizations including community based organizations to effectively reduce the vulnerability of city and municipal residents to any earthquake that may strike in the National Capital Region or elsewhere in the country.

This Handbook likewise attempts to establish a high capability of protecting citizens from the effects of earthquake, to respond effectively to the actual occurrence of any earthquake and to provide full recovery in the aftermath of earthquake occurrences involving extensive damage and other debilating influences on the normal pattern of life within the community.

The handbook further aims to provide the following possibilities:

1) Provide guides on what to do before, during and after an earthquake. – This guide advises how people should react with practical steps and suggestions how to behave accordingly in the event of an earthquake;
2) Serves as guide in designing the appropriate organizational arrangements to effectively counter earthquakes and their destructive consequences. The appropriate organizational arrangements are necessary in the effective implementation and coordination of earthquake counter measures i.e. mobilizing resources, coordinating various responses and other assistory efforts critical during this specific disaster;
3) Select strategic options how earthquakes may be properly countered. - Long range institutional and policy options will guide disaster coordinators in selecting the appropriate strategy to counter earthquake occurrences and other disasters;
4) Minimize risk – the aim is to reduce to negligible minimum loss of lives and damage to properties; and
5) Formulate the necessary policies supportive to earthquake mitigation plans and programs including the definition of the roles and responsibilities of disaster management coordinators as well as the roles of the whole communities in general.

USERS

1) This Handbook is primarily designed to be used by local governments in the NCR and secondarily, for other local governments countrywide. This means the provinces, cities, municipalities and the barangays even outside Metro Manila can make use of this Handbook on Earthquake Mitigation.
2) The second major category of users are the members of the Disaster Coordinating Councils at the national, regional, provincial, city, municipal and barangay levels. Since the Disaster

Councils are the primary organizational mechanisms to counter disasters such as earthquakes, the members thereof are also the primary target users.

3) Schools in all levels whether private or public are also one of the biggest potential users of this handbook in Metro Manila and in other parts of the country.
4) The protective services like the Bureau of Fire Protection and the local Police Forces can also make use of this handbook as they perform their respective tasks before, during and after earthquakes.
5) Health services, whether governmental or non-governmental are also identified primary users.
6) Commercial firms and industry sectors are another major user considering the resources and number of personnel the private sector have; and
7) The volunteer organizations, the non-governmental organizations and community-based organizations are also important potential users of this handbook.

It will be noted that the range of potential users of this Handbook on Earthquake Mitigation reflects practically the various sectors of the community in a pluralistic society like the Philippines.

The logic of this handbook need not be belabored to have additional justifications for its formulation. The reasons mentioned herein and the identified potential multiple users are more than adequate to show the universal value of this document.

The Handbook is organized into eight chapters. For those who are interested to fully use this document, but do not have the immediate time to examine its content, an overview of the handbook by chapters is included in this Introduction.

The chapters in this book are as follows:

CHAPTER I INTRODUCTION

This introductory part of the handbook explains its rationale and how the same document may optimally be used.

CHAPTER II LEGAL AND INSTITUTIONAL ARRANGEMENTS

This chapter provides an overview of the legal basis as to how local disaster coordinating councils operate in accordance with PD 1566 and the provisions of the Local Government Code including city and municipal ordinances on disaster mitigation, which can be used as basis for action.

CHAPTER III EARTHQUAKE

This chapter explains the types of earthquakes and their respective characteristics that should be known by the public. This chapter also includes the cycle or occurrences including earthquake frequencies. It also has short portion useful to the users of this handbook and the community as the beneficiary to learn what earthquake can do and how prevention and risk reduction can minimize casualties and other damages.

CHAPTER IV EARTHQUAKE EFFECTS AND POTENTIAL EARTHQUAKE SCENARIOS FOR METRO MANILA AREA

This chapter present potential earthquake scenarios for Metro Manila, which can motivate local governments to take the necessary anticipatory measures before an earthquake occurs and to inform all concerned what to expect after an earthquake has subsided.

CHAPTER V STRATEGIES ON EARTHQUAKE MITIGATION

This chapter provides how the public, government agencies, and other institutions may prepare and protect themselves before an earthquake occurs and how to respond during an earthquake and after an earthquake has subsided.

CHAPTER VI EXISTING RESOURCE AGENCIES IN METRO MANILA

The national and local agencies including other agencies in the Metro Manila Area, which are resource agencies for emergency are included in this chapter such as hospitals, fire stations, police posts, communication centers and the like.

CHAPTER VII CAPACITY BUILDING AND TRAINING COURSES IN EARTHQUAKE DISASTER MITIGATION

The concept of capability building in disaster mitigation is important in order to provide the necessary preparedness and training of all disaster managers, local government officials and the public in general, the purpose of which is to minimize the destructive effects of earthquake.

CHAPTER VIII COMMUNITY BASED DISASTER MITIGATION

This chapter describes how community based disaster mitigation may be formulated in order to prepare communities for disaster and include in their preparedness planning the concept of self-reliance or self-help.

Chapter II

LEGAL AND INSTITUTIONAL ARRANGEMENTS

Chapter II
Legal and Institutional Arrangements

LEGAL BASES IN THE FORMULATION OF AN EARTHQUAKE MITIGATION HANDBOOK

The formulation of this Handbook is premised on four cultural-legal considerations.

The legal basis that provides the logic for the handbook is Presidential Decree 1566 and the provisions of the Local Government Code specifically Sections 558(iv), 447 (iv), and 389(6) which are quoted herein:

The cities under Section 558 (iv), are empowered to organize themselves for countering disasters. It states that cities shall:

> *"Adopt measures to protect the inhabitants of the city from the harmful effects of man-made or natural disasters and calamities, and to provide relief services and assistance for victims during and in the aftermath of said disasters or calamities and in their return to productive livelihood following said events;"*

The municipalities likewise are empowered to do the same in Section 447 (iv).

> *"Adopt measures to protect the inhabitants of the municipality from the harmful effects of man-made or natural disasters and calamities, and to provide relief services and assistance for victims during and in the aftermath of said disasters or calamities and in their return to productive livelihood following said events;"*

The barangays at the same time also are authorized to organize themselves effectively as provided for under Section 389 (6) of the Local Government Code. It provides that Barangays shall:

> *"Organize and lead an emergency group whenever the same may be necessary for the maintenance of peace and order or on occasions of emergency or calamity within the barangay."*

A city or municipal ordinance on disaster mitigation which the local governments have already adopted is more than adequate legal framework for the formulation of a disaster handbook i.e. Earthquake Mitigation. Moreover, the culture and tradition in Philippine society such as helping others or one community helping another community during disaster is an old time practice, which finds its origin in Filipino culture and tradition. This, as a matter of fact, is much stronger than any laws that exist relating to the need to assist community during disasters like earthquake.

INSTITUTIONAL ARRANGEMENTS

The institutional arrangements to counter earthquakes are categorized as both formal and informal arrangements.

The formal official structures refer to the following:

1) National Disaster Coordinating Council
2) Metro Manila Disaster Coordinating Council
3) City Disaster Coordinating Council
4) Municipal Disaster Coordinating Council
5) Barangay Disaster Coordinating Council

The members of such councils in all levels are defined in Section 4 of PD 1566. It will be noted, however, that because of the provisions of Sections 558(iv), 447(iv) and 389(6) in the province, city, municipality and barangay laws in the Local Government Code, local authorities can reorganize these councils to suit their situational needs.

Such formalistic structures for disaster mitigation can either be increased or decreased in membership. It must be borne in mind that one of the recommendations to make these councils at all levels to be functional, is to reduce its members to the minimum and only to be composed of critical agencies whose functions are very much directly related to disaster mitigation.

There are also informal organizational arrangements, which are likewise critical to disaster mitigation. Referred to herein are non-governmental organizations which are either centrally based or community based volunteer organizations. The classification of non-governmental initiatives in disaster mitigation includes the private sector as well as indigenous organizations existing at the community level.

Examples of the categories mentioned are the Chinese Volunteers Organizations for Disaster in Metro Manila. The barangay tanods are another example.

There is, however, one principle espoused in Section 1(a) of PD 1566 which provides that:

> *"Self reliance shall be developed by promoting and encouraging the spirit of self help and mutual assistance among the local officials and their constituents;"*

The observance of this principle should always be kept in mind as local governments continue to adopt modern techniques to counter disaster i.e. earthquakes.

The observance of Section 1(a) of PD 1566 is a good assurance that needed capabilities to respond effectively to disaster will be sustained.

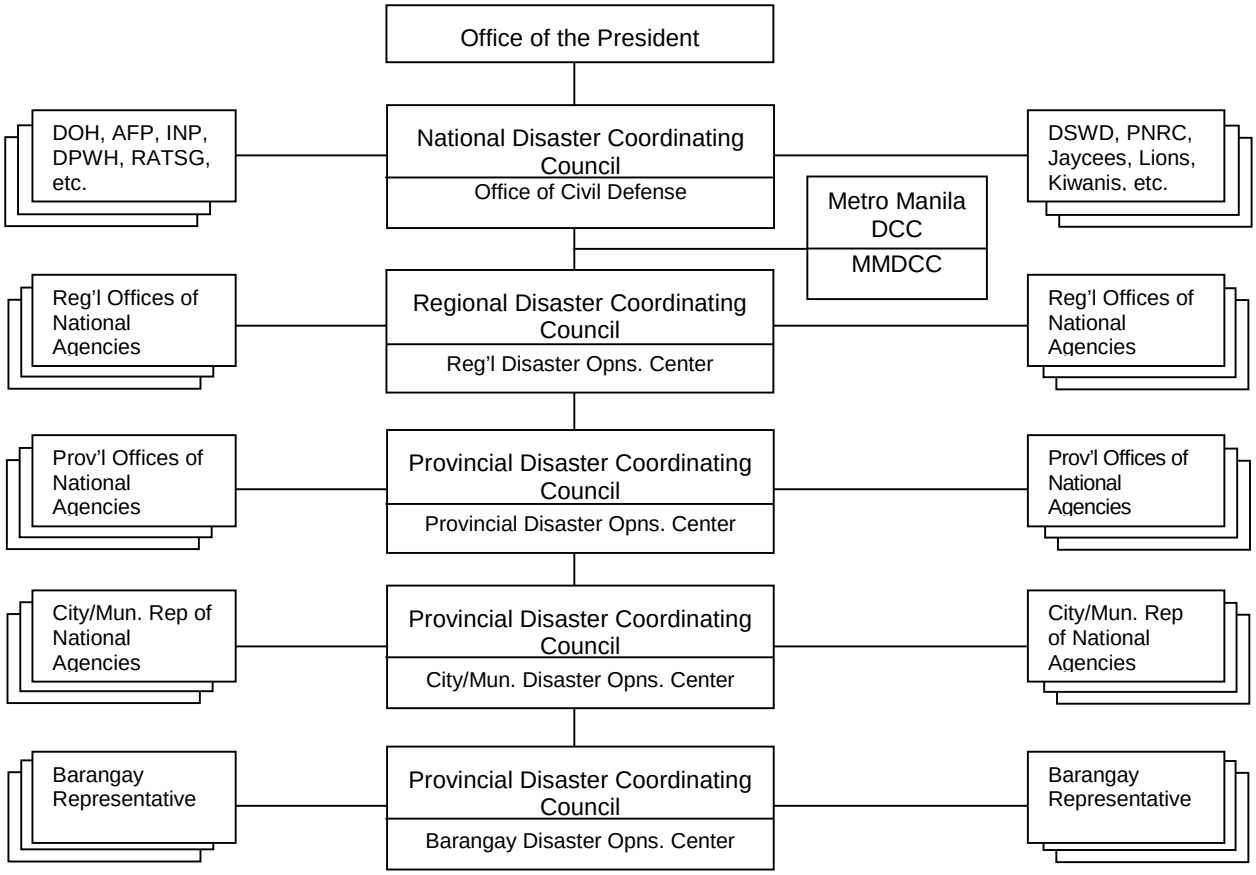


Figure 2.1 Organization Chart No 1

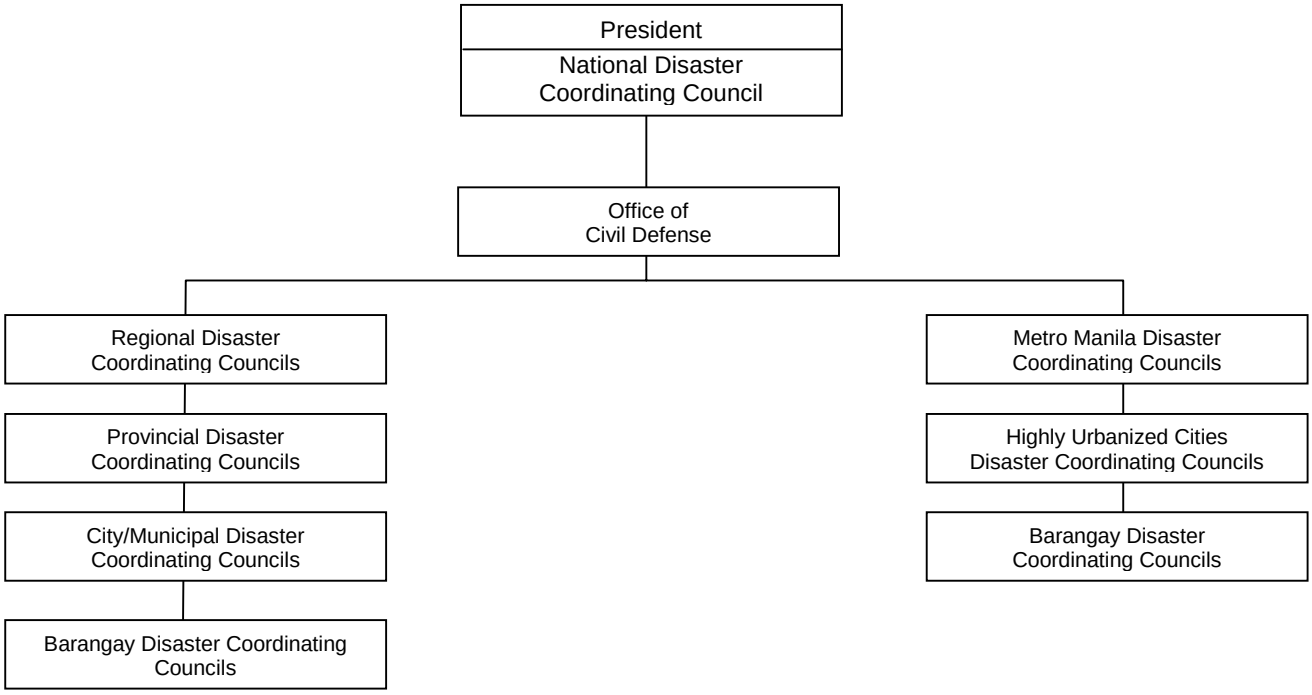


Figure 2.2 Organization Chart No 2 National Disaster Coordinating Council

Note: Functional relationship of NDCC with the regional & sub-regional disaster coordinating council. Also, based on PD 1566 which is 25 years old document

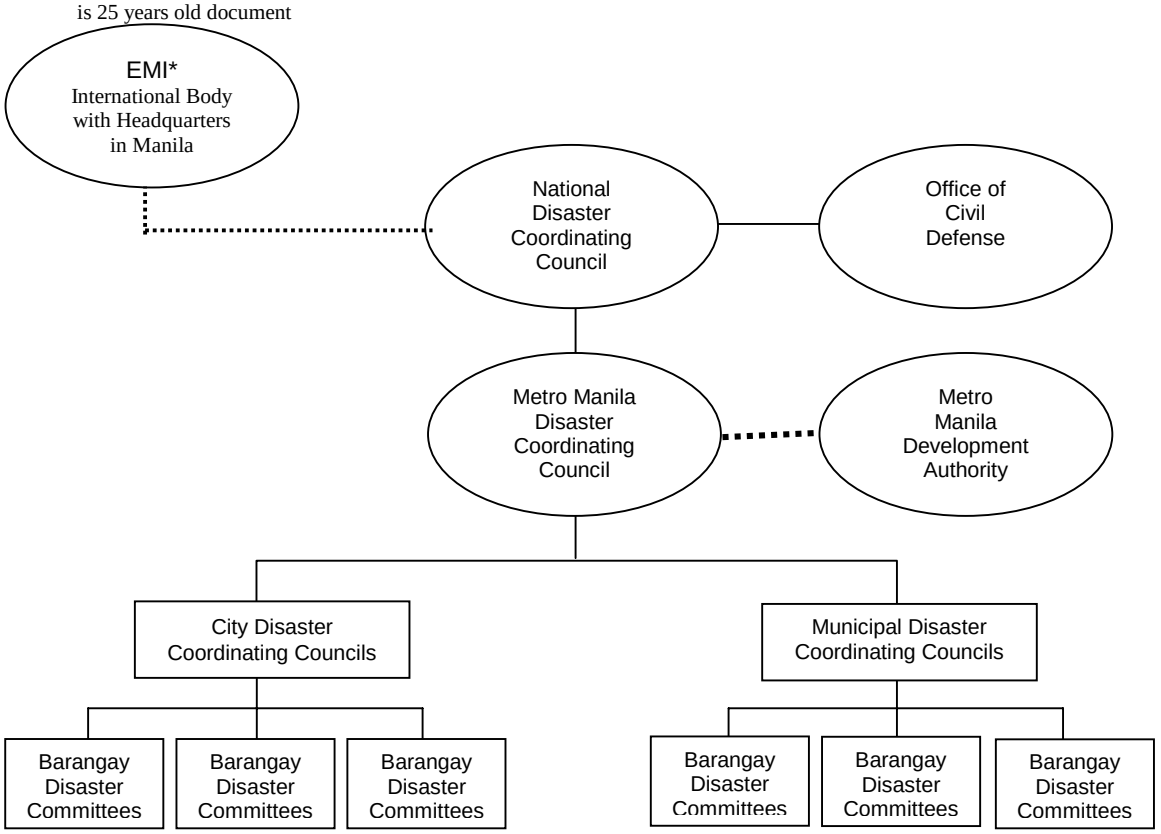


Figure 2.3 Organization Chart No 3

Note: Earthquake and megacities initiative

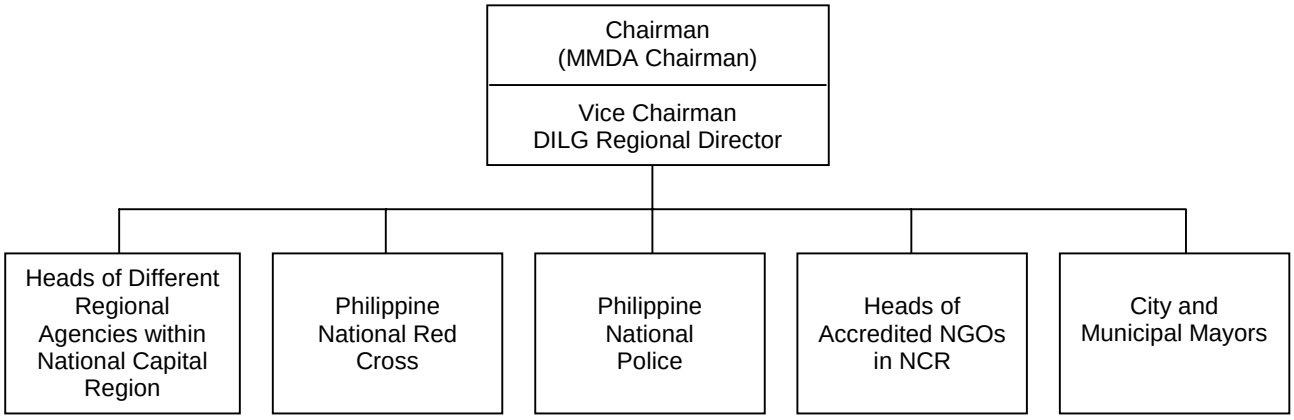


Figure 2.4 Organization Chart No 4 Metropolitan Manila Disaster Coordinating Council

Note: The tasks of the thirty (30) members of the MMDCC are stipulated in the MMDCC document describing its mandates in times of disaster or emergency. However, this was stipulated 25 years ago and therefore needs acritical review.

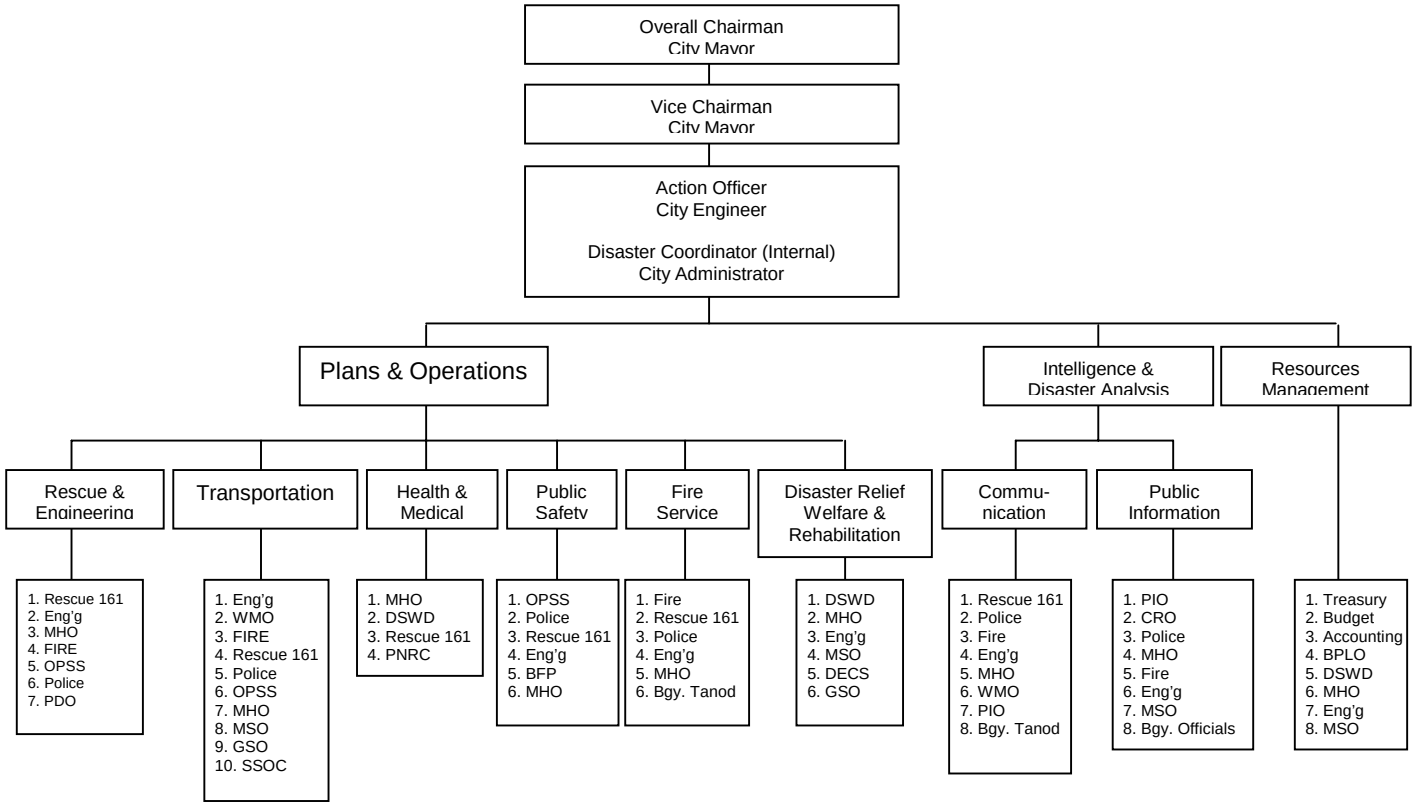


Figure 2.5 Organizational Chart No. 5 Organizational Chart of a City Disaster Coordinating Council, Marikina Disaster Coordinating Council

Note: A typical sample of a City Disaster Coordinating Council in Metro Manila

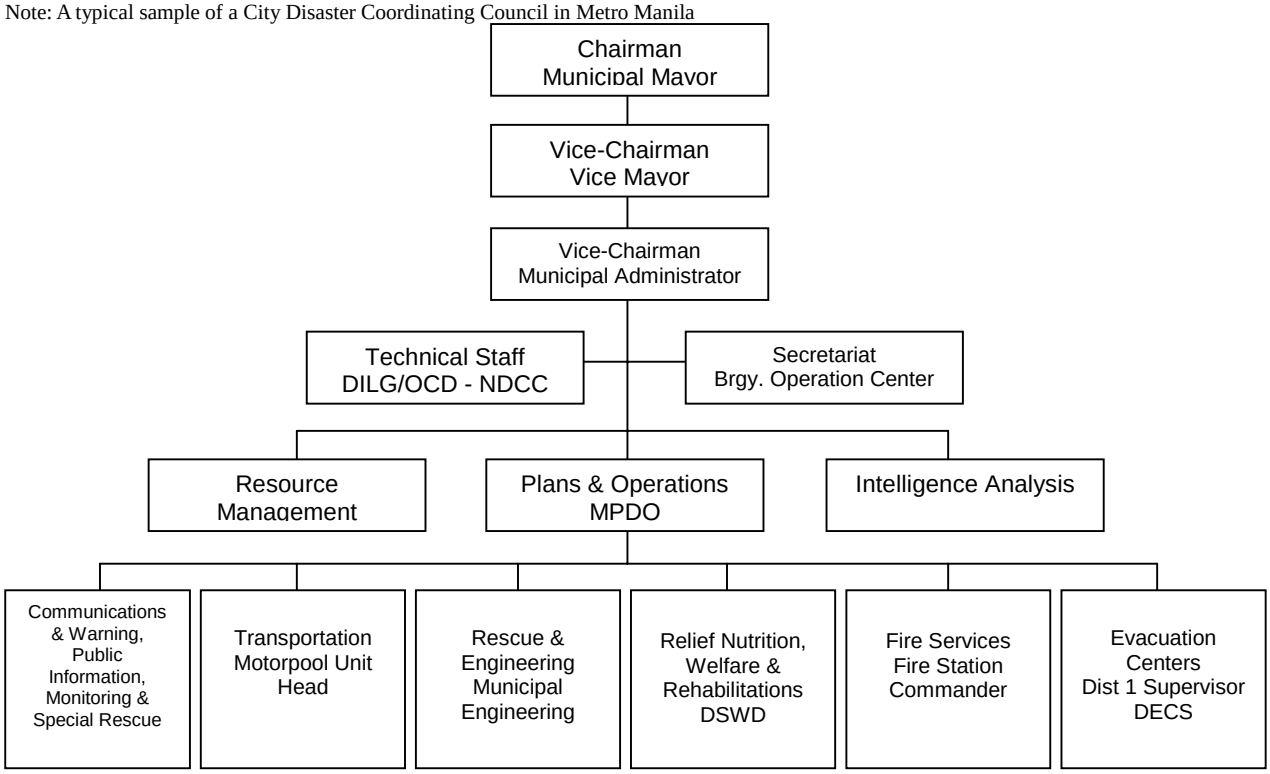


Figure 2.6 Organizational Chart No. 6 Organizational Chart of a Municipal Disaster Coordinating Council, Navotas Disaster Coordinating Council

Note: A typical sample of a Municipal Disaster Coordinating Council in Metro Manila

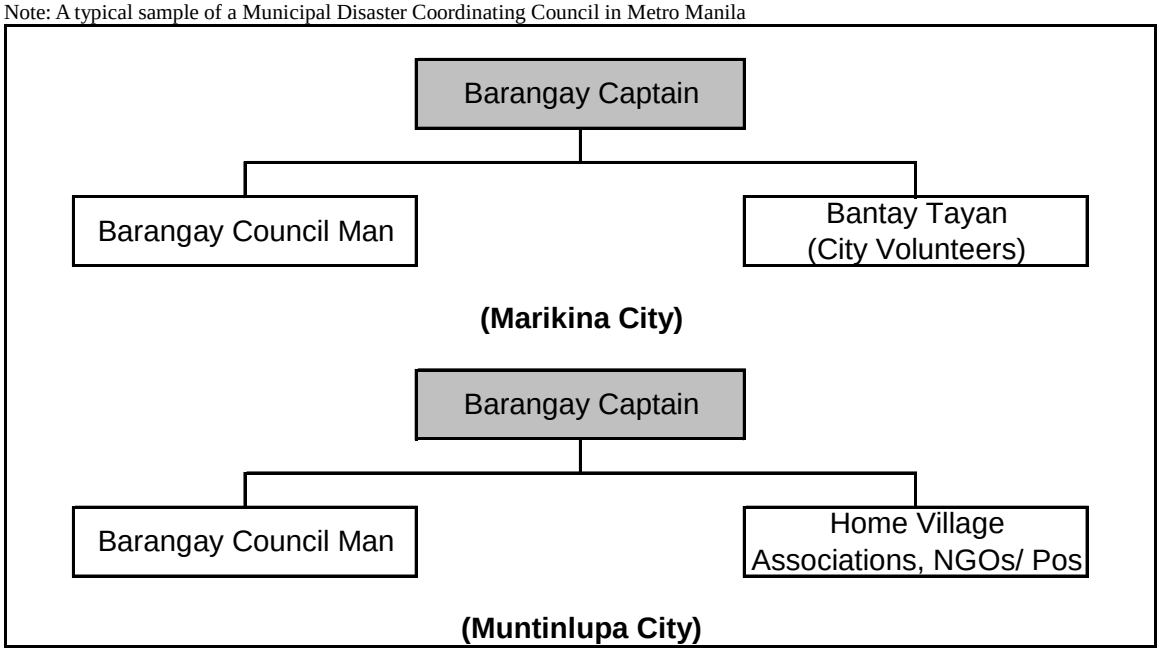


Figure 2.7 Organizational Chart No 7 Organizational Chart of a Barangay Disaster Coordinating Council

Note: Typical Organization of a Barangay Disaster Coordinating Council

CHAPTER III

EARTHQUAKE

Chapter III
Earthquake

WHAT IS AN EARTHQUAKE?

An EARTHQUAKE is feeble shaking to violent trembling of the ground produced by the sudden displacement of rocks or rock materials below the earth's surface. Sudden displacements along fault fissures in the solid and rigid layer of the earth generate TECTONIC EARTHQUAKES. Those induced by rising lava or magma beneath active volcanoes generates VOLCANIC EARTHQUAKES.

EARTHQUAKE PRONE AREAS (WHERE AND HOW EARTHQUAKES OCCUR)

ALONG TECTONIC PLATE MARGINS

The earth has an outermost shell, about 80km thick, which is solid and rigid. This shell is called LITHOSPHERE. The lithosphere is subdivided into small and large pieces with some pieces large enough to contain continents. These pieces of lithosphere are called TECTONIC PLATES or, simply, PLATES.

Immediately beneath the lithosphere is another thin shell called ASTHENOSPHERE. Which can be made to flow by slowly applied deforming forces but behaves essentially as solid. The lithosphere and its tectonic plates float on the asthenosphere. Because the asthenosphere is being induced to flow by convection cells produced by rising hot materials from the earth's interior and by the sinking of these materials back into the earth's interior as they experience cooling during their upward journey, the floating tectonic plates are being jostled about and displaced relative to one another. This jostling of plates and the relative displacements of plates along their margins generate tectonic earthquakes.

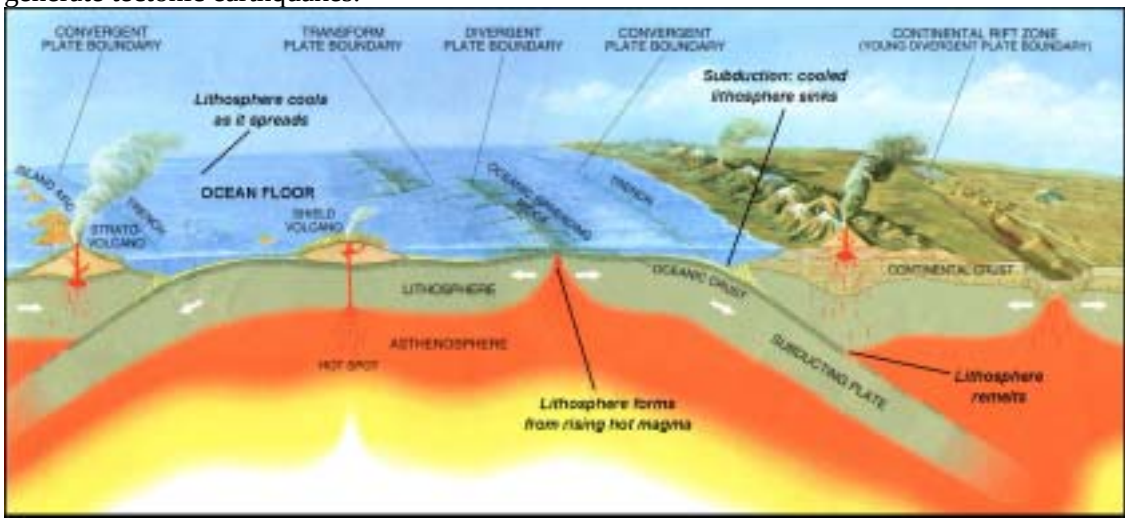


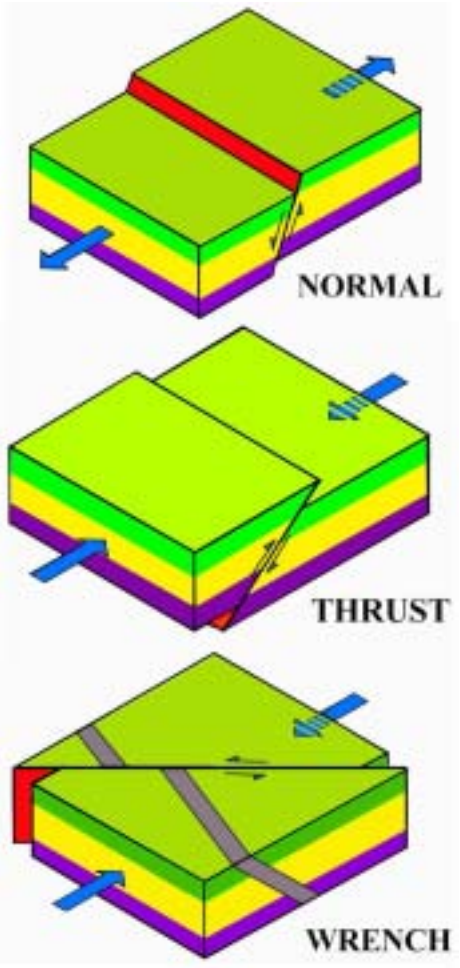
Diagram showing the lithosphere, asthenosphere, trench, subduction zones and mid-oceanic ridge. The processes resulting from the movement of plates are indicated in italized letters (From Simkin, et.al., 1994)

There are 3 types of plate boundary along which relative movements of neighboring plates can occur and trigger the occurrence of earthquakes. The first type is called a DIVERGENT PLATE MARGIN where 2 neighboring plates move away from each other or are pulled apart. The pulling apart of plates and the insertion of lava along divergent plate margins are accompanied by shallow-seated earthquakes. Divergent plate margins coincide with the axes of mid-oceanic ridges which lie on the seafloor under 3 to 4 km of water.

The second type of plate boundary is called a CONVERGENT PLATE MARGIN where 2 neighboring plates move towards and push against each other. An active convergent plate margin is marked either by a deep-sea trench like the Philippine Trench or by a long mountain chain like the Himalayas. A deep-sea trench defines the points of entry of one of the plates as it descends into the earth's interior beneath the other plate. Earthquakes associated with convergent plate margins have depths ranging from shallow (0 to 70km deep) to very deep (down to about 700km deep).

The third type of plate margin is called a TRANSFORM FAULT. A transform fault is a vertical surface that cuts and breaks the continuity of divergent and convergent plate margins. When it transects mid-oceanic ridges, the only active part of the fault where adjacent plates slide past each other is bounded by the axes of the disconnected ridge segment. Earthquakes generated along transform faults are shallow-seated (from 0 to 70km deep). The famous San Andreas Fault of California is an example of transform fault.

ALONG ACTIVE FAULTS



Faults are breaks or zones of weakness in rocks along which displacements had occurred or ca occur again. They may extend of kilometers across the earth's surface and tens of kilometers downward, even down to the base of the lithosphere. Faults showing signs or documented history of recent displacements are called ACTIVE FAULTS (e.g. Philippine Fault Zone and Valley Fault System).

There are 3 types of faults based on the orientation of fault surfaces and nature of relative movement of displaced rock masses. A NORMAL FAULT has an inclined surface (about 70 degrees) and is characterized by the downward sliding of the fault block situated above the fault surface. A THRUST or REVERSE FAULT has also an inclined surface but sloping only about 30 degrees and is characterized by the upward sliding of the fault block located above the fault surface. A WRENCH or STRIKE-SLIP FAULT has a very steep to vertical surface along which one fault block may move horizontally to the left or to the right with respect to the opposite block. Sudden displacements along these types of fault are accompanied by weak to very destructive earthquakes.

Earthquakes which generated by movements along faults are all shallow-seated (from 0 to 70km deep). Very destructive earthquakes may originate from fault movements occurring at shallow (less than 30km) between 2 successive displacements along the same segment of a fault. If strong shallow earthquakes occur under the sea and displace parts of the seabed, tsunamis are oftentimes generated.

INTENSITY VERSUS MAGNITUDE

There are two general ways to describe the strength of an earthquake. One method is based on how people, man-made structures, natural objects and land surfaces behave and react in the areas affected by an earthquake. By observing and documenting all these behaviors and reactions, one arrives at the felt INTENSITY of an earthquake within a given area.

The PHIVOLCS EARTHQUAKE INTENSITY SCALE (PEIS) was formally launched and adopted in 1996 replacing the nine-point Adapted Rossi-Forel Scale for reporting macroseismic information. The PEIS is a ten-point scale with Intensity I described as scarcely perceptible and Intensity X as completely devastating (Table 3.1).

Usually, area nearest the epicenter shall have higher intensities than those situated farther away. However, areas lying close together, like Manila and Quezon City, may have different intensity scale values. For example, an earthquake will register as Intensity IV for Manila but as Intensity III for Quezon City. The reason for this noticeable difference is due to the nature of the underlying ground beneath the two cities. Manila rests on former river delta deposits consisting of loosely consolidated layers of mud and sand, while Quezon City is built on relatively more consolidated layers of adobe or volcanic tuff. Because of this, Manila tends to shake more than Quezon City during the passage of an earthquake.

The other method of describing the strength of an earthquake is based on instrumentally-derived information and correlates strength with the amount of total energy released at the earthquake's point of origin. MAGNITUDE is calculated mathematically using the amount and duration of movements that ground vibration causes on the needle of a standard seismograph.

Charles F. Richter, an American seismologist, devised a scale for expressing the total energy released by an earthquake, following the suggestion of H.O. Wood. In 1935, Richter proposed a magnitude scale which is an open-ended scale of 1 to 9. This scale is the now famous and internationally used RICHTER SCALE (Table 3.2).

In the Richter Scale, for every unit increase in magnitude, the seismic energy released increases by 30 times. Thus, an earthquake with Magnitude 5 has an accompanying seismic energy 30 times more than a Magnitude 4 earthquake but 30 times less than the one with Magnitude 6. For the purpose of appreciating how much energy is released during occurrences of great earthquakes (Magnitude 7 and above), it can be told that a Magnitude 8 earthquake has a seismic energy equal to 10,000 atomic bombs of the vintage that annihilated Hiroshima during the end of World War II.

Table 3.1 PHIVOLCS Earthquake Intensity Scale

Intensity Scale	Description
I	Scarcely Perceptible. Perceptible to people only under favorable circumstances. Delicately balanced objects are disturbed slightly. Still water in containers oscillates.
II	Slightly Felt. Felt by few individuals at rest indoors. Hanging objects swing slightly. Still water in containers oscillates noticeably.
III	Weak. Felt by many people indoors specially in upper floors of buildings. Vibration is felt like the passing of a light truck. Dizziness and nausea are experienced by some people. Hanging objects swing moderately. Still water in containers oscillates moderately.
IV	Moderately Strong. Felt generally by people indoors and some people outdoors. Light sleepers are awakened. Vibration is felt like the passing of a heavy truck. Hanging objects swing considerably. Dinner plates, glasses, windows and doors rattle. Floors and walls of wood framed building Creak. Standing motor cars may rock slightly. Water in containers oscillates strongly. Rumbling sounds may sometimes be heard.
V	Strong. Generally felt by most people indoors and outdoors. Many sleeping people are awakened. Some are frightened; some run outdoors. Strong shaking and rocking are felt throughout building. Hanging objects swing violently. Dining utensils clatter and clink; some are broken. Small, light and unstable objects may fall or overturn. Liquids spill from filled open containers. Standing vehicles rock noticeable. Shaking of leaves and twigs of trees are noticeable.
VI	Very Strong. Many people are frightened, many run outdoors. Some people lose their balance. Motorists feel like driving with flat tires. Heavy objects and furniture move or may be shifted. Small church bells may ring. Wall plaster may crack. Very old or poorly-built houses and man-made structures are slightly damaged though well-built structures are not affected. Limited rockfalls and rolling boulders occur in hilly to mountainous areas and escarpments. Trees are noticeably shaken.
VII	Destructive. Most people are frightened and run outdoors. People find it difficult to stand in upper floors. Heavy objects overturn or topple. Big church bells may ring. Old or poorly-built structures suffer considerable damage. Some well-built structures are slightly damaged. Some cracks may appear on dikes, fish ponds, road surface, or concrete hollow block walls. Limited liquefaction, lateral spreading and landslides are observed. Trees are shaken strongly. (Liquefaction is a process by which loose saturated sand loses strength during an earthquake and become a liquid).
VIII	Very Destructive. People are panicky. People find it difficult to stand even outdoors. Many well-built buildings are considerably damaged. Concrete dikes and foundation of bridges are destroyed by ground settling or toppling. Railway tracks are bent or broken. Tombstones may be displaced, twisted or overturned. Utility posts, towers and monuments may tilt or topple. Water and sewer pipes may be bent, twisted or broken. Liquefaction and lateral spreading cause man-made structures to sink, tilt or topple. Numerous landslides and rockfalls occur in mountainous and hilly areas. Boulders are thrown out from their positions particularly near the epicenter. Fissures and fault rupture may be observed. Trees are violently shaken. Water splashes or slops over dikes or banks of rivers.
IX	Devastating. People are forcibly thrown to the ground. Many cry and shake with fear. Most buildings are totally damaged. Bridges and elevated concrete structures are toppled or destroyed. Numerous utility posts, towers and monuments are tilted, toppled or broken. Water and sewer pipes are bent, twisted or broken. Landslides and liquefaction with lateral spreading and sandboils are widespread. The ground is distorted into undulations. Trees are shaken very violently with some toppled or broken. Boulders are commonly thrown out. River water splashes violently or slops over dikes and banks.
X	Completely Devastating. Practically all man-made structures are destroyed. Massive landslides and liquefaction, large scale subsidence and uplifting of land forms and many ground fissures are observed. Changes in river courses and destructive seiches in large lakes occur. Many trees are toppled, broken or uprooted.

Note: When an earthquake occurs, observe and determine its intensity in your locality by using this intensity scale. Report the observed intensity to PHIVOLCS immediately. Call collect any of these telephone numbers: 926-7749 & 926-9338

Table 3.2 Richter Magnitude Scale

Magnitude Scale	Description
1	Earthquakes with M below 1 are only detectable when an ultrasensitive seismometer is operated under favorable conditions
2	Most earthquakes with M below 3 are the "hardly perceptible shocks" and are not felt. They are only recorded by seismographs of nearby stations.
3	Earthquakes with M 3 to 4 are the "very feeble shocks" where damages are not usually reported.
4	Earthquakes with M 4 to 5 are the "feeble shocks" where damages are not usually reported.
5	Earthquakes with M 5 to 6 are the "earthquakes of moderate strength" and are felt over the wide areas; some of them cause small local damages near the epicenters.
6	Earthquakes with M 6 to 7 are the "strong earthquakes" and are accompanied by local damages near the epicenter. First class seismological stations can observe them wherever they occur within the earth.
7	Earthquakes with M 7 to 8 are the "major earthquakes" and can cause considerable damages near the epicenters. Shallow seated-or near-surface major earthquakes when they occur under the sea, may generate tsunamis. First class seismological stations can observe them wherever they occur within the earth.
8	Earthquakes with M 8 to 9 are the "great earthquakes" occurring once or twice a year. When they occur in land areas, damages affect wide areas. When they occur under the sea, considerable tsunamis are produced. Many aftershocks occur in areas approximately 100 to 1000 kilometers in diameter.
9	Earthquakes with M over 9 have never occurred since the data based on the seismographic observations became available.

Remarks: For deep focus earthquakes the above descriptions are not applicable

THE PHILIPPINES AS AN EARTHQUAKE PRONE COUNTRY

The Philippine Archipelago lies between 2 major tectonic plates, the Philippine Sea Plate and the Eurasian Plate. Philippine sea Plate is moving towards the Philippine Archipelago at the rate of about 7cm/year. The Eurasian Plate is being subducted along western side of Luzon and Mindoro at the rate of 3cm/year except on Mindoro and northwest of Zamboanga where collision is taking place. At the intersection of these 2 plates is found the Philippine Fault Zone which decouples the northwestward motion of the Pacific with the southwestward motion of the Eurasian Plate. Movements along other active faults are responsible for the present-day high seismicity of the Philippine Archipelago.

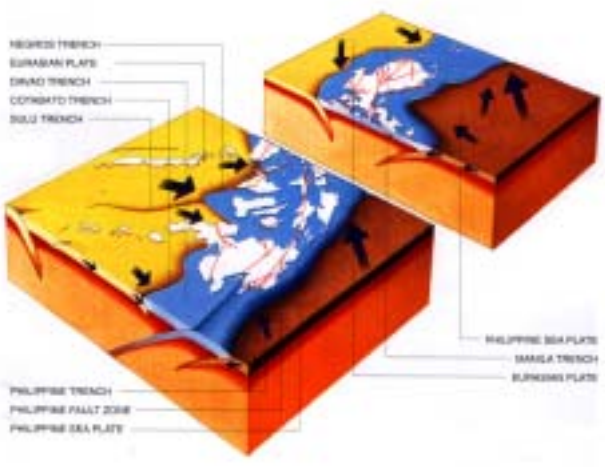


Fig. 3.1 Block diagram showing the Philippine Archipelago with its bounding trenches and subduction zones and active faults (modified from Punongbayan, et.al., 1998).

For the last 35 years, the Philippines had been affected by 10 earthquakes with magnitude greater than 7.0. Hence, the likelihood of these destructive earthquakes occurring again in the future is indeed very strong.

At least 5 earthquakes per day occur in the Philippines. Based on the distribution of earthquake epicenters, the most seismically active part of the country is its eastern section containing eastern Mindanao, Samar and Leyte with an average of 16 perceptible earthquakes per year. This is due to active subduction processes going on along Philippine Trench. The other relatively active parts are found at the eastern side of northern Luzon and the area in the vicinity of Lubang Island and Mindoro. The presence of the East Luzon Trough, Casiguran Fault and northern segment of the Philippine Fault Zone all make the places at and near Dingalan Bay and Casiguran Sound earthquake prone.. The high frequency of earthquakes in the offshore areas of Lubang Island and nrthern Mindoro may be due to a complicated tectonics characterized by faulting. Subducts and collisional processes.

GROUND SHAKING

The destructive effects of earthquakes are due mainly to intense GROUND SHAKING or vibration. Because of severe ground shaking, low and tall buildings, towers and posts may tilt, split, topple or collapse, foundation of roads, railroad tracks and bridges may break, water pipes and other utility installations may get dislocated, dams and similar structures may break and cause flooding, and other forms of mass movement may be generated. It can also cause secondary hazards such as liquefaction and landslides. Liquefaction and landslides can be experienced as far away as 100km from the epicenter. These destructive effects of earthquakes may cause casualties and short to long term socio-economic disruptions.

Hyatt Hotel, Baguio City, 16 July 1990 Luzon Earthquake

LIQUEFACTION

LIQUEFACTION is a process where particles of loosely consolidated and water-saturated deposits of fine sand are rearranged into more compact state. Water and sediments are squeezed out towards the surface in the form of water and sand fountaining (sand boiling) and thus creating a condition resembling ‘quick sand’. The consequent loss in volume and underlying support results in subsidence of the ground on top of the liquefying sandy layers and with it, the sinking and /or tilting of any structures above it. Liquefaction prone areas can be found in beach zones, sand spits, sand bars, tombolos, wide coastal plains,

A.B. Fernandez St., Dagupan City, 16 July 1990 Earthquake

deltaic plains, floodplains, abandoned river meanders, former lake beds, former or existing marshlands and swamplands, and in areas underlain by sandy lahar deposits.

LANDSLIDES

Landslides are downward movement of slope materials either slowly or quickly. A landslide may be a rock fall, topple, and slide or lateral spreading. Intense ground shaking can trigger a landslide by loosening the cohesion that bonds the slope materials together, thereby making it easier for gravity to pull it downwards. Hilly and mountainous areas, escarpments, and steep river banks, sea cliffs, and other steep slopes are prone to landsliding. The main effect of landsliding is burial.

GROUND RUPTURE

Many strong earthquakes originate along faults that break the earth's rigid crust. GROUND RUPTURE is a deformation on the ground that marks the intersection of the fault plane with the earth's surface. The most common manifestation is a long fissure extending from a few kilometers to tens of kilometers, although ground rupture may also occur as a series of discontinuous crack, mounds or depressions. The length of ground rupture and the width of the zone of deformation generally increase with the magnitude and type of earthquake. A ground rupture is rarely confined to a simple narrow and distinct line and the zone of deformation could be as wide as 100m.

Calapan, Oriental Mindoro, 15 Nov. 1994 Mindoro Earthquake

TSUNAMI

Tsunamis are giant sea waves generated mostly by submarine earthquakes. Not all submarine earthquakes, however, can cause tsunamis to occur. Tsunamis can only occur when the earthquake is shallow-seated, and strong enough about (M6) to displace parts of the seabed and disturb the mass of water over it. Other causes of tsunamis include submarine or coastal landslides, pyroclastic flows and large volume debris avalanches from submarine and partly submerge volcanoes, and caldera collapse.

Brgy. Malaylay, Baco, Oriental Mindoro, 15 Nov. 1994 Mindoro Earthquake

FIRE

One hazard which may be indirectly caused by earthquakes, especially in heavily built-up areas, is fire. Fires can be sparked from power or gas lines or other flammable facilities that are damaged during earthquakes. Earthquake-related fires are common occurrences in countries where gases for domestic and commercial use are piped. During the 1990 Luzon earthquake disaster, fire that was reportedly sparked by a carelessly thrown cigarette consumed a collapsed factory building in

the Export Processing Zone in Baguio City, along with the victims trapped inside (Punongbayan and Tayag, in press).

HOW TO REDUCE EARTHQUAKE LOSSES

The occurrence of earthquakes cannot be prevented. Furthermore, although some work is currently being done to understand earthquakes in more detail, no earthquake prediction can yet be issued with confidence. Therefore, the only way to prevent disasters caused by earthquakes is to anticipate and prepare for them.

WHAT TO DO BEFORE THE EARTHQUAKE

The key to effective disaster prevention is planning. Evaluate the structural soundness of the buildings and places wherein you frequently stay. Determine whether the site is traversed by a ground fracture, technically known as a fault, which may give way or cause buildings to fail. Note the presence of other potential sources of hazards due to secondary effects of earthquakes like steep hillslopes, hanging heavy objects, dams, storage tanks, falling debris and others. After this evaluation process, you shall be more aware of the hazards which need attention or consideration.

Prepare your place of residence for the event. Most causes of injuries during earthquakes are from sliding and falling objects. Latches should be installed on drawers, cabinets and cupboards. Heavy materials should be identified and placed in the lower compartments of cabinets. Breakable items should be secured while harmful chemicals and flammable materials should be stored properly to minimize the possibility of falls or spills.

Strap heavy furniture to restrict sliding or toppling during earthquakes. It is also advisable to provide blocks to stop the movement of furnishings or equipment on wheels. The chances that an earthquake shall hit when you are in bed is as high as when you are up. Therefore, check your bedrooms for hanging or unstable objects which may fall on you during earthquakes.

Familiarize yourself with your place of work. Know and master the routes to take to get out of your building. Also, find and mark the places where fire extinguishers, first aid kits, alarms, utilities and communication facilities are located. One thing to note, though: do not use the elevators during and after an earthquake. Any structural or power failure can cause you to be stranded indefinitely in the elevator.

Lastly, but most importantly, plan on coping for the event. It is wiser to prepare an emergency plan to cope with the disaster than to regret the absence of anticipation later. Prepare a stock of potable water, flashlight, radio and batteries, spare clothes and some food packed and ready to take with you in case an earthquake forces you to evacuate your place. The authorities may take sometime to react to your needs since it is possible that they may also be affected by the event. Discuss with your family a reunification plan and identify a contact person or place in case you get separated or in case an event occurs when one family member is away.

WHAT TO DO DURING THE EARTHQUAKE

If you are indoors, stay there! The best thing to do is to protect your body from falling debris by getting under a sturdy table or desk or by bracing yourself in the doorway or corner of the room. Be aware and stay clear of heavy and sharp materials which may fall or topple on you. Be

particularly wary of glass fragments from windows, bookcases, cabinets, chandeliers, hanging plants and lighting fixtures.

If you are outside, move to an open area away from power lines, posts, trees, walls and the like. Also, be aware of any debris which may fall down from high places. If the event occurs when you are amid tall buildings, find a corner, doorway or structural indentations where you can be protected from falling debris. If an earthquake occurs while you are out in the fields or forests, stay clear from steep escarpments which may be affected by landslides.

When driving a vehicle during the earthquake, pull to the side of the road and stop. Park away from bridges, overpasses, overhead wires, posts and similar things which may fall unto the vehicle. If electrical wires had fallen on your vehicle, stay inside and wait for assistance. Do not attempt to cross bridges or overpasses which may have been damaged by the earthquake.

In crowded places like stores, theatres, malls and churches, do not rush to the exit! Try to calm the crowd and direct them away from materials which may fall.

If you are residing in a coastal area, always be aware of tsunamis. If you felt an unusually strong earthquake, you and your family should immediately run to higher ground.

WHAT TO DO IMMEDIATELY AFTER THE EARTHQUAKE

Check yourself and others for injuries. Also check for trapped persons and others who may need assistance like disabled or sick people.

Wear shoes and protection. Expect floors and roads to be strewn with sharp objects and it is best to protect yourself from further accidents.

Use a flashlight when searching. Gas leaks, chemical spills and flammable materials always abound after earthquakes and an open flame will add to the risk of starting fires.

Check for fires and if any, have it controlled! Some earthquake damage had been aggravated by the occurrence of fires. In case you see a fire, locate the nearest fire control or alarm unit and use it.

Check your water, electrical, or gas lines for defects. If any damage is suspected, turn the system off in the main valve or switch. Before turning the lines on again, check with the utility servicemen for instructions.

Clean up spills immediately. Start cleaning the flammable and toxic materials first to avoid any chain of unwanted events.

Never touch fallen electrical wirings or objects touched by these wires. If any fallen power line is observed, fence this off to prevent others from electrocution. Inform the authorities of any power line damage.

Do not use the telephone except for emergency calls. During earthquakes, communication lines are being used as information link during the warning, rescue, relief and security operations.

Gather information from battery operated radios or from victim assistance centers which the government shall provide for the purpose. Do not spread or easily believe in rumors.

Do not use your vehicle unless there is an emergency. Roads may be closed to traffic or hazards may still have to be checked along your route. Do not go sightseeing.

Be prepared for aftershocks. Use extreme caution when entering damaged buildings since aftershocks can bring them down.

Obey public safety precautions. Instructions to reduce the effects of earthquakes shall be issued by the authorities. Keep streets clear for the passage of emergency vehicles.

Take note of what you observe and be prepared to inform authorities of the presence of victims needing assistance, materials needing attention and information of scientific value.

If you must evacuate, leave a message on where you are headed and take with you a first aid kit, flashlight, portable radios, food, clothes, important papers, toiletries, personal items and blankets. Your destination may not immediately have all the necessary items for your comfort.

(Source: PHIVOLCS Brochure)

CHAPTER IV

POTENTIAL EARTHQUAKE SCENARIOS AND EARTHQUAKE EFFECTS IN METRO MANILA

Chapter IV
Earthquake Effects and Potential Earthquake Damage Scenario for Metro Manila

HAZARD ANALYSIS

Analysis Unit

Analysis unit is defined at first.

The unit is defined based upon consideration of quality and quantity of available data for the target area.

Grid system is often applied.

500m x 500m grid system is applied for Metropolitan Manila.

Data on natural conditions, ground conditions, buildings, population, lifelines, etc. are prepared in this 500m x 500m grid system.

Results on earthquake hazards and damages are calculated in each grid.

The results are finally added up to administrative boundaries unit or jurisdiction boundaries unit for further detail considerations

Earthquake Scenario

The prediction of time, place and magnitude of future earthquake is impossible under present technology. Concept of “scenario earthquake” is applied this time.

At first, various earthquakes are assumed based on historical earthquakes that have affected Metropolitan Manila area, active faults and recent seismic activities. Total 18 scenario earthquakes are set.

Then earthquake hazards are estimated for every scenario earthquake.

And finally, three earthquakes are selected for detail consideration of earthquake damage.

Case for “West Valley Fault (Model 08)”, the most serious damages to Metropolitan Manila are estimated.

Case for “Manila Trench (Model 13)”, possibility of Tsunami hazard are estimated.

Case for “Manila Bay (Model 18)”, damaged area prevails alongside of Manila Bay.

Peak Ground Acceleration

This physical value directly shows degree of ground motion. The greater the value is, the greater ground shakes. These figures are referred in structural design consideration on seismic performance.

PHIVOLCS Earthquake Intensity Scale (PEIS)

A scale of seismic intensity is a way of measuring or rating the effects of an earthquake at different sites. PHIVOLCS Earthquake Intensity Scale from one(1) to ten(10) is used seeking information on the severity of earthquake effects in the Philippines.

The Intensity Scale differs from the Richter Magnitude Scale. Details are explained in Chapter 3.

Liquefaction susceptibility

5 ranks, high, relatively high, relatively low, low, none are applied for liquefaction susceptibility against each grid. Even the rank shows “high”, liquefaction does not occur at once at whole area of each grid.

Occurrence possibility, area and number are high compared to other area.

Tsunami

Tsunami heights alongside of Manila Bay are preliminary estimated for case “Manila Trench (Model 13)”.

Flooding occurs in lowland area in several tens of minutes after vibration. The Tsunami runs up into rivers for long distance.

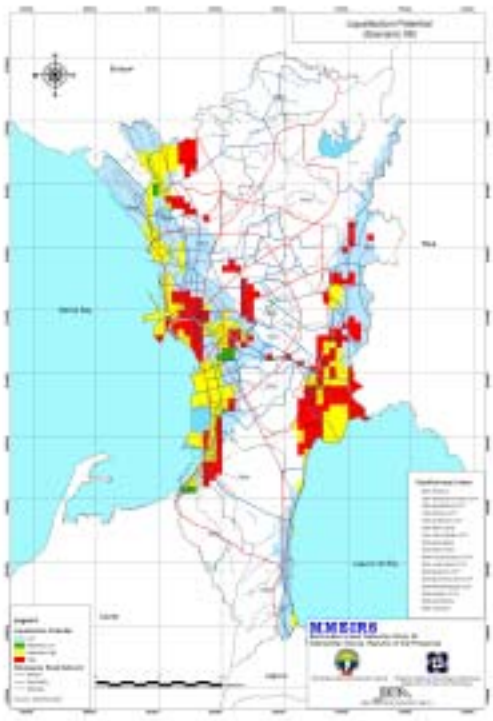
These Tsunami flows out many structures, vehicles, or people.

Tsunami is not a one phenomenon. It come and go several times.

Hazard (Earthquake Scenario 08)

PGA Distribution

Seismic Intensity



Liquefaction Scenario 08

DAMAGE ANALYSES

Building Damage

Residential building damage are estimated. Vibration of ground and liquefaction causes the damage. Here only residential buildings are considered because of availability of data. Once data on public facilities or commercial purpose building are available, these damages are also estimated.

Residential buildings damages are classified as:

Heavily: Collapse or heavy structure damage

For evacuation: Unusable, Danger

For living: Unusable without repair or rebuild

Partly: Partly to moderate structure damage

For evacuation: Usable

For living: Necessary for repair

Damages are represented as number and ratio for each grid.

Human Casualties

Human casualties are estimated. Cause of Damage is mainly building collapse. Casualty by Fire is counted separately.

Data on day-time and night-time population is not available and therefore National Population Census data are assumed as night-time population.

Human casualties are classified as

Death: Instant death under collapsed building structure and trapped in collapsed building and not rescued promptly

Injured: Bone fracture, rupture of internal organs, crush-syndrome, etc.; needs hospitalization

Casualties are represented as number and ratio for each grid and finally summed up for each LGUs.

Fire occurrence, Fire spreading, Fire hazards

Number of fire occurrence and fire spreading area are estimated.

Fire occurs mainly from residential houses, by electric short circuit, LPG leakage.

Flammable buildings are defined using National Building Census data as wood-walled, Half Concrete Half Wood-walled, small houses (Floor Area less than 10m2).

Possible area of fire spreading is defined as less open space area and many wooden buildings area.

Wind speed directly affects fire spreading. Total burnt area, burnt buildings and death by fire are estimated.

Bridges and Flyovers

Pasig River, Marikina River and many minor rivers passes across Metropolitan Manila area. There are many river bridges crossing these rivers. Also there exist many flyovers crossing road or railways. Damages to these structures affect traffic.

Once these are falling down, evacuation, emergency response activities, restoration activities and rehabilitation activities are severely restricted.

Damages to lifeline system

Damages to lifeline system directly restrict emergency response activities, restoration activities and rehabilitation activities.

Three major items are considered.

1) Water Pipeline Damage: number of break points of water distribution pipe and joint, which leads to water cut off.
2) Electricity Cable Damage: Total damaged length of transmission, distribution cable, which leads to electric power cut off
3) PLDT Telephone Cable Damage: Total damaged length of aerial cable and underground cable, which leads to telephone cut off

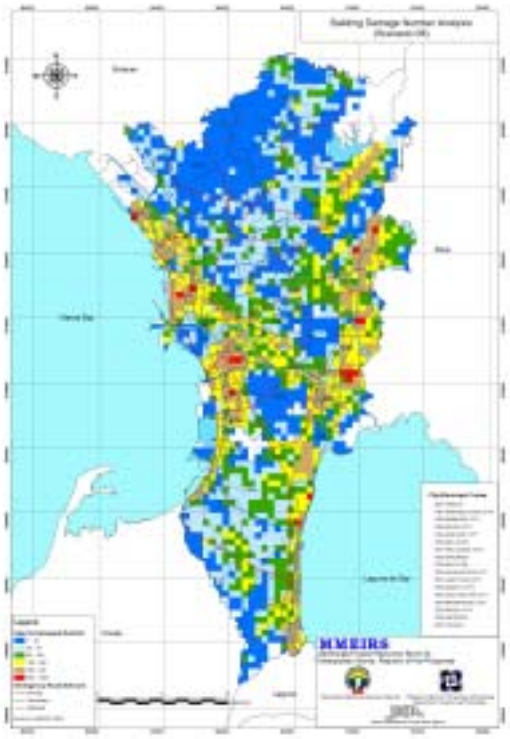
Damages to facilities, for example pumping stations, exchange stations, substations and etc., are not studied this time. These are to be studied together with these utility function systems.

Public Facilities

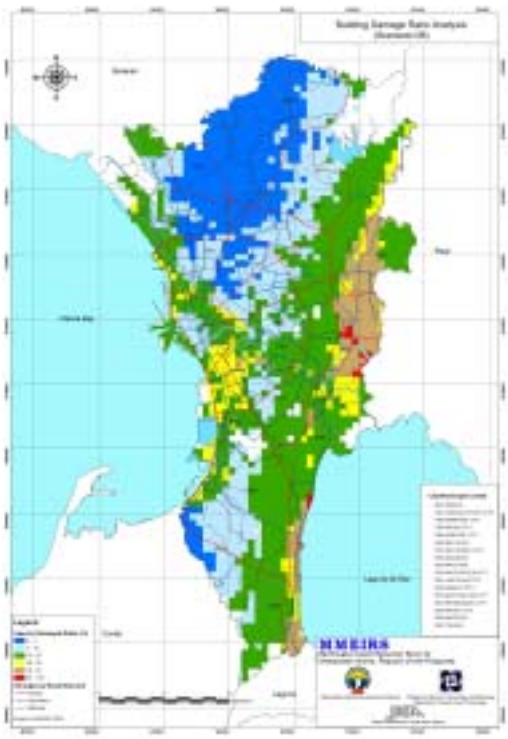
Damages to public purpose buildings directly restrict emergency response activities, restoration activities and rehabilitation activities.

Damages to Hospital, Schools, Fire Stations, Police Station, Government Offices and etc. are studied.

Damage (Earthquake Scenario 08)



Building Damage Number

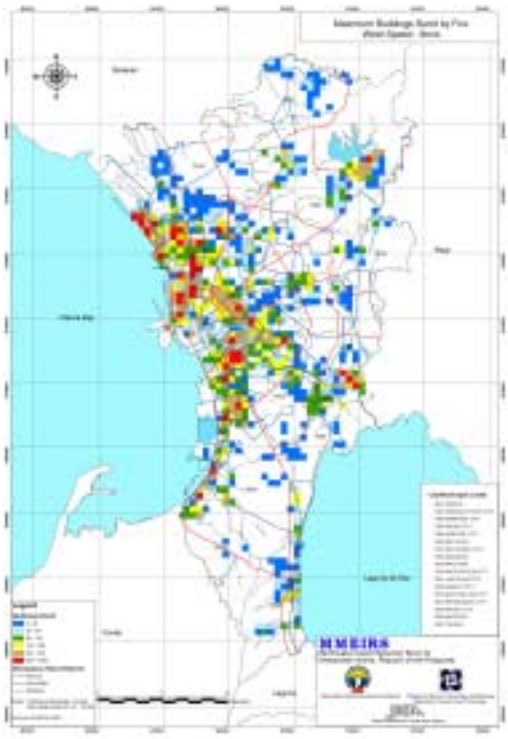


Building Damage Ratio Analysis

Death Number Analysis

Death Ratio Analysis

Fire Spread Possibility



Maximum Bldgs. Burnt by Fire
Wind Speed: 8 m/s

Bridges/Flyovers Stability Analysis

Water Pipeline Damage

Electric Powerline Damage

Telecommunications Cables Damage

REGIONAL VULNERABILITY ANALYSIS

Regional vulnerabilities are characterized once data on inventories, hazards and damages are combined and analyzed together.

Building Collapse

Degree of building damage is characterized relatively in Metropolitan Manila. Applied indexes are:

1) Rate of building heavily damaged
2) Rate of building partly damaged

Flammability

Flammability are characterized relatively in Metropolitan Manila

Applied indexes are:

1) Rate of flammable area and rate of wooden building
2) Rate of possible affected area by the secondary explosions

Evacuation Difficulty

Evacuation difficulty is characterized as difficultness of area for securing road for evacuation. Applied indexes are:

1) Total length of road with width 6 and 8m or more, applicable for evacuation
2) Number of heavily damaged buildings

Comprehensive Regional Vulnerability

Once above three items considered together, comprehensive regional vulnerability is characterized as

1) Flammable and evacuation difficulty
2) Building collapse and evacuation difficulty
3) Flammable risk areas
4) Evacuation difficult areas
5) Others

Possible Regional Separations by Earthquake Impact

Furthermore, bridge damages affect transportation and finally Metropolitan Manila will be possibly separated into four regions by earthquake impact.

Fire Extinguish Service Shortages

Fire Extinguish Service Shortage areas are characterized. Applied indexes are

1) Service Area Density of Fire Stations
2) Flammable Risk
3) Evacuation Difficulty

Evacuation Facility Shortages

Evacuation Facility Shortage areas are characterized. Here public school is considered for the primary evacuation site. Applied indexes are

1) Service Area Density of Public School
2) Building Collapse Number

Hospital Service Shortages

Hospital Service Shortage areas are characterized. Applied indexes are

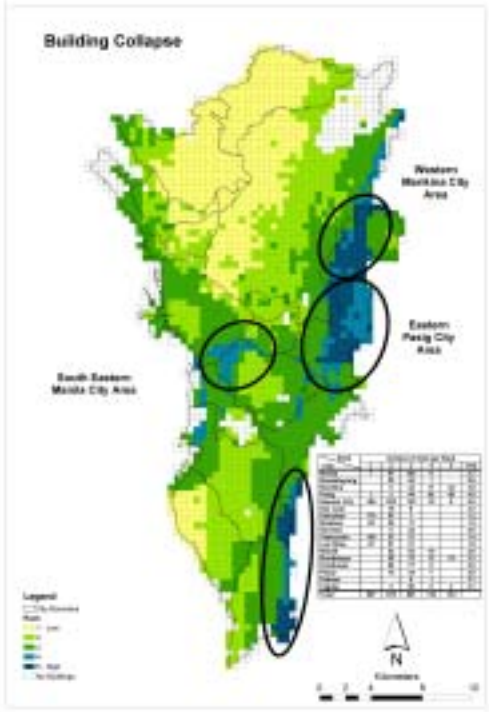
1) Service Area Density of Hospital
2) Building collapse number

Evacuation Area Shortages

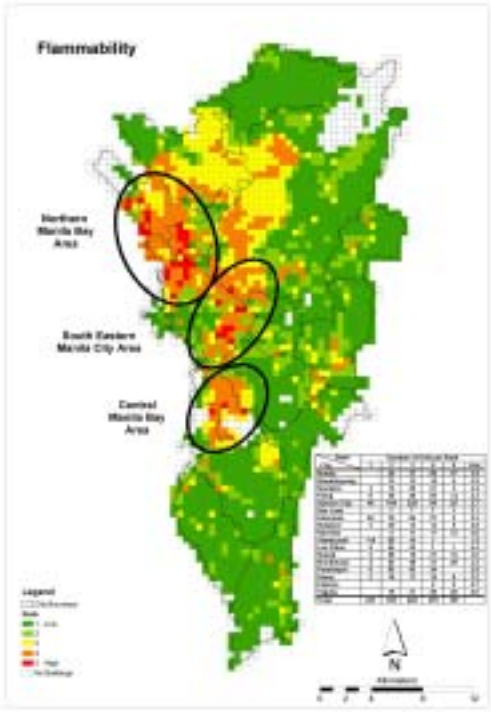
Hospital Service Shortage areas are characterized. Applied indexes are

1) Service Area Density of Park and Open Spaces
2) Building Collapse Number

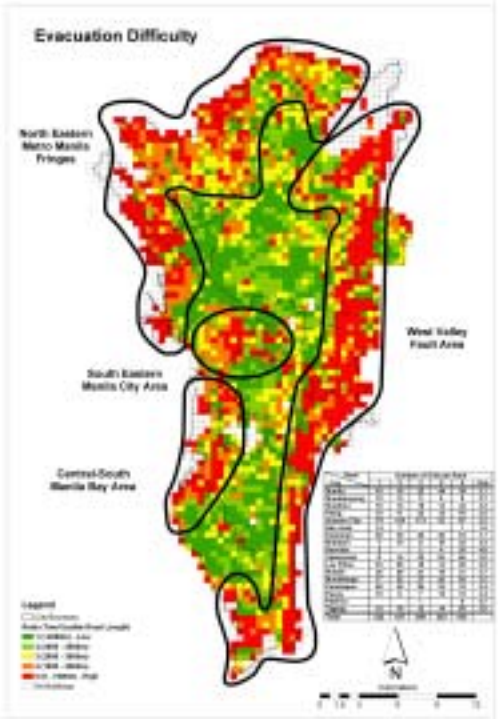
REGIONAL VULNERABILITY



Building Collapse

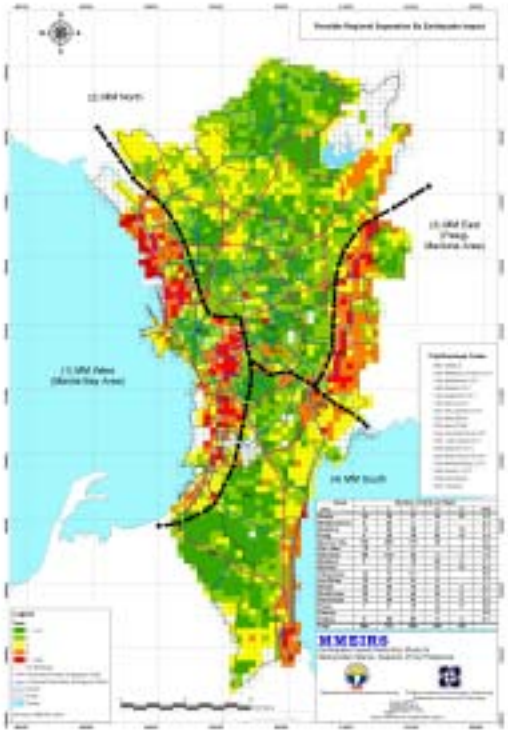


Flammability

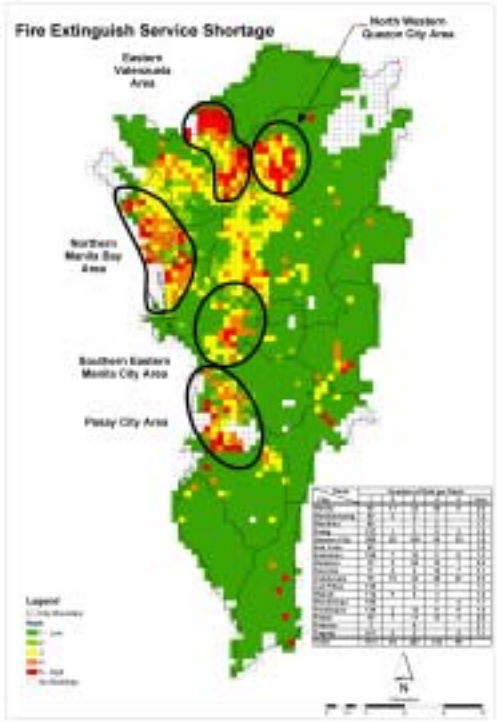


Evacuation Difficulty

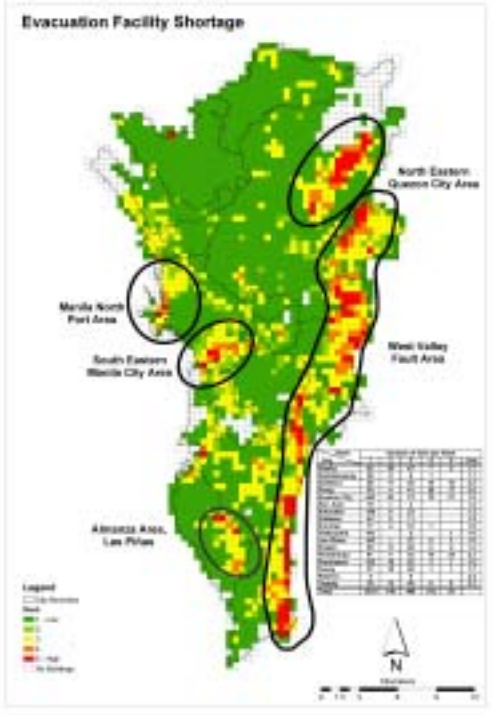
Comprehensive Regional Vulnerability



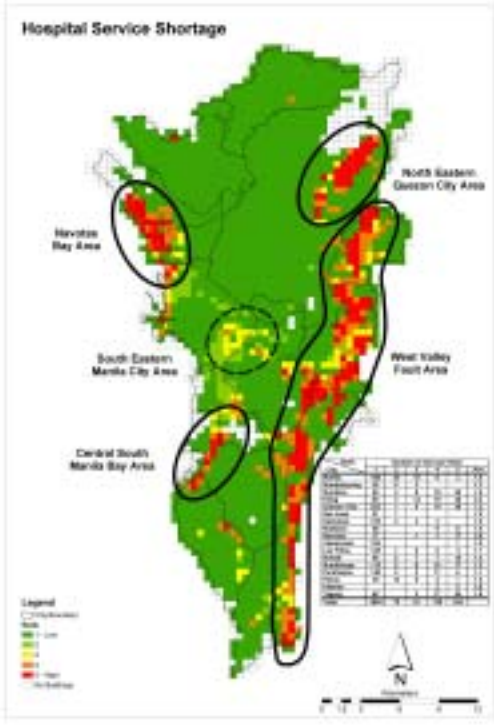
Possible Regional Separations
by Earthquake Impact



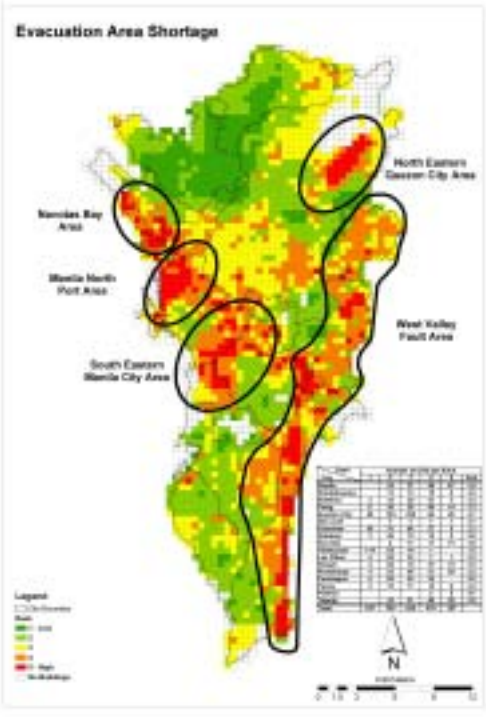
Fire Extinguish Service Shortages



vacuation Facility Shortages



Hospital Service Shortages



Evacuation Area Shortages

DAMAGE SCENARIO

Earthquake Damage Scenario

Basic Inventories

Population (NSO2000)		9,932,560
Residential Buildings (NSO2000)		1,325,896
Mid-rise and Hi-rise Buildings (including commercial and Residential Building)	10-30 Stories	981
	Over 30 Stories	119
Public and Governmental Facility Buildings	MMDCC Organizations and 17 LGU City and Municipal Halls	53
	Police	43
	Fire Fighting Station	124
	Hospitals	177
	Schools (Public and Private)	1,412
Electric Power Supply Cable		4,861,708 m
Water Supply Pipe		4,613,985 m
Telephone Line		13,351,630 m
Bridge and Flyovers		225

Earthquake Damage Scenario

Basic Condition **-Scenario earthquake: Model 08 (West Valley Fault, Magnitude 7.2)**
-Occurrence of earthquake: 7PM, wind speed 8m/sec.

Items		**0-1 hour**	**1-24 hours**	**1-3 days**	**3-7days**	**7days after**
Buildings	Residential houses	• Many residential building heavily damaged or collapsed • Liquefaction affected building alongside of Manila Bay	• Aftershock causes further building damage • Many people lost their residential house (people living in collapsed or heavily damaged residential buildings)			• Debris removal
	Hospital, school, fire fighting, police, government	• Some building damaged or collapsed	• Residents begin to evacuate to slightly damaged public buildings • Official function severely limited	• Public buildings are occupied with refugees • Staffs can not reach to the Buildings • Official function severely limited		• Temporary repairs initiated • Debris removal
	Mid-rise and High-rise	• Some building damaged or collapsed	• Many people are trapped in elevators	• Collapse of moderately damaged buildings by series of aftershocks • No power and water supply in not severely damaged buildings		
Casualties	Dead	• Many people dead from pressure of collapsed building • This figure includes trapped persons who are not rescued from collapsed buildings and die. • Number of dead is small in squatter area	• Many people trapped in damaged building burnt to death • Burnt to death in squatter area occurs • Building Collapse by aftershocks make further dead people		• Persons trapped in the collapsed building are all dead. • Some dead bodies are dug out • Absolute limitation of burial • Death of heavily injured persons as to limitation of appropriate medical treatment	• More dead bodies are dug out
	Injured	• Many people with non-life-threatening injuries • Trauma, fracture of a bone, visceral cleft caused by collapsed building and falling furniture • Non structural elements fall from mid-rise and high-rise buildings	• Non structural elements fall from mid-rise and high-rise buildings	• Many crush syndromes occur to the rescued from collapsed building	• Limitation of clean water • Patients increasing by contamination, unsanitary living conditions, especially in infants • Wounds become infected	

Items		**0-1 hour**	**1-24 hours**	**1-3 days**	**3-7days**	**7days after**
Fire	Outbreak of Fire	• Many fire outbreak by electricity short circuit • Fire from Factories, Hospitals, Residential Kitchens • Petroleum leakage from storage tank • LPG leakage from storage tank	• Explosion of LPG and petroleum and tanks by spreading of fire around • Magnification of fire spreading		• New fire outbreaks occur by short circuit of resuming of power supply	
	Spread of Fire	•	• Fire hydrants incapable • Fire engine unreachable to the fire areas because of congested or debris-blocked roads • Fire fighting system incapable • Many residential building burned out in wide area • Heavy smoke causes respiratory illnesses		•	• Fire almost extinguished
Lifelines	Water Supply	• Failure of water supply caused by damage to water supply pipe at many points	• Failure of water supply over the whole city		• Damages to Angat reservoir and water purification plant causes stopping of water supply for long term	
	Electricity Supply	• Electric transmission facilities, electric transformer substation on the fault is damaged • Many snapping of cables caused by building collapse	• Power failure over the whole city • Damaged area expands by spread of fire	• Partially recovering in area of building damage is not severe	• Damages to transformer substation is not recovered • Power failure continues over the whole city	
	Telephone	• Snapping of cables occurs at many places • Many snapping of cables caused by building collapse • Cellular phone broken off as results of damages to base transceiver station • Telephone and cellular phone service is congested and out of use	• Telephone services suspended over the whole city • Suspended area expands by spread of fire	• Partially recovering applying emergency backup generators • Limitation of available fuel for the generator • Limited time of telephone		
Transportation	Airports	• Runway slightly damaged • Some loss of function in airport facilities	• Closure of runway • Only helicopter available • Poor visibility by fire haze	• Runway reopening • Incapable Instrumental landing system by electricity problem • Only daytime visual flight		
	Ports and Harbors	• Wharfs in Northport, Southport and Container terminal are damaged and tilted by liquefaction • Damages to cargo-handling machine	• General shipping impossible to come alongside the pier • Incapable loading and unloading			
	Roads and Bridges	• Some bridges collapsed	• Fire occurs from vehicles left on roads	• Almost all roads are occupied with vehicles • Almost all roads are disabled • Many people having difficulty in returning to their residence		
Central Government		• Residential buildings around the Maracanang Palace, the Upper House are severely damaged • Liquefaction around The Lower House area	• Danger to fire spreading to the Maracanang Palace	• Public buildings are occupied with refugees • Staffs can not reach to the Buildings • Official function stopped		

Major Response

Organization	0-1 hour	1-24 hours	1-3 days	3-7 days	7 days after
MMDCC					
MMDA					
Each Organization					
Each LGU					
NDCC					
OCD					
Each Organization					
Assistance from surrounding provinces					
Foreign assistant teams					
Others					

Social Impact, Required Measures

Item	0-1 hour	1-24 hours	1-3 days	3-7 days	7 days after
Workforce availability					
Diffusion or migration of poisonous materials					
Peace and order					
Evacuation sites					
Temporary shelters					
Food and water supply					
Economic impacts					
Debris Treatment					
Assessment of Damage					
Relocation					
Cemetery and mortuary services					
Others					

Earthquake Damage Script during One Week from Occurrence of Earthquake

Day 1

Evening. August 26, 2003 is a typical Tuesday, the traffic, the crowd, the sunset at 6:14 as announced by PAGASA. Except that today you are not coming home from work, but from the WORKSHOP at Shangrila Hotel. You are almost home, looking forward to a simple tinolang manok that you know is stewing in your kitchen.

You get off from the bus and navigate your village road. As you are walking the last few meters to your gate, you feel a sudden jolt. It sort of pushes you forward. At first you don't know what it is. But the ground continues shaking, up and down, sideways, getting stronger every second. You fall to the ground, unable to keep standing. You hear a booming sound. You hear screams from people inside their homes. You hear breaking glasses. Telephone and power poles sway violently. Then the power goes off. In front of you, the village road is heaving, as if you are riding waves. The strong ground shaking goes on for 50 seconds. It is the longest 50 seconds of your life.

The ground shaking has stopped but you remain on the ground, still feeling dizzy. You try to get up, your knees shake under you. People start pouring out of their homes. Panic and confusion are everywhere. Occasional cries and wails add to the confusion. Around you are toppled poles and fences, collapsed houses, cracked roads, broken water pipes.

You got home as quickly as you can. You recognize your family amongst the crowd on the village street. They are all home, shaken but unhurt. You let out a sigh of relief and say a prayer of thanks. But your family refuses to enter your home. A barangay leader gives instructions to you and your neighbors to move to the basketball court to keep away from objects that may fall or topple.

You move your family as instructed. You try to make a call to other relatives but your mobile phone has no signal. Still you dialed a number. It didn't work. You finally walked back to check your home. But home is something you barely recognize. Everything seems to be piled up on the floor – appliances, shelves, books, lighting fixtures, family portraits, clothes, your prized Jollibee collectibles, even the tinola dinner.

Among the pile of mess on the floor, you pick up the old battery-operated transistor radio that your mother-in-law refuses to part with. You turn it on. At first you only get static. You play with the dials and catch this piece of news: PHIVOLCS issued a bulletin that says a devastating earthquake, with magnitude 7.2 generated by the nearby West Valley Fault, hit Metropolitan Manila. The ground shaking was felt at PEIS VIII in Metropolitan Manila. Weak to strong aftershocks are expected.

You rummage for blankets and go back to the basketball court. You try to think happy thoughts knowing this would be a very long night. You stay tuned in to the radio. News trickles in.

- There is a major power outage in Metropolitan Manila as well as in the neighboring provinces in Luzon.
- Telephone lines, including cellular networks, are down.
- Many residential houses are heavily damaged and collapsed

- Some school buildings collapsed.
- A few hospitals are heavily damaged, ICU patients need to be transferred, and other patients need to be evacuated.
- Fires broke out in several residential clusters, chemical plants, and few other factories and hospitals.
- Hundreds, if not thousands, are estimated trapped dead or injured from collapsed or burning houses, buildings and factories.
- Abandoned cars, some damaged by falling objects, littered the streets of Metropolitan Manila.

Within the next few hours after the earthquake, the National Disaster Coordinating Council convened. Not all the member agencies have representatives immediately available.

Day 2-3

You are one of the more fortunate. No one is injured in your household. But your house is damaged and you are not sure if it will survive the next strong aftershock. Also, food and drinking water are becoming scarce. The barangay leaders and community members work together to provide for everyone.

Overnight you felt several moderate to weak after shocks. There is still no electricity, telephone communication, and water. Haze from burning buildings darkens the horizon. Fires still spread unabated.

News reports give more dismal picture of the extent of damage brought by the earthquake:

The President declares a state of calamity. She mobilizes the Armed Forces of the Philippines for rescue, clearing of debris, and construction of temporary shelters. She suspends schools and offices.

Philippine flags fly at half-mast.

PHIVOLCS confirms movement of the West Valley Fault after it conducted an aerial survey over Metropolitan Manila.

Volunteer rescue groups from Olongapo and Baguio City coordinate with the NDCC.

Back-up power generators are available only in critical public and private offices.

There are more reports of collapsed houses, now numbering in the thousands, mid- to high-rise buildings, and major bridges

Many roads are impassable.

The LRT and MRT railways remain standing but not operational.

Reports of casualties continue to rise to several thousands.

Several thousand families have lost their homes and begin to occupy open spaces.

People rescued from collapsed buildings show crush syndromes and given medical attention on site in temporary medical shelters. They cannot be transferred immediately to hospitals because ambulances cannot get through the roads littered with debris and cars.

The police contain random acts of looting.

Day 4-7

You continue to occupy the basketball court. There is still no power, communication and water supply.

In the tent clusters that sprouted in parks and other open spaces, the lack of clean water supply makes the outbreak of infectious diseases a threat.

In hospitals, injured patients are lined up even along corridors. Again, the lack of clean water is a major problem.

Many people, especially children, suffer from shock, traumatized by the strong ground shaking, the sight of destruction, or being temporarily trapped.

Bodies exhumed from rubbles are lined up along the streets. The air has the distinct smell of decay.

International volunteer rescue teams coordinate with the NDCC. Rescue will continue in the next few days.

Clearing of debris will continue for several weeks to months. Bodies will continue to be recovered among building debris.

Relief goods are distributed in evacuation centers. Some evacuation centers receive more relief goods than others.

Neighboring Asian countries pledge and extend technical, medical and other forms of support.

The Government appeals to those with capabilities to join forces in responding to the disaster. Recovery and rehabilitation will take years and years.

(The script was developed by Lynn Paladio-Melosantos of PHIVOLCS, based upon damage data. Script contents were finalized with the JICA Study Team)

CHAPTER V

STRATEGIES FOR EARTHQUAKE MITIGATION

Chapter V
Strategies for Earthquake Mitigation

PRECONDITIONS FOR AN EFFECTIVE STRATEGY(S) CHOICE

There are preconditions essential to the right choice of optimal strategy(s) for earthquake mitigation in a community. Recommended are six (6) elements vital to a successful local earthquake mitigation program. A seventh element, Development of Mitigation Plan to Reduce the Impacts of Earthquakes, builds upon the foundation created through implementation of activities in the first six elements.

Establish an Effective Local Government Counter Disaster Committee (Council)

Local governments are to establish a Local Government Counter Disaster Committee. In the case of the Philippines, the local Disaster Councils are what is referred to as the Disaster Committee. Ideally, the Mayor should chair this committee and the Chief Executive Officer should be appointed as the Committee's (council) Executive Officer. Membership of the committee should be drawn from local government officials, local emergency services, and community and local industry bodies as appropriate. An effective committee or council provides the structure to ensure that all aspects of mitigation and disaster response and recovery are addressed and appropriately linked.

Develop an Awareness of the Potential for Earthquake Events

- Apply risk management processes to identify potential hazards and assess the community's vulnerability to those hazards, i.e. risk.
- Define risk treatment strategies to deal with anticipated risk; local government will need to determine priorities and the emphasis to be placed on various mitigation strategies and/or preparing for response and recovery functions.
- Disseminate information about earthquake hazards and vulnerabilities.
- Provide advice to the community on contingency planning and disaster management arrangements.

Develop an Effective Plan for Response and Recovery

- The local plan will provide the guidance necessary for effective response to and recovery from the impact of earthquakes by the community.
- The plan should be reviewed regularly and updated, and should address the following:

Prevention – measures to eliminate or reduce the impact of earthquakes;

Preparedness – procedures and systems to ensure the rapid mobilization and deployment of all resources and services which may be required to respond to earthquakes;

Response – procedures to be taken during and immediately after a disaster event to ensure minimization of impact; and

Recovery – procedures which will assist the community to return to normal life.

Develop a Local Government Disaster Operations (Coordination) Centre

An effective Local Government Disaster Coordination Centre is vital in order to ensure disaster response is timely and relevant. Functions of the centre are as follows:

- Control of local disaster management operations;
- Coordination of local resources; and
- Provision of a communication center for coordination with all other relevant agencies.

Promote Community Awareness

To protect lives and property, it is essential to alert the community to local hazards and provide information on preparedness strategies. Local government should:

- Conduct public programs advising the community about local characteristics, potential hazards and possible impacts;
- Provide public education on how individuals can prepare themselves for earthquakes;
- Develop information dissemination plan for ; and
- Allow and encourage public access to the local Mitigation and counter disaster response and recovery plans.

Be Committed

- Ensure that earthquake and other disaster management is adopted as a key local government function and that is applied as part of local government core business.
- Ensure resources are readily available for disaster management purposes and that coordination procedures are in place.
- Prepare your community by providing information about local hazards and how their effects can be minimized.

FORMULATION OF STRATEGIES FOR EARTHQUAKE MITIGATION

The formulation of Strategies for Earthquake Mitigation shall consider the three phases of an earthquake event. These phases are:

1) Before the earthquake occurs
2) During an earthquake
3) After an earthquake

PARTIAL INVENTORY OF STRATEGIES

There are many measures that can be undertaken by local governments before an earthquake occurs, in order to save lives and prevent or minimize damage to property. Some of these relate to buildings and structures, some to institutional capacity, and still others to public information and education. A partial inventory of some measures implemented by various cities follows. Not all strategies will be equally feasible, affordable, or effective; they must be evaluated within the social, political, economic, and physical environment of the city and region.

1) Emergency planning and response
   - Determine earthquake hazards and risks in coordination with scientific and technical organizations and neighboring cities
   - Plan for response using a team approach and simple format
   - Identify resources needed and available to carry out emergency response functions such as search and rescue, debris removal
   - Assign responsibilities
   - Establish survivable communications systems and services
   - Conduct training and drills
2) Public information, education and research
   - Work with local media to form a partnership
   - Encourage schools to be prepared for earthquakes
   - Encourage businesses to increase their survivability in case of earthquake
   - Help families and neighborhoods to prepare
   - Help prepare the elderly and disabled
   - Encourage volunteer participation in mitigation, preparedness, response and recovery activities
   - Encourage scientific and technical research on earthquake risk reduction measures
   - Encourage inclusion of information on earthquake risk reduction in school curricula

3) Existing buildings and structures
   - Evaluate the seismic resistance of existing buildings and lifelines
   - Inventory hazardous buildings and structures needing upgrading
   - Strengthen critical facilities
   - Reduce nonstructural hazards in critical facilities such as hospitals
   - Regulate and protect against hazardous materials
4) Enhance future development
   - Integrate earthquake hazard information into land use plans
   - Provide for adequate open space and fire protection in new development
   - Restrict building in hazardous areas
   - Strengthen building and fire provisions and design review for new buildings
5) Recovery
   - Plan to restore community services
   - Establish procedures to assess damages and needs
   - Plan to inspect and restrict entry to unsafe buildings
   - Plan for debris removal
   - Plan for providing social, health care, and other services to victims

BEFORE THE EARTHQUAKE OCCURS

Some recommended measures that local governments and institutions can implement for earthquake mitigation before an earthquake strikes include the following:

1) **Establish a Legal Framework for Earthquake Preparation and Mitigation** through a local ordinance. A city or municipal ordinance will legitimize disaster preparations, e.g. appropriating funds for disaster management, and institutionalize duties and responsibilities of various officials and entities.
2) **Reiterate and or Redefine Local Government Policies on Earthquake Mitigation.**
   This should include actions of local authorities to create awareness on the part of the community regarding what are the existing policies concerning disaster preparations in the locality.
3) **Organizing for Disaster**
   The local governments should organize themselves following the Provisions of PD 1566 and the Local Government Code (Sections 558 (iv), 447(iv) and 389(6),

   Local personnel who are tasked to assist in cases of disaster and emergencies must have their roles and responsibilities already defined.

4) **Disaster Plans and Programs**

A local government can respond to disaster much more effectively if it has already formulated its disaster management plans and programs well ahead before any disaster occurs. Such plans and programs should capitalize on its own resources and strengths. However, the local government should also be fully aware of its own weaknesses and compensate for them, to the extent possible, through mutual aid agreements and acquisition of additional resources.

In addition to the threat of natural disasters, communities have become increasingly dependent on lifelines such as electricity, gas, water supply, sewerage and telecommunications. Any breakdown in these services can result in loss of life, human suffering, economic cost or harm to the environment.

Disasters are costly in terms of loss of life, human suffering and economic cost. Effective disaster management arrangements at local government level offer potential to significantly reduce these costs.

5) Develop an Emergency Public Information Program

As earthquakes strike suddenly, it is important that the public be aware of how to protect themselves from earthquakes before the event occurs. It also is essential to have mechanisms to communicate important information to the public, e.g. provide damage situation information, evacuation procedures and locations, and warnings on how to protect against aftershocks. Public officials should work with the media to ensure that radio communications survive the earthquake and proper instructions and information can be disseminated in a timely manner.

6) Inventory of Tools for Disasters, i.e. Earthquake

Local government plans and programs for disaster can sometimes be constrained by the inadequacy of available equipment and other resources needed in times of disaster. Through specialized training, local government disaster coordinating officers should be capacitated to determine the kinds and quantities of tools their jurisdictions may need which are essential in saving lives.

7) Inventory of Local Resources

Complimentary and very much related to the inventory of tools is an accounting of the resources of a local government. Resources in this sense refer to financial, institutional, material and technical resources which a local government can avail of during emergencies. Local governments should inventory the resources available for use in their area and compile information on how to access them. Resources in general can be either internal within the local government or external which can be provided by outside sources.

8) Inter-local Mutual Aid Agreement

Local governments are encouraged to enter into formal agreements between and among local governments that they will help one another in case of emergencies such as fires or earthquakes. The conceptual – sociological framework of such a formal agreement is the traditional “bayanihan” spirit or community assistance.

9) Public Education and Community Awareness Program

To protect lives and property, it is essential to alert the community to local hazards and provide information on preparedness strategies. Local government should:

- Conduct public programs advising the community about local characteristics, potential hazards and possible impacts.
- Provide public education on how individuals can prepare themselves for disaster events;
- Prepare and follow an information dissemination plan; and
- Allow and encourage public access to the local mitigation and counter disaster response and recovery plans.

10) Community Based Disaster Mitigation Program

A barangay based or community level disaster mitigation program is important for two main reasons. First, communities should develop their self-reliance capacities for times of disaster. Then second, external aid and assistance from the central and local governments may not be adequate and also may not come in time

DURING A DISASTER

During an earthquake, some functions of special agencies and institutions are critical. For example:

1) **Monitoring** emergency aid and assistance including search and rescue, emergency medical treatment, and evacuation transportation and relocation sites and their adequacy is crucial.
2) **Coordination** of the assistance and help of government and private agencies to assure that the help is timely and quick to reach the victims of disaster.
3) **A workable Disaster Management Information and Reporting System** should already be in placed or established. This refers to administrative and management tools that allow effective monitoring of the countermeasures against earthquake, including the implementation of such measures during response to emergencies.
4) **In this phase, the overall capabilities of local government** need to be mobilized and made operational to minimize loss of lives and destruction of properties. The roles and responsibilities of each agency and official must be clearly defined and should be included in checklists of duties of key personnel. Operational priorities should be established as well as the incident command structure (who is in charge).

AFTER AN EARTHQUAKE

After an earthquake, what immediately become relevant are the following:

1) **An Earthquake Disaster Evacuation Plan**

This refers to pre-identified open spaces where temporary housing facilities for earthquake victims can be arranged. The evacuation plan also includes the required supplies and distribution systems for food, medicines and even water and electricity that should last for some time, as well as management, security, and information and registration services.

2) **Distribution of health, mental health, and medical supplies and services.** The inventory of resources in Chapter VI of this handbook are relevant in this regard and applicable at this phase of an earthquake occurrence.

3) **Health and medical response also established** to preempt the spread of unmanageable diseases. Sanitation requirements especially in evacuation areas must be strictly maintained.

4) **Disaster Recovery Plan**
The recovery plan refers to measures whereby earthquake victims are being assisted to regain their lives and livelihoods, as well as the recovery of the full range of public services and utilities including water, electricity, communications, and transportation, and social services to the affected areas.

This may include such measures as relocating families to new sites, extension of financial assistance to families, or assisting victims to reacquire gainful employment. It may also include measures for restoring normal government operations, removing debris, repairing and rehabilitating damaged facilities, and provision of temporary housing and/or temporary business locations. The recovery plan should also provide for re-establishing the local economy, reconstruction, improving land use (e.g. incorporating more open space and wider streets), and mitigating against future disasters.

DEVELOPMENT OF A LOCAL GOVERNMENT MITIGATION PLAN TO REDUCE THE IMPACTS OF EARTHQUAKES

After consideration of the various kinds of strategies listed above, each strategy should be evaluated in the context of the **local** legal, institutional, social, economic, and physical environment. Then selected strategies should be consolidated into a **Local Government Mitigation Plan to Reduce the Impacts of Earthquakes.** The key steps are to:

- Work with government and community representatives to define the regulatory, physical, preparedness and capacity building measures which should be undertaken to prevent or lessen the effects of earthquakes. Determine priorities, timeframe, and entities responsible for implementation.
- Gain the support of the appropriate authorities, and submit the mitigation plan to them for approval and funding.
- Monitor mitigation actions and regularly review progress in implementing the mitigation plans to take account of changing circumstances.

Recommended Actions at Personal Level During an Earthquake

Don't panic! Panic is one of most significant causes of injury in earthquakes, and is especially dangerous if parents panic because kids will copy them (follow their lead).

The three primary rules to follow in an earthquake are:

- Drop to the floor or ground
- Cover under something sturdy
- Hold until the shaking stops

If indoors:

Drop, cover and hold. Stay inside. The best protection is to get under heavy furniture (desk, table, bench) and hold onto it. If in the kitchen move away from overhead cabinets and large appliances.

If in a high-rise - Drop, cover and hold; if you're not near a desk or table move against an interior wall away from windows and protect your head with your arms. Stay on the same floor; and don't use the elevators. Be aware that alarms and sprinklers may go off.

If in a store, move away from shelves and other hazards. Try to take cover under a solid counter. Protect your head from overhead objects. Don't rush for the exit; it is not the safest place.

If outdoors:

- Move away from buildings, streetlights, and utility wires. Stay in an open area. Greatest danger is directly outside buildings, at exits and exterior walls. Casualties result from collapsing walls, flying glass, and falling objects.

If in a vehicle:

- Pull over out of traffic, stop, stay in car.
- Pull over to the side of the road and stop.
- Avoid overpasses, power lines, and other hazards.
- Stay inside the vehicle until the shaking stops.

After the earthquake
At home:

- Think! Don't panic. Prepare for aftershocks and plan where you will take cover.
- Check yourself and your families for injuries.
- Help injured or trapped persons.
- Give first aid where appropriate.
- Check for fire or utility control problems at home.

- Protect a possible water source by turning off the water intake valve to your hot water heater and extinguishing the pilot light. This prevents contamination and the stored water can be accessed from the lower valve.
- Hang a “NEED HELP or OK” sign on the door.
- Dress properly before going outside (sturdy shoes, warm clothing).
- Stay off the phones unless calling emergency personnel. An overload of calls will make the system go down. If the main system is down try using pay phones for emergencies.
- Listen to the radio for disaster instructions (KIRO 710).
- Report for duty.
- Once phones can be used, call family and inform them of your location. If the phones are still not working, contact family through the ham radio system as instructed by relief workers.
- If you have to leave home, return only when authorities say it is safe.

At work or school:

- Help injured or trapped persons.
- Give first aid where appropriate.
- Listen to the emergency radio station for direction.
- Immediately following the quake, use the phone only for requesting emergency help. Notify family and inform them of your location when phones or other types communication become available.
- Respect others’ privacy. Work at getting along. It could be a long few days.
- Return home only when authorities say it is safe.

If in a vehicle:

- Use caution on the roads after a quake; there may be road damage.
- If you leave your vehicle parked, leave a note with your name and where you've gone.

Neighborhood Damage:

- Beware of hazards threatening your neighborhood such as broken water mains, leaking gas lines, broken windows, collapsed structures, and fallen trees or power poles.
- Check with neighbors to establish if help is needed and do a neighborhood damage survey for hazards.
- Establish if anyone has special needs or needs medical attention and help each other until emergency services can arrive.

CHAPTER VI

EXISTING RESOURCE AGENCIES IN THE METRO MANILA AREA

Chapter VI
Existing Resource Agencies in the Metro Manila Area

An effective emergency management or disaster preparedness plan should minimize the impact of disaster and help local governments to effectively utilize RESOURCES.

The listing of Resource Agencies in the Metro Manila Area (MMA) includes both public and private agencies. These agencies are also classified as to functions.

A list of resource providers should be maintained together with the type of resources that they can access within the community, Voluntary community organizations and local business should be included. Special equipment which could be used in different disasters should also be included in the resource inventory.

Public Access to Communication Sector

Agency Office	Category	Telephone Numbers*	Remarks
1. PLDT	Private	534 5521	Landline
2. Globe	Private	730 1000	Communication service provider
3. SMART	Private	511 2890 / 888 1111	Communication service provider
4. Sun Cellular Network	Private	395 8000	Communication service provider
5. Bayan Telephone	Private	412 1212	Communication service provider
6. Eastern Telecommunications	Private		Communication service provider

* Records of contact numbers are as of November 11, 2003.

Public Access to the Public Transportation Sector

Agency/Office	Category	Telephone Numbers*	Remarks
1. Bureau of Land Transportation	Public	922 9061 to 66/ 921 0293	Can provide contact numbers of taxis, public transport, etc.
2. Philippine Coast Guard	Public	527 8481	
3. Philippine National Railways	Public	361 4346 / 287 3062	
4. Armed Forces of the Philippines	Public	911 6001 / 911 7882 / 911 6436	
5. Department of Public Works and Highways	Public	304 3000 / 304 3280	
6. Department of Transportation and Communications	Public	727 7960 to 79	
7. Bus Operators Association	Private		
8. Transport Contractors	Private		
9. Inter Island Ship Owners	Private		
10. Light Rail Transit	Private	832 3141 to 59 / 833 2466	
11. Metro Rail Transit	Private	929 5347 / 924 0052	
12. Taxi Companies	Private		
13. Jeepney Associations	Private		

* Records of contact numbers are as of November 11, 2003.

Public Access to Major Hospitals

Name of Hospital	Category	Telephone Number	Remarks
1. Philippine General Hospital	Public	521 8450 / 524 5651 526 1722	
2. San Lazaro Hospital	Public	732 3776 to 78 711 6979	
3. National Orthopaedic	Public	711 4276 to 80	
4. Ospital ng Maynila	Public	524 6061	
5. Valenzuela Hospital	Public	294 6711 / 294 6717	
6. Taguig-Pateros Hospital		837 8131 / 837 8132	
7. Las Piñas Hospital	Public	874 6872 / 873 1891	
8. Tondo Hospital	Public	251 9406	
9. Sampaloc Hospital	Public	794 0215 / 749 7222	
10. Delpan Hospital	Public		
11. St. Lukes Hospital	Private	723 0101	
12. Makati Medical Center	Private	815 5911	
13. Manila Doctors Hospital	Private	524 3011	
14. Medical Center Manila	Private	523 81 31	
15. Metropolitan Hospital	Private	255 0401	
16. Asian Hospital and Medical Center	Private	771 9000	
17. Cardinal Santos Medical Center	Private	727 0001 to 25	
18. Polymedic Hospital – Dr. Victor R. Potenciano Medical Center	Private	531 4911	
19. Capitol Medical Center	Private	371 2161 / 372 3825	
20. FEU Hospital – Dr. Nicanor Reyes Medical Foundation	Private	983 5941	

Public Access to the Energy and Power Sector

Agency/Office	Category	Telephone Numbers	Remarks
1. Meralco	Private	631 1111	
2. NAPOCOR	Private	921 3541 to 80	
3. City Government Generators	Private	*[*]	Disaster Coordinator should make inventory of LGUs with generators
4. Municipal Government Generators	Public	*	
5. Generators of Industrial Firms	Private	*	Disaster Coordinator to inventory industrial firms with generators
6. Generators of Commercial Firms	Private	*	Disaster Coordinator to inventory commercial firms with generators
7. Generators of Private Houses	Private	*	Coordinator to inventory private houses with generators
8. Light Generated by Ships in Harbor	Private	*	
9. Energy from Solar Panel	Private	*	
10. Stores with Lamps	Private	*	
11. Stores with Flashlights	Private	*	
12. Candle Sticks	Private	*	

[*] It is suggested that City Disaster Management Officers should inventory and record of private sources of energy and power

Source of Water

Agency/Office	Category	Telephone Numbers	Remarks
1. Maynilad Water Corporation	Private	1626	
2. Water Bottlers	Private	*	
3. Supermarkets	Private		
4. Artesian Wells	Private		
5. Deep Wells	Private		
6. Shallow Wells	Private-Private		
7. Gasoline Stations	Private		
8. Some Hospitals	Private-Public		
9. Private Water Tanks	Private		
10. Swimming Pools	Private	*	
11. Transporting Water to Metro Manila Area	Community effort - government	*	

* It is suggested that City Disaster Management Officers should inventory and record of private sources of energy and power

Public Access to Police Stations and their Telephones

City/Municipality	Category	Telephone Numbers	Remarks
1. Caloocan City	Public	362 3276	
2. Las Piñas City	Public	872 4047	
3. Makati City	Public	899 9008 / 899 9030	
4. Malabon City	Public	281 1139	
5. Mandaluyong City	Public	532 2145 / 532 5001	
6. Manila	Public	523 5461 / 523 5611	
7. Marikina City	Public	646 1631	
8. Muntinlupa City	Public	862 2611	
9. Navotas	Public	281 8632	
10. Parañaque City	Public	826 8121	
11. Pasay City	Public	831 8070 / 831 5054	
12. Pasig City	Public	641 0436	
13. Pateros	Public	642 3391 / 642 82 35	
14. Quezon City	Public	927 4444 / 921 6146	
15. San Juan	Public	724 2515 / 725 0404	
16. Taguig	Public	642 3911 / 642 2062	
17. Valenzuela City	Public	292 0518	

Emergency Police Assistance: 166

Public Access to Fire Stations

City/Municipality	Category	Telephone Numbers	Remarks
1. Caloocan City	Public	324 6518 / 324 6257	
2. Las Piñas City	Public	874 6177 / 806 0625	
3. Makati City	Public	816 2553 / 818 5150	
4. Malabon City	Public	447 1998	
5. Mandaluyong City	Public	532 2189	
6. Manila	Public	527 3627 / 527 3653	
7. Marikina City	Public	933 3076	
8. Muntinlupa City	Public	842 2201	
9. Navotas	Public	281 0854	
10. Parañaque City	Public	826 9131	
11. Pasay City	Public	844 2120	
12. Pasig City	Public	641 1939	
13. Pateros	Public	6411365	
14. Quezon City	Public	928 8363	
15. San Juan	Public	725 8044	
16. Taguig	Public	837 0740	
17. Valenzuela City	Public	292 3519	

Public Access to Disaster Coordinators

City/Municipality	Disaster Action Officer	Tel. No.	Fax No.	Email Address
City of Manila	Col. Ernesto G. Dionisio (Ret.)	527-49-39	527-49-39	CITYADMIN@CITYOFMANILA.COM.PH
Quezon City	Manuel N. Sabalza	924-18-51/924-18-44	921-10-42	None
Caloocan City	Mamerto M. Manahan	287-21-23	287-30-68	mcaloocan.gov.net
Malabon City	Engr. Ferdie C. Tengson	282-74-51	281-34-05	BONG@FCT@YAHOO.COM
Navotas	Danilo S. Dar Santos	281-41-74 loc. 106	281-41-74	None
Valenzuela City	Danilo C. Seno, Jr.	292-05-25/292-02-11	292-05-25	None
San Juan	Coun. Clemente P. Vargas	725-18-97	724-83-66 tfax	none
Mandaluyong City	Arnold G. Ador	532-50-01/07	532-21-60	none
Marikina	Ma. Lourdes C. Fernando	646-16-34	646-52-77	mayor MCF@MOZCOM.COM marikina@mozcom.com
Pasig City	Marlon F. Caparas	640-95-23	641-19-21	none
Pateros	P.Supt. Joel R. Baloro	642-82-35	641-10-90	None
Taguig	Ricardo J. Jordan	642-12-46	642-35-88	none
Makati City	Co. Ricardo R. Pagulayan (Ret.)	899-89-31/895-40-01 loc. 235	899-90-44	None
Las Pinas City	Mr. Romero R. Villaraza	871-43-45	873-07-65	none
Pasay City	Atty. Ernestina B. Carbajal	833-37-34/833-21-61	831-37-44	TCARBAJAL@PASAY.GOV.PH
Paranaque City	Eulogio S. Rodriguez	829-09-13	826-16-03	none
Muntinlupa City	Oscar P. Oquendo	862-26-64/862-27-11	862-53-16	No email

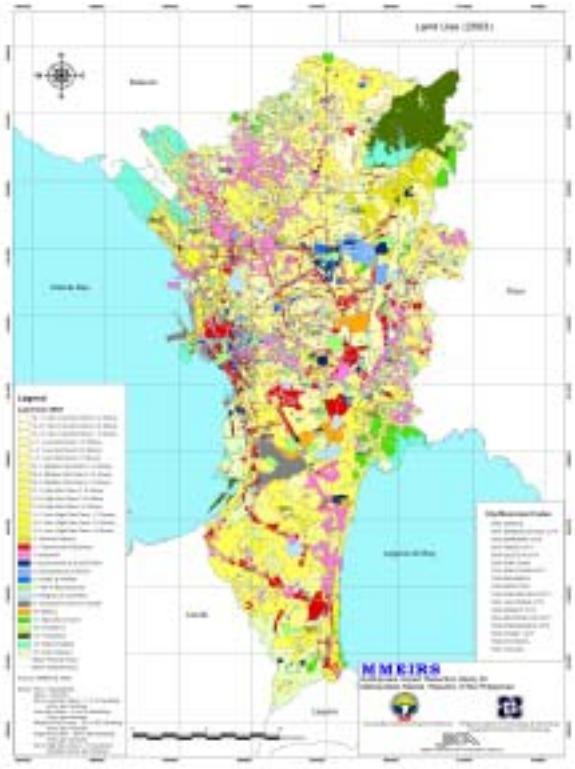
Metropolitan Manila Disaster Coordinating Council Contact Numbers

Agency	Head	Tel. No.	Fax No.	Email Address
LTFRB	Atty. Glenn N. Zaragoza	926-63-46	925-73-66	
PAG-ASA	Dr. Florentino O. Tesoro	373-34-25	837-74-94	FTESORO@LAGUNA.NET
DPWH	Engr. Ramon P. Aquino	304-37-00	304-39-10	AQUINO.RAMONP@DPWH.GOV.PH
PIA	D/Gen. Renato S. Velasco, Phd.	920-43-86	920-12-24	WWW.PIA.GOV.PH
DTI	Ms. Luwina S. Enecio	811-82-31	811-82-71	NCR@DTI.CPM.PH LSE@NET.ASIA.COM
DILG	Director Serafin M. Benaldo	912-89-63/64	912-89-60	NCR_BENALDO@HOTMAIL.COM
DA	Dennis B. Araullo	920-03-88-	920-20-18	none
NEDA	Romulo L. Neri	631-37-23/631-37-16	631-37-47	RLNERI@NEDA.GOV.PH
DOJ	Maria Monica P. Pagunsan	523-68-26	523-68-26	none
NFA	Atty. Jose D. Cordero	563-94-51	563-94-51	none
DOLE	Ciriaco A. Lagunzad	525-94-87 loc. 15	400-62-41	none
PHIVOLCS	Mylene M. Villegas	927-45-24	926-32-25	MARTINEZ@PHIVOLCS.DOST.GOV.PH
PLDT	Mario C. Paguio	816-84-45/817-32-01	894-22-99	MCPAGUIO@PLDT.COM.PH
MWSS	Engr. Orlando C. Hondrade	922-37-57	921-28-87	MWSSOCH@ITEXTRON.COM
MERALCO	Nestor P. Sarmiento	631-22-22 loc. 6654	632-86-45	NPSARMIENTO@MERALCO.COM.PH

INVENTORY MAPS

STUDY AREA

ELEVATIONS



LAND USE

BRIDGES

TRANSPORT

RAILWAYS

FIRE STATION

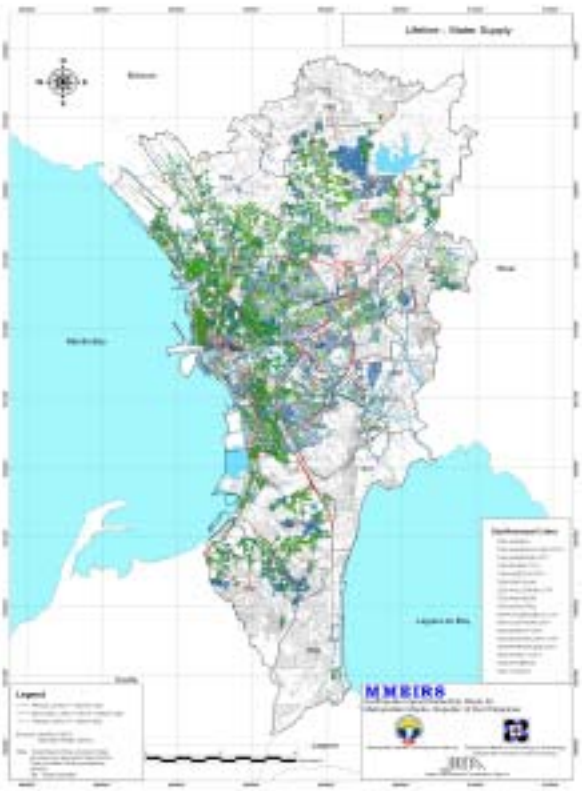
HOSPITALS

POLICE STATION

SCHOOLS

MMDCC

NDCC



WATER SUPPLY

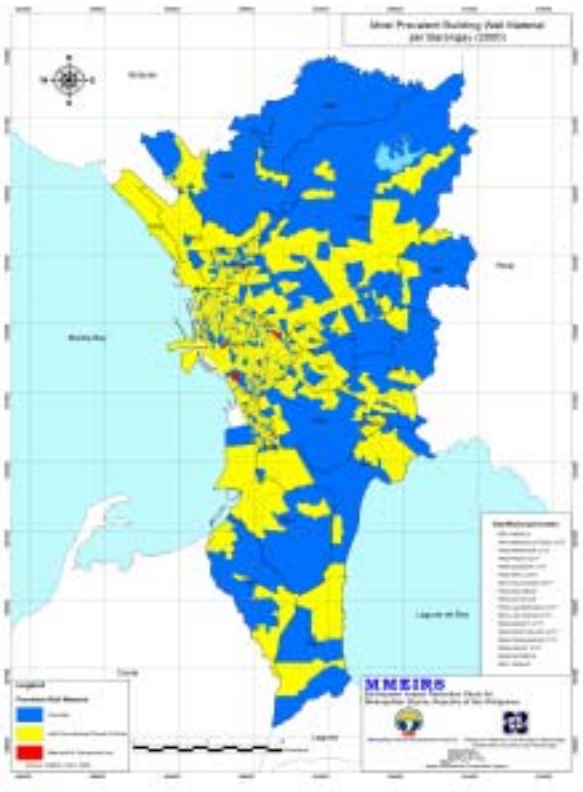
RAILWAYS

ELECTRIC POWER SUPPLY

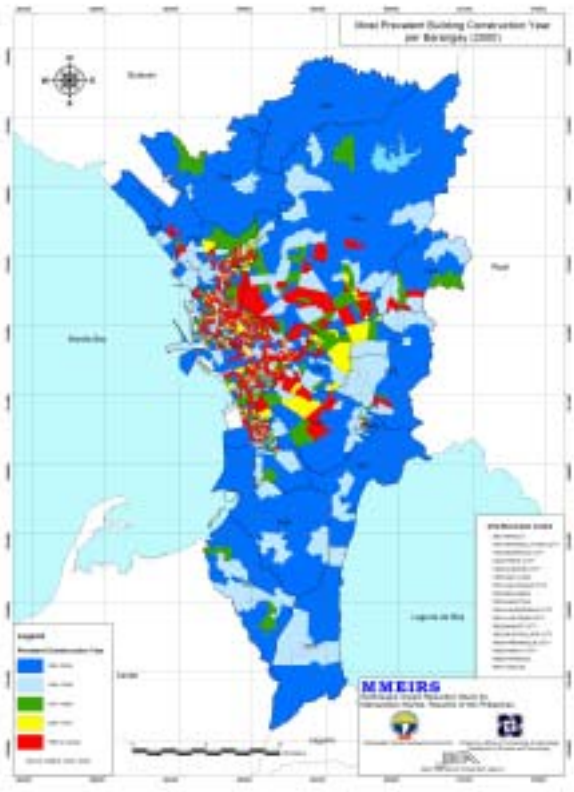
HAZARDOUS FACILITIES

HAZARDOUS MATERIAL

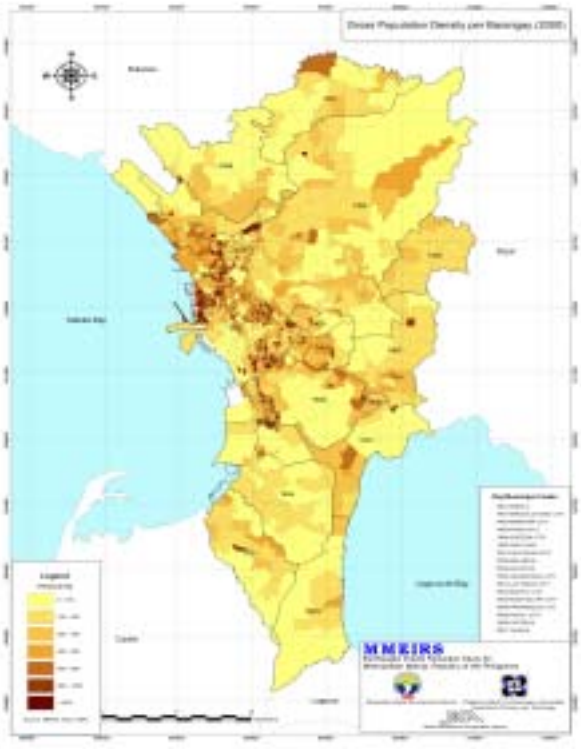
ANALYSIS MAPS



PREVALENT BUILDING WALL MATERIAL



PREVALENT BUILDING CONSTRUCTION YEAR



GROSS POPULATION DENSITY PER BARANGAY
2000

CHAPTER VII

CAPACITY BUILDING AND TRAINING COURSES IN EARTHQUAKE DISASTER MITIGATION

Chapter VII
Capacity Building and Training Course in Earthquake Disaster Mitigation

RATIONALE

Capacitating both individuals and institutions, as an anticipatory move in preparation for an earthquake, is a very critical step that can save lives and properties.

The capability to respond quickly in case of earthquakes is possible only if there is constant training among those who are responsible in disaster preparedness and in emergency response. The internalization of the need for disaster preparedness is imperative.

CAPABILITY BUILDING

Likewise the concept of capability building involves institutional financial and technical dimensions.

Capability Building in connection with disaster preparedness and planning requires an efficient system of institutional support mechanisms and administrative arrangements like establishing procedures or defining the roles and responsibilities of key personnel involve in disaster management. An important sector of capability building is the financial aspect or the resources necessary to mitigate earthquakes for example. Capabilities to provide resources are just as equally important as the institutional requirement in effective disaster mitigation.

Finally, the third dimension of capability building is upgrading the technical competence of institutions as a whole and the competence of individual staff in particular.

SOME TRAINING COURSES

There several training interventions and training modules on disaster preparedness and mitigation i.e. earthquake.

A metro wide training plan can set forth basic government policy and direction in pursuit of the vision for a safe Metro Manila area (MMA).

Specific training courses and details of their implementation can be designed based on training goals and objectives that are pre-planned and pre determined.

It is not practical to include in this handbook all the important training courses on earthquake preparedness. Besides space as a limitation training needs are situational.

A basic guide in determining training requirements is undertaking training needs assessment, thereby identify real felt needs.

Some Training Courses, which are critical and useful, are the following:

Course Title: Understanding the Nature and Processes of Earthquake Phenomena

This course will dwell on the nature and process related to the phenomenon of earthquake and its destructive nature.

Earthquake classification including their characteristics and effects will be discussed.

Understanding liquefaction, fires, landslides and tsunami (harbor wave) as earthquake related events causing disasters and what should be done in these instances will be given priority treatment in the training discussions.

Public and private agencies involved in earthquake preparedness should undertake this course

Course Title: Workshop on Earthquake Mitigation

This workshop is designed to identify measures made in advance before earthquake occurrence in order to reduce earthquake destructive impact in the community.

Public institutions responsible in earthquake mitigation and volunteer organizations should participate in the workshop in order to sharpen their capabilities to respond effectively in such emergencies.

Course Title: Contingency Planning

Contingency planning as a course has the following objectives:

1) Mobilize effective actions and resources for emergency response.
2) Generate commitment among parties involved to act in a coordinated manner before the emergency occurs.
3) Design a concrete and continuous plan until the emergency occurs and which can be discontinued when the earthquake is considered no longer to be threatening.

All public and private agencies concerned with earthquake disaster should undertake this specific course. All those who are concerned with disaster preparedness and or earthquake mitigation management should attend this course primarily because contingency planning can be the key to flexibility in planning/preparations and its effectiveness. This course is suggested to all disaster coordinating offices.

Course Title: (Earthquake) Disaster Prevention and Mitigation

This course will include preventive measures necessary before an earthquake occurs including recommendations of the steps to take before, during and after an earthquake. Mitigation measures such as evacuation and recovery plans will be part of the course. Basic recommended steps to take by individuals caught in specific situations during earthquakes whether in offices, schools or in buses or cars are some of the useful hints intended to save lives.

Course Title: Emergency Management Planning

This course will address the nature of disasters or emergencies i.e. earthquakes and why management planning is important. The institutional infrastructure necessary for effective

management planning in preparation and response to emergencies will form part of the multi sectoral approach of the course. Financial, personnel and policy requirements in emergency management planning will be major components of the course.

This course is ideal for all those who are responsible for resource mobilization, emergency response and others primarily concerned with disaster management planning in general.

Course Title: Multiple Use of Resources in case of Earthquake

This course will discuss the various categories of resources for disasters i.e. earthquake including the multiple uses of such resources in response to emergencies.

Interlocal government mutual aid agreements, resources mobilized in the community, including those sourced from public and private sectors are all likely to be utilized in a multiple variety of uses for various types of victims of disaster including rehabilitation of evacuees and reconstruction of properties destroyed by incidence of earthquakes.

Course Title: Inter active Governmental Coordination

This course aims to institutionalize horizontal and vertical coordination between and among disaster agencies both public and private. Because coordination is in most cases vital to effective disaster program implementation, an interactive governmental coordination is a must. Potential problem analysis in arranging interactive governmental coordination mechanism will be part of the course.

Also for deliberation in this course is the base authority and power essential to those who will coordinate disaster plans and operations as well as similar disaster related actions.

Local Government Disaster Coordinators should take this course including local Disaster Management Directors

Course Title: Citizens Involvement in Earthquake Preparedness and Response.

This course will stress the importance and need of the participation of the community in earthquake preparedness and response planning. Using the concept of Community Based Disaster Management, the course will emphasize on the self-reliance capabilities of communities during disaster emergencies like earthquake.

To be stressed in the course is the bayanihan (community assistance) tradition practiced by many communities during emergencies at the time when the help of all is very important.

Volunteer organizations, barangay officials and other community leaders should take this course.

Course Title: Earthquake Evacuation and Recovery Plans

This course will focus on developing approaches and strategies how to formulate evacuation plans that will accommodate earthquake victims. The course will assist participants how to locate evacuation sites, recommendation on the kinds of temporary housing facilities to construct including the formulation of recovery plans for the disaster victims return to their normal lives.

The financial and technical feasibilities of recovery plans including the formulating the recovery is an important component of the course.

Local government engineers and social welfare officers are some of those who should take the course, including volunteer organizations as well as other NGOs.

Course Title: Earthquake Management and Reporting System

This course will tackle administrative and managerial aspects in establishing a management and reporting system in times of emergency.

The minimum requirements of a reporting system essential in the effective monitoring of an ongoing disaster will be taught to the participants.

Post disaster reporting as a monitoring medium is part of the course. Equally unimportant component is a discussion on the concepts and principles of management in disaster related situation.

Participants in this course should be Local Coordinators on Disaster, assistory and welfare agencies of government and other key local government officials tasked to perform responsibilities in the event of a disaster.

FORMULATION OF TRAINING MODULES

Useful to training Directors and training managers in the effective implementation of a training intervention is a guide on how to formulate a training design. There are formats and principles to observe in the administration of training programs

Suggested Outline of a Course Module on Disaster Management Training

Title of Training

Title of training course explains the focus or thrust of the training activity to be conducted . The title of the training course should be attractive enough to encourage participation of the right participants

Rationale and Objectives

Rationale explains the justification and merit of the training proposed while the objectives explained what the training activity aim or plans to accomplish.

Type of participants

The kind and number of participants are pre-identified before the training activity. This is important in budgeting training cost and in the management of training activity.

Methodology

Methodology will explain how the training will be conducted. What are the training tools to be used. The identification of institutional and individual resources required in training are very important to the success of the training program.

Training materials and time frame

The use of the appropriate and adequate training materials are essential in the learning process of the participants. The time frame limits or delimits the timetable of the training activity. Coordination and the management of training can be either facilitated or prejudiced by a given time frame.

Training Budget

Explains budgetary requirements of the training activity. Budget requirements from specific sources i.e. matching fund or combination of funds from various sources is possible.

Training Venue

Training venue refers to the training site which should be carefully selected considering first that the site should be conducive to optimal learning and secondarily, cost effectiveness may come in as a factor in the selection

Expected Outputs

This part of the training module formulation should be related to the Rationale and Objectives part (Part II). However, the expected output portion should quantify the qualitative end goals of the training proposed.

Training Evaluation

This part when implemented should begin with establishing a pre-training benchmark by means of questionnaire asking training expectations of the participants. Then undertake a post training evaluation to get the evaluation and impressions of the participants as to how training was conducted.

A more equally important or even more useful to training management is to evaluate and or monitor how the lessons learned in the training course are applied in the work situation of the participants.

SOME GUIDING PRINCIPLES IN THE CONDUCT OF TRAINING PROGRAMS ON DISASTER MITIGATION

1) Set specific training objectives – define what is to be accomplished in every specific training course
2) Pre-identify the participants. Train only those who are still trainable, who will be able to learn as well as use their acquired knowledge. Otherwise training cost effectiveness becomes an issue.
3) Select appropriate training venue one that is conducive to learning whether training is live in or live out. Many times learning capacity of participants are induce by a suitable environment.
4) Training programs should be formulated based on a training needs assessment or visible felt needs. Training should start where the participants are

5) The appropriate training materials should be made available. If possible, well a head of time – Training materials should be both local and foreign in order to optimize the learning process of the participants.

6) Identify and choose competent resource persons, who really know the subject, they are going to teach. Also important in this case are resource persons who can effectively articulate and communicate their ideas and knowledge. The learning process should be both ways, the participants as well as the resource persons will find the training activity primarily as part of the individuals continuing learning curves. A useful rule for resource persons to observe, is that ideally for one hour of lecture, two hours preparation may be necessary.

7) Monitor participants' role and involvement during the training course. Evaluate who among the participants are learning and those who are not learning and why.

8) As much as possible training courses should include potential problem analysis (PPA) and goal oriented planning. These are useful strategies in capability building in the long run.

9) When necessary training counselors may be utilized to determine the effectiveness of a particular training course and the extent that participants are learning over a period of time.

10) An effective training program can be achieved if all relevant agencies and institutions, pool resources and conduct a training course in an integrated and comprehensive manner. A consortium of training agencies would be an ideal set up in the conduct of training.

CHAPTER VIII

COMMUNITY BASED DISASTER MITIGATION

Chapter VIII
Community Based Disaster Management Strategy

RATIONALE

The essence of Community Based Disaster Management (CBDM) strategy is to mobilize community resources in time of disasters, such as earthquakes. Even more important is to reduce vulnerabilities, to minimize casualty and to protect properties at the time of disasters.

The CBDM approach is important because at the time of calamity, the assistance of local governments is not only inadequate but usually do not come on time. Therefore, the community response capacities at the initial golden 72hours are critical.

Relevant to the CBDM concept is the principle of self-reliance as advocated in Section 1 of Presidential Decree (P.D.) 1566, which states

> *"Self-reliance shall be developed by promoting and encouraging the spirit of self help and mutual assistance among the local officials and their constituents;"*

This principle of self-reliance and self-help is very relevant to the CBDM strategy in Metro Manila Area. The need for communities to help themselves will allow limited aid of government to be utilized for more urgent priorities in disaster mitigation.

GUIDE FOR FORMULATING CBDM STRATEGY

There are several steps on how to develop a CBDM strategy:

1) Vulnerability and Capacity Assessment (VCA)

The barangay or community should undertake an assessment of its strengths and weaknesses in countering disaster i.e. earthquake. Such knowledge and information are the useful basic starting point in making a plan of action. This is important since earthquake can cause extensive damage.

Information and knowledge of the vulnerabilities of a barangay are important in minimizing casualties and destruction of properties. Knowing the characteristics of the possible hazards, particular to one's area is the first thing to do. For example, knowing the kind of soil in the community will prepare such a community of the destructive effects of liquefaction.

The identification of potential sources of water to suppress fire is very critical. Likewise the inventory of alternative road networks to be used in the event the main roads are impassable is equally important in the CBDM strategy. Vulnerability and Capacity Assessment aims for knowledge development and awareness raising on the part of the community concerning possible earthquake damages.

Vulnerability and Capacity Assessment will also allow a barangay to formulate or review the following mitigation pre-requisites:

- Public Education and Community Awareness Program
- Inventory of Disaster Tools

- Inventory of Barangay Resources
- Disaster Alert Program
- Search and Rescue Plan
- Emergency Medical Plan
- Disaster Information Management System
- Disaster Evacuation Plan
- Disaster Recovery Plan
- Inter-Barangay Cooperation Agreement

Public Education and community awareness program help barangay residents appreciate pre-disaster preparedness plans. In turn the barangay resident's appreciation will also allow them to internalize the value pre-disaster plans in saving lives and properties. However, public education and community awareness program regarding earthquake will have to be undertaken by BDC on a regular basis.

It is also suggested under the CBDM strategy that a barangay should have a disaster alert program. The barangay may resort to using indigenous methods of advising the residents of a coming or pending disaster, such as using bells or gongs for as examples.

Where applicable a barangay can warn its residents of an impending disaster through the means of radio, hand phones or through television.

Even if a disaster has not yet occurred, it will be advisable for the BDC together with Barangay Council to develop an evacuation pan for earthquake victims. An evacuation plan prepared and completed will show the extent of the disaster preparedness plan of an anticipatory barangay administration. Relevant in this regard is the pre-determination of potential evacuation sites as well as materials for temporary housing of the victims.

This evacuation plan exercise must also include sourcing food, medical supplies including clothing.

A barangay disaster recovery plan is also useful in normalizing the lives of earthquake victims. The BDC supported by the CDCC or the MDCC should jointly formulate a comprehensive recovery plan for the victims, prior to the occurrence of the disaster like earthquake.

A recovery plan completed prior to the occurrence of a disaster will help to improve the predictive capabilities of a barangay or the community acting as a whole.

Also important in disaster preparation is to establish a management reporting system which should be able to monitor the coordination of action taken during a disaster, the effectiveness of the action including the identification of actual and potential problems that require resolution. Good reporting systems need not to be sophisticated. As long it serves the purpose of those involved in disaster mitigation, it should be good enough. It is good however, to review the system in order to improve it.

One of the important things to know in the barangay is what does it have which can be used as disaster tools. Tools as simple as big hammers, iron bars, spades or wheelbarrow are what referred to as useful items, which can be utilized in case of emergency.

The richer barangay of course are expected to have more sophisticated tools such as cutter, airbag lifters and marine plywood rescue boats.

An equally important action of a barangay within the umbrella of the CBDM strategy is the inventory of barangay resources.

The resource inventory within the barangay will include financial resources, and community assistance that can be mobilized for disaster mitigation and various materials in the community. The inventory of barangay resources will include government agencies that can provide emergency assistance and non-governmental organizations, which can also be useful during emergencies.

Rural and urban communities have a long tradition of helping families and the whole community residents in times of disaster. In manner a barangay in need of assistance and because of tradition, is immediately being assisted by other barangays.

This practice is currently being formalized and structured through an inter-barangay cooperation agreement.

Several Barangays in the Metro Manila have signed memoranda of agreement operationalizing mutual aid agreements among themselves.

ORGANIZING FOR COMMUNITY BASED DISASTER MITIGATION

The BDCC Chairman should take the lead in developing an organization that can effectively implement the CBDM. The organizational network should include all community (barangay) based organizations whether an NGO, people's organizations or government organizations, which will show the organizational network in the community. Such an organizational network is structured thus:

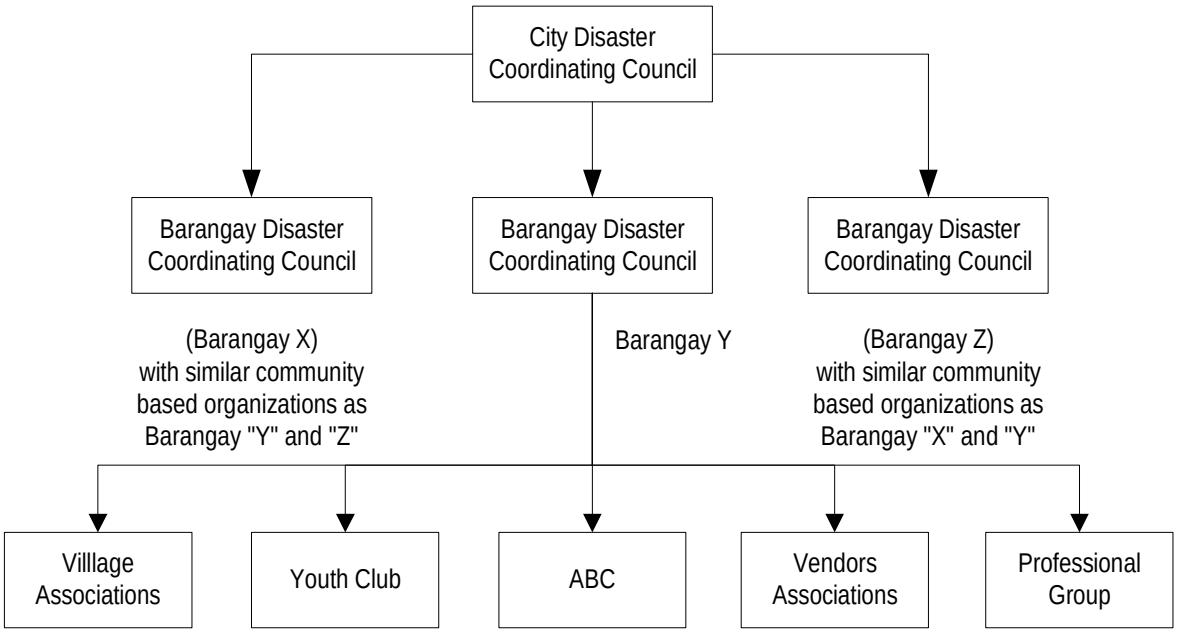


Figure 8.1 An Illustrative Barangay Disaster Coordinating Council Organization

Work committees or subcommittees may be organized which will be tasked to perform certain responsibilities including those that the barangay has to prepare in order to be prepared prior to an earthquake occurrence. These institutional arrangements will be basic essentials in the overall preparedness plan for disaster mitigation. The Barangay Disaster Coordinating Council should be organized as an effective networking mechanism. It should be able to mobilize as well as coordinate community resources in times of earthquake.

COMMUNITY RESOURCE MOBILIZATION FOR CBDM

A pre-requisite to the optimal utilization of community resources in times of disaster is a complete inventory of the overall community.

1) Available labor and materials
2) Voluntary organizations
3) Government agencies
4) Contribution form private sector
5) Donations

Pre identification of such resources herein listed, before an earthquake occurs is a must. A pre disaster resource inventory will facilitate mobilization of resources when a disaster like an earthquake occurs.

CBDM APPROACH AND STRATEGY

There are four basic essentials, which consists an effective approach in formulating community based disaster mitigation. These are:

1) Enhance barangay leadership
2) Undertake confidence building measures among community residents
3) Use indigenous approaches or methods that will facilitate the participation of the community in the CBDM program
4) Incorporate the acceptable or tested strategy as part of the daily chores of the community residents.

Barangay leadership, which can be exercised by the barangay officials and other community leaders, is important in the planning, implementation and sustainability of the CBDM. Without the leadership of the community assuming a primary role in the concept of CBDM, a community can be a totally exposed to full destructive characteristics and implication of an earthquake.

Equally to developing the capabilities of community leaders is initiating confidence building measures among the residents of the community. People in the community should be made to understand that they can be effectively protected against earthquake if they will start helping themselves first, without being prevented from receiving external resources at the same time.

CAPABILITY BUILDING PROGRAM

As stated before, Community Based Disaster Mitigation formulation requires the prerequisite of enhancing community leadership, initiating confidence building measures and the incorporation of indigenous approaches to the daily chores of the community.

All these steps mentioned can be very well facilitated through a series of training interventions as well as seminars and workshops on disaster management and/ or disaster mitigation.

Capability building at the barangay level should be coordinated and/or managed by the barangay council or any of its training arms.

Chapter VII of this handbook provides some guiding principles as to how training courses can be implemented effectively.

The concept of capability building can also be extended for community group involved in voluntarism.

A well-established volunteers group at community level is also an effective medium in developing self-reliance.

Another important concern in the CBDM capability building program is enhancing networking at the community level. In turn, networking should likewise promote functional horizontal and vertical relationship between and among agencies and non-government organizations, which are concerned with disaster management and mitigation and grassroots level.

PUBLIC EDUCATION AND AWARENESS ON DISASTER MITIGATION

Citizen's participation is an important factor in any program, and is vital to the sustainability of the program itself. This end goal can be very much achieved through public education and awareness program i.e. in formulating a disaster management and mitigation for earthquake.

Awareness on the dangers of disasters will likely trigger the community to exert disaster preparedness to its highest degree. Public education and awareness on disaster will not only save lives and properties, it also encourages the community to develop self-reliance and intermutual aid agreements in respond to disaster.

The traditional medium to promote public education and awareness such as schools, churches and other community based organizations can be very complemented with public technology such as radio, television and other digital or satellite operated media.

MONITORING AND EVALUATION

Any long range and sustainable program like the CBDM needs to be monitored when implemented and thereafter evaluated periodically as to its effectiveness.

The CBDM administrator can design a monitoring and evaluation system that will respond under a given circumstances and environment the following:

1) What is CBDM program

2) Why is a CBDM program important
3) Who are implementing a CBDM program
4) When is the CBDM implemented
5) Who formulated CBDM
6) How is CBDM implemented

A full response of the above guides is a good monitoring and evaluation system useful to CBDM

BARANGAY ORDINANCE

A CBDM as an approach and as a community-wide program deserves the support of all at the community level.

An approach that will insure the support of the whole community is for the barangay council to legitimize CBDM through a barangay council resolution, which will endorse the adoption of the concept by a particular community.

Moreover, a more binding legal instrument stronger than a barangay resolution would be a Barangay ordinance on Community Based Disaster Management

The barangay council can easily draft the barangay ordinance, formulating one is well within the power of the barangay government to do so.

A sample barangay resolution can be formulated as indicated herein:

Barangay Resolution No. _____

s. 2003

WHEREAS, Barangay "X" is identified as a community that is with the West Valley Fault;

WHEREAS, Barangay "X" can minimize lose of lives and destruction of properties in the even of an earthquake;

WHEREAS, Presidential Decree 1566 mandates that local governments including barangays are to organize themselves and establish pre disaster preparations;

WHEREAS, Section 386(6) of the Local Government Code authorizes and empower barangays to counter the destructive effects of calamities, like earthquake;

RESOLVED AS IT IS HEREBY RESOLVED that Barangay "X" adopt a CBDM program with the aim in view of protecting lives and properties in the community;

Resolve, further that the Barangay Council shall pass a barangay ordinance authorizing the official adoption of CBDM as a barangay project, establish an organizational mechanism, appropriating funds therefore and for other purposes.

APPROVED UNANIMOUSLY by all members of the Barangay Council in session, this ____ of November 2003.

Certified correct:

_____

Barangay Secretary

ATTESTED:

Barangay Captain:

APPROVED:

In summary, therefore, a good Community Based Disaster Mitigation program should have the following essential elements:

1) A definition of what is CBDM
2) An explanation why CBDM is important
3) Public Education and Awareness Program on Disaster
4) Guide in formulating a CBDM
5) Capability Building Program
6) Monitoring and Evaluation System
7) Legitimization of CBDM through a barangay ordinance

The steps in formulating a CBDM can be summarized as follows: