Pressures of Urbanization: Flood Control and Drainage in Metro Manila

Edited by **LEONARDO Q. LIONGSON, GUILLERMO Q. TABIOS III,** *and* **PETER P. M. CASTRO**

Pressures of Urbanization: Flood Control and Drainage in Metro Manila

Pressures of Urbanization: Flood Control and Drainage in Metro Manila

Edited by
Leonardo Q. Liongson, Guillermo Q. Tabios III, Peter P.M. Castro

Published by the UP-CIDS

ISBN 971-742-040-8

Recommended entry:
Pressures of urbanization: flood control and drainage in Metro Manila/edited by Leonardo Q. Liongson, Guillermo Q. Tabios III, and Peter P.M. Castro.
p. cm.

1. Flood control — Metro Manila, Philippines — Addresses, essays, lectures, etc. 2. Floods — Metro Manila, Philippines — Addresses, essays, lectures, etc. I. Liongson, Leonardo Q. II. Tabios, Guillermo Q., III. III. Castro, Peter P.M. IV. 1998 Conference on Metro Manila Floods

HD1676 P92 2000

Cover and Book Design: Ariel Manuel
Editorial Assistance: Ramon Fernan III & Maricor Baytion
Production Coordinator: Joy Aparis

Printed in the Philippines

On the cover: Estero de Binondo, then and now
(Philippine Commission Reports and UP-CIDS)

CONTENTS

PREFACE

This monograph is the outcome of at least two activities sponsored by the UP Center for Integrative and Development Studies (UP-CIDS).

The first activity was the formation in 1997 of a UP faculty-convenors group on Flood Control, this infrasector being one major component of the Mega Issues Project of UP-CIDS with funding support from the National Academy of Science and Technology (NAST).

The convenors, composed of this writer and other civil engineering faculty members from UP Diliman, performed the uncommon task of bringing together a group of experts from academe (civil engineering faculty from UP Diliman), government (scientists from PAGASA and engineers from the DPWH), and the private sector (engineers from construction and consulting firms). These professionals conducted a series of roundtable discussions about the nature, problems, and mitigation of floods, with emphasis on urban flooding. The results of the discussions, which were heavily oriented toward science and engineering given the background of the group, were essentially a consensus about the flooding issues and an inventory of a few basic technical facts.

Within the year, these results were presented to a bigger consultative group for criticism, validation, and wider discussion. The consultative meeting was attended by representatives of many agencies concerned with flood control and drainage (NEDA, several divisions of the DPWH, PAGASA, NAPOCOR, NWRB, LGUs such as those of Marikina and Quezon City, and associations of residential villages, among others).

The consultative meeting was very productive in that the issues raised and elaborated on by the participants surpassed and broadened the initial technical inputs provided by the experts group. Aside from the very technical aspects (meteorology, hydrology, hydraulics, project design, construction, operations) covered by the discussions, a wider scope of urban flood issues and problems was articulated, such as the need for better coordination and cooperation among government agencies, the incompatibility between the flood-control works of the local government units and those of the DPWH, a call for people's participation and advocacy, and a perceived need to involve social scientists and practitioners in succeeding consultations.

The few months that followed saw the convenors attend at least three UP-CIDS workshops (held at DAP and UPLB) for all UP-CIDS researchers and convenors from various disciplines and programs. The gestated ideas and resolve, planted during the flood-control consultative meeting and further enriched by the collegial synergy generated by the periodic multidisciplinary UP-CIDS workshops, eventually led to the second flood-control group activity sponsored by UP-CIDS in 1998.

On August 28, 1998, the UP-CIDS flood-control convenors group conducted a conference on Metro Manila Floods in UP Diliman. Papers were presented in the morning, while a discussion among all the participants took place in the afternoon. As may be seen below, the experts group decided to expand itself and include social science faculty as paper presentors. The government was represented by paper presentors from PAGASA and DPWH.

This monograph, thus, is essentially a collection of the conference papers and the highlights of the open forum of the 1998 Conference on Metro Manila Floods. The conference papers which had been edited for purposes of this publication were as follows:

- Flooding Issues and Concerns in Metro Manila by Guillermo Q. Tabios III, Leonardo Q. Liongson and Peter P. M. Castro, Department of Civil Engineering and National Hydraulic Research Center, UP Diliman.
- Climate, Hydrology, and Flood Characteristics by Alan L. Pineda, Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA).
- Flood Control and Drainage Network/Operations/Plans in Metro Manila by Nonito F. Fano, Department of Public Works and Highways (DPWH).
- Floods and Governance: Some Considerations by Simeon A. Ilago, National College of Public Administration and Governance, UP Diliman.
- Metro Manila Flooding: The Sociocultural Dimension by Joy B. Page, Department of Sociology, College of Social Sciences and Philosophy, UP Diliman.
- Conference Highlights: Metro Manila Floods by the editors.

As in the 1997 gathering, participants in the 1998 conference, with their varied backgrounds and disciplines, enlivened the discussion. Many who came from government had attended the first conference. They participated in the open forum with as much interest and concern.

Upon good advice of UP-CIDS colleagues, articles which were not presented in the conference are included in this publication with the aim of providing a more rounded treatment of the flood control mega-issue. These are the following:

- The *Esteros* of Manila: Urban Drainage a Century Since by Leonardo Q. Liongson, Department of Civil Engineering and National Hydraulic Research Center, UP Diliman.
- Flood Landscapes of Metro Manila by Doracie B. Zoleta-Nantes, Department of Geography, College of Social Sciences and Philosophy, UP Diliman.

Almost two years have passed since the 1998 conference of Metro Manila floods. Aside from the opportunity to make editorial changes and improve the papers, the time interval has also provided us the chance to update our facts and rethink some of our ideas.

It may be helpful for the reader to acquire first an overall perspective that extends beyond the confines and circumstances of Philippine and Metro Manila flooding situations—in other words, to gain local as well as global perspectives on the flood-control issues. We therefore take this opportunity to add a brief but helpful summary or enumeration of flood types, causes and mitigation measures that is an updated and cumulative product of textbooks, experience, research and exchange (whose local and global contents evolve rapidly nowadays):

1. There are mainly two kinds of rain-induced flooding: local flooding and river flooding.

a. Local flooding is flooding by temporary accumulation of undrained water on road surfaces, urban lots, farmlands and other open spaces due to excessive local rains. The causes of local flooding (local drainage problems) are several:
- high rainfall intensity of sufficiently long duration (thunderstorms, monsoons, typhoons);
- impervious surfaces (asphalt and concrete pavements, roofs);
flat topography;
- inadequate road drainage design-capacity (curbs, culverts, mains);
- clogging of road drainage by garbage and other debris; and
- obstruction or encroachment of small natural ditches and creeks.

b. River flooding is overflow of water from major channels into adjoining banks and floodplains. Its causes further include:
- large tributary and overland inflows into the main river;
- high tide and storm surge at the downstream reaches;
- land subsidence due to overexploitation of groundwater and other causes;
- channel narrowing by property encroachment (loss of waterway);
- siltation with sediment, garbage and other debris; and
- downstream flow obstruction by bridge log-jams, debris and other constrictions.

2. The various flood-control mitigation measures are grouped into two: structural (with hardware and construction by agencies, either as upstream [u/s] or downstream [d/s] measure), and nonstructural (with software and community-based participation).

a. The structural measures are as follows:
- dams, spillways and reservoirs; sabo and check dams for sediments (u/s);
- roadway curb inlets, culverts, drop-shafts (u/s);
- dikes, levees, super levees (d/s);
- river walls and revetments (d/s);
- floodways (open, underground) (d/s);
- bridges and viaducts (elevated, overflow) (d/s);

- river widening and dredging, cut-off channels (d/s);
- pumping stations, garbage screens (d/s);
- floodgates, storm barrage or barrier (d/s);

b. The nonstructural measures are as follows:
- watershed, floodplain and coastal management (conservation and management of soil, forest, flora, fauna, wetlands, local communities);
- river protection and preservation (people participation);
- flood forecasting and warning (telemetry, computer models and telecommunications, sirens, traffic management);
- flood evacuation, rescue and relief (housing, health, food);
- land-use and zoning plans (open spaces, lagoons);
- house/building rainwater collection and infiltration facilities;
- municipal building-code enforcement, flood proofing;
- flood insurance.

Among the measures listed above, there are a few which are not yet applied or least applied in the Philippines due to the novelty and huge costs involved: the drop-shafts and underground floodways (big subterranean tunnel-reservoirs for storing floodwaters beneath urban centers), super levees (high levees whose very wide land-side faces (1 vertical:30 horizontal) are gently sloping, landscaped and habitable terrain where safely low current velocities will develop in case river overtopping happens at all), and house or building rainwater collection and infiltration facilities (which conveys rainwater for percolation to the groundwater aquifer). The expensive underground floodway and super levees are powerful options for megacities with the financial means, either now or in the future.

3. There are other types of floods as well as related disastrous events:

a. Debris flows (flows of water with high suspended or floating solid content such as mountain clay, lahar sand, felled trees, ice, construction debris, etc.) in water-logged and unstably-steep or earthquake-prone river banks). Example: Pinatubo lahar.

b. Landslide and slope failures (following earthquakes and rainstorms in water-logged and unstably-steep places). Example: 1999 Cherry Hill tragedy, Antipolo.

c. Dam-break floods (due to structural or foundation failure of upstream dams, whether man-made or naturally-formed). Example: 1976 Teton Dam failure, USA.

d. Breakouts of municipal water-supply lines and toppling of huge water tanks due to earthquakes. Example: 1996 Northridge earthquake, L.A., USA.

It is hoped that this publication will benefit academics, researchers, planners, scientists, engineers, policy and program advocates, decision makers, and the general reader. As many will agree, flooding is one phenomenon which has been progressively dominated by human influence. The human factors are population growth (settlements in flood-prone area), urbanization factors (loss of permeable open space, encroachment of natural waterways, increase of impervious surfaces), and the effects of infrastructure (design criteria and know-how of the technical people, and the realized effects of the constructed structure on the flooding process itself). This about makes everybody a flood-causing agent as well as a potential flood-mitigating person.

Leonardo Q. Liongson
Co-Convenor
Flood Control Program
NAST and UP-CIDS

THE *ESTEROS* OF MANILA: URBAN DRAINAGE A CENTURY SINCE

Leonardo Q. Liongson

Compared to the more voluminous accounts of public works on fortifications, roads, bridges, railways, water supply, and shipping undertaken by the Spanish authorities in the Philippines during the nineteenth century,[1] similar descriptions of Spanish-era flood-control and drainage measures are far fewer and scanty. This fact indicates the lack of significant achievement in this area by the first colonial masters. When the Americans took over the municipal public works of Manila at the turn of the twentieth century, their engineers would cover in their reports the entire survey of the Spanish-era road drainage system in only one or two brief paragraphs before they embarked on lengthier narratives of the more modern design standards and criteria of American engineering which they applied in the city.[2] On the other hand, this underachievement of Spanish flood-control and drainage engineering is compensated for by the world-class scientific reputation earned by the Society of Jesus in the meteorology of typhoons that it developed at the Manila Jesuit Observatory in the late nineteenth century.[3] This was important because typhoon-induced rainfall accounts for much of the seasonal floodwaters that need to be drained. Thus, there was better science on the inflow side than on the outflow side.

Just like the super typhoons, colonial masters (both political and technological) have come and gone, but certain features of the city's landscape have remained basically unchanged and have thwarted every effort to drain the city dry. These are the *esteros* of Manila which comprise the estuarial network of narrow tidal creeks defining the Pasig River Delta. The San Juan River and the *esteros* of Binondo, Quiapo, and San Miguel are the principal waterways on the north bank of the Pasig River, while the Estero de Pandacan is the only significant tributary from the south bank. Other waterways drain directly into Manila Bay, such as the Estero de Vitas in the north and the Estero Tripa de Gallina which later joins Parañaque River in the south. Furthermore, Pasig River plays an important geographical role, connecting the Marikina River in the northeast and Laguna de Bay via Napindan River at Taguig in the south with the sea.

The *esteros* used to be interconnected and reached out to the river estuaries of Bulacan and Pampanga provinces. This was the traditional domain of the Tagalogs (literally, river dwellers). The Tagalogs and the Capampangans of the adjacent Pampanga River Delta owned *bancas* and cascoes (barges made of bamboo) with which to trade goods with Manila. Their stilt-post houses were erected on the riverbanks, framed and floored with bamboo canes, and walled and roofed with nipa shingles made from the leaves of the mangrove *sasa* palms growing on the tidal banks. They lived on rice and fish which thrived in the aquatic habitat; and drank the *tuba* or fermented sap of *sasa*. The seasonal rains and floods, in addition to the hourly tidal variations, shaped their daily livelihood and the pattern of their travels.

This short narrative provides a historical perspective of the factors that determined how the *esteros* were used not only as a flood and storm drainage system, but also as sewerage and transportation artery. Most of the discussion is based on facts and data gathered from the late Spanish and early American periods, marking the transition from one colonial master to another and the time of the Philippine Revolution. The reading of the American critique made then of the Spanish public works achievement will be very instructive from both technological and historical points of view. The Iberian finally encounters the Anglo-Saxon in the *esteros*, and it will always be interesting to know how the aftermath impacts on the lives of the Tagalogs, Capampangans, and Sangleys (Chinese) plying the tidal currents of the *esteros*. Not all significant events will be dealt with here, but it is hoped that this article will cover the important technological changes that transpired at the moment of colonial transition.

It is notable that Jose Rizal himself referred to the *esteros* when he hinted that the water carriers of Binondo occasionally used river water to fill their containers (see Chapter 1, *Noli Me Tangere*), or when he wrote of the outrageous and Pharaonic proposal of Simoun (Chapter 1, *El Filibusterismo*) to use native forced labor—enraging both Filipinos and Spaniards alike—to excavate a navigation canal between the mouth of Pasig River and Laguna de Bay, cutting across settled areas of Manila.[4] (Of course, however Rizal satirized Manila's public works in his writings, he would later seriously construct similar works during his exile in Dapitan, Zamboanga del Norte.)

Colonial Beginnings of Manila

In the year 1564, with the arrival of the Adelantado Miguel Lopez de Legaspi, two towns were situated at the mouth of the Pasig River. The town on the south side was Maynilad, named after *nilad*, a mangrove shrub, while on the northern bank was Binondoc, meaning mountain or high place. Both towns were under the political control of Rajah Sulayman who was kin to the Bornean sultanate. The following 1903 historical summary[5] provides data relevant to flood drainage (p. 328):

> ... these two towns were surrounded by a stockade consisting of *palma brava* and earth, and it is more than probable that the sites themselves had been raised by filling in with earth or by the accumulation of filth. The mouth of the river and the surrounding shores were densely screened by mangrove trees, and the land extending further back was to a certain extent filled in with mangrove swamps ....

As the city spread, the grounds to the north, east, and south became more or less filled in by the natural accumulation of domiciliary filth, or by the sand taken from the Pasig River. At the present date (year 1902) the mangrove swamps and many of the bayous have disappeared, and it is more than probable that the entire valley in which Manila is located has already been raised, since the Spanish conquest, from 5.0 to 10 feet. Notwithstanding this substantial improvement, it will be necessary still to raise a large portion of the city site from 3.0 to 4.0 feet before it can be regarded suitable for habitations and sufficiently elevated above the surface water, which can be reached almost anywhere by digging down from 1.0 to 3.0 feet.

The Spanish conquerors selected as a site for their town the highest ground on the south side of the river, and immediately began the construction of the present walled city....

The moat surrounding the walled city is not altogether artificial, for at the time of the Spanish invasion Maynilat [sic] was surrounded by a wide natural estero or bayou, which was used at that time for commercial purposes. In plan of the city dated 1710 this *estero* is shown containing a number of small islands, canoes, and sailing vessels.

Road Drainage during the 19th Century Spanish Period

Don Pascual Enrile y Alcedo, Spanish governor general (1830-1835), was given major credit for the preparation of later maps of the Philippines and the construction of many primary and secondary roads and bridges in Luzon. In 1868, by a royal order from Madrid, control of all public highways in the Philippines was vested in the Insular Government in Manila. The Spanish governor general was designated chief of public works; assisting him was an advisory council known as the *Junta Consultiva* composed of an inspector general and all first-class civil engineers employed by the government and residing in Manila. Road drainage was a necessary part of roadway construction, and this was recognized in a 1950 historical report:[6]

... This order further provided that road widths should be 5.0 meters for the provinces in Luzon north of Laguna, Rizal, and Tayabas (now Quezon). Including the above provinces, road widths of 6.0 meters were authorized for the rest of the Islands except for the island of Panay where road widths were set at 8.0 meters. Ditch design consisted of steep sides and a width of 50 centimeters at the bottom. Surfacing was from ditch to ditch and the thickness was set at 25 centimeters except for a strip 75 centimeters wide at each side where the thickness of 8.0 centimeters was specified. In Panay, surfacing was 6.0 meters wide, 80 centimeters thick, with shoulders at either side. Surfacing generally consisted of boulders or adobe rocks, and more seldom gravel or coral, but broken stones were apparently not in use during the time.

American Comments about the *Esteros* under the Spanish Regime

Some general comments about canals and waterworks under the Spanish regime were made in a 1901 report[7] without, however, any explicit mention of floods and drainage (p. 27):

> Very few works of this kind have been made in the Philippines and of very little importance, which, even taking into consideration the climatic conditions of the country, would doubtless be of the greatest utility if carefully executed in certain districts. For waterways the Filipino people take advantage almost entirely of the marshes of the rivers which, fortunately, are many. Some ditches and small canals have been built by the monks on their properties, and possibly some by municipalities or province, assisted by the state with a small credit; but in all of them are works of relatively little importance and merely of local or very partial utility.

In a 1903 report[8] about the sanitary conditions in Manila, the first detailed description of (as well as prescription for) the *esteros* were provided (p. 331):

> There are over thirty *esteros* or branches of *esteros* within the city limits, and although they are dirty, foul, and ill-smelling, their value to the city as commercial waterways, sewers, open drains, and irrigating ditches is almost incalculable. Very few of them are properly walled or cleaned out. The sewers from a large number of the private houses empty into the *esteros*, and the night soil from all the adjoining nipa shacks is dumped into them. A thorough survey of the *esteros* of the city should be made and the lines of those retained corrected and their sides properly walled. They should also be thoroughly dredged out and cleaned, their contents being used to fill in low places in the city. The flushing of the *esteros*, which is now done by the tide, could be greatly accelerated by constructing above the Malacañang a canal which could be connected with the *estero* system and dammed up by means of a gate. At low tide this water could be allowed to sweep through the system and in this manner scour it out.

Figure 1, taken from the 1898 Spanish almanac,[9] is a map of Manila and its suburbs at the close of the Spanish era, showing the extensive network of *esteros*. The *esteros* ran through the urban districts of Binondo, Sta. Cruz, Quiapo, and San Miguel as well as penetrated the suburban rural parts of Tondo and Sampaloc in the north and Paco in the south.

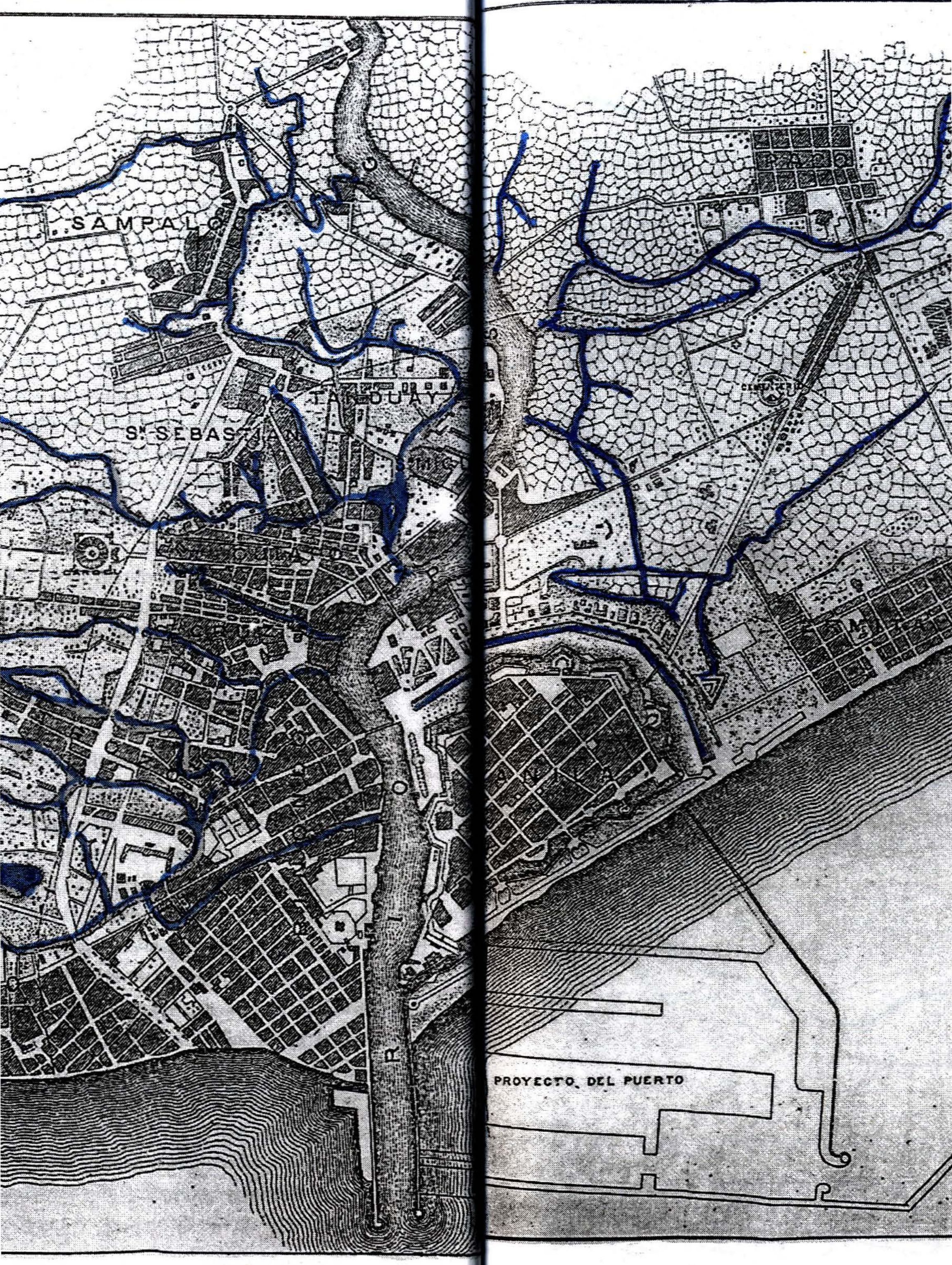
Storm-Water Drainage during the American Period

A 1905 report[10] contains observations which spelled the first scientific and systematic design standards and criteria applied to storm-water drainage in the city of Manila under American rule, to quote (pp. 126-129):

> ... It is unquestionable that the removal of storm water must be undertaken in drains entirely separate from the sewerage carriers, and that the water courses must be utilized in the design of the system. The solution of the problem is greatly simplified by the small drainage areas and short leads to the *esteros*, but is much complicated by the small gradients encountered. Before a definite design may be determined upon all districts, observations on estero flow and groundwater levels must be taken and the results tabulated, and gaugings of streams and present sewers recorded for the definite absorption and runoff coefficients. The records of the Weather Bureau must be redrawn to make them more than passably valuable for this work. Auxiliary gauges should be set up in Tondo and Sampaloc to obtain more definite knowledge of the intensity of rainfall, as the local conditions are apparently quite different there as observed at the station in Ermita (location of Jesuit Observatory).

The same report further elaborated on the technical criteria. The minimum low tide was taken as 10 meters city datum = 30 feet sewer datum which practically never occurred. The minimum elevation of sewer outfalls was placed at 10.30 meters city datum or 31 feet sewer datum. It was also observed that high water in *esteros* far from the sea occurred at no definite period after the high tide in the free bay. The time of the low water, however, seemed to be coincident or nearly so with low water in the free bay, although the height of this low water is greater than that of the bay. The flat grades of the natural surface which were found in Manila made it necessary to set the minimum street gradients to gutters as two in 1,000, which would under ordinary rainfall and with reasonably well-kept road surface, suffice to drive the water to the inlets in a satisfactory manner. It was also assumed that it would be sufficient to provide for a rainfall of 2.0 inches per hour [50 millimeters per hour], with a runoff coefficient of 75 percent in built up districts and 50 percent in rural and suburban districts.

The report also noted the fact that the Spanish drains were connected to two different *esteros* at least, and hence tidal currents were set up in them which brought deposits of sand and decayed vegetable matter inside the drains. To prevent this condition from occuring, the thorough separation of all drainage areas was proposed, meaning one drainage area should be served by one *estero*. In order to remove the storm waters promptly, an


PROYECTO DEL PUERTO


PASIG RIVER
SAN MIGUEL
ARROCEROS
PASIG RIVER

interval of 120 meters between catch basins was believed to be the absolute limit (or maximum) of separation.

In addition, the drains were designed according to Kutter's formula (which quantifies resistance to flow, although this formula had been dropped from present practice since the 1970s and completely superseded by Manning's formula). The roughness factor "n" in Kutter's formula had been taken as 0.013 for good salt-glazed pipe and 0.015 for Japanese vitrified clay pipe and cement pipe. (Earth, for example, has a roughness factor of 0.025; finished concrete, 0.012).

The Moat of Intramuros and the other *Esteros*

An incisive appraisal of the sewerage and drainage system of Manila was given by the same 1905 report (pp. 157-158):

> No system of sewerage, and only a very limited system of drainage, located mostly within the Walled City, and also near the banks of the Pasig River on the north side, has ever been constructed in Manila.
>
> The drainage system as constructed is composed mostly of stone drains, built of rectangular blocks of the prevailing class of volcanic rock laid on a stone foundation, with brick or stone coverings and without manholes. These drains were built in such a manner as to be quite deficient for sanitary purposes, and not entirely satisfactory for the removal of storm water from the streets.
>
> Intramuros, being the highest and most completely improved part of the city, has naturally fared the best, and is generally well provided with storm-water drains of the class previously mentioned. All drains located within the Walled City discharge either into the river or into the moat, and as these drains during later years have been made use of for disposing of the sewage from dwellings and possibly the overflow from cesspools, the tendency has been to convert the moat into an open sewer, in which the velocity of the current is so slight that nearly all solid matter from the sewage is deposited, and the odors from which cause an intolerable nuisance and a menace to public health, especially during the hot dry seasons.
>
> The conditions found to exist in the moat are also applicable in a greater or less extent to all *esteros* located within the city, for the reason that they directly or indirectly receive a very large percentage of all the filth accumulations from the districts through which they pass. The actions of the tides and the heavy storms which prevail during the rainy season, however, keep these natural water courses reasonably well flushed and purified, but during the long, dry, hot season the offensive odors given by these open sewers become almost unbearable.

The existence of these open water courses are very essential, both for commercial purposes and to act as a means for removing all storm water during the heavy rains as expeditiously as possible from the various parts of the city through which they pass. A discontinuance of the present sources of pollution will at once purify the *esteros* and remove all opposition to the continuance of a system of navigation which is largely responsible for the commercial importance of the city.

Technological Changes

A 1906 report[11] narrated the work of filling the moats under the direction of the office of water supply and sewers of the city of Manila (p. 448):

> ... The filling was commenced on February 12, 1905 and completed on May 18, 1905. The dredger of the Atlantic, Gulf, and Pacific Company employed in excavating the new harbor of Manila was connected to a 24-inch steel pipe extending along the south side of the reclaimed area to the moat, and branches were laid from this as the work progressed. After the moat had been filled the dredged material was pumped to the lowlands on the east side of the Bagumbayan drive, between the city hall and the building known as the "old post of Manila." The old *estero* of the athletic field, extending from Luneta to Calle Nozaleda, was also filled. This new ground is gradually settling. The moats are still subject to partial inundation from high tide and heavy rainfalls.

The same 1906 report (p. 499) presented the findings of the observations of *estero* flows in 26 gauge stations located throughout the city. Observations began on January 9, 1905. The work was done by 24 Filipinos familiar with rod readings (taken to the nearest centimeter) who were divided into day and night shifts of 12 hours each, with a foreman and assistant foreman assigned to each shift. Graphs of water-level heights above mean low water versus time interval were plotted and then studied to reveal the following: (1) high water in the *esteros* occurs at a more or less definite time period after high water in the bay, depending upon the *estero*'s distance from the bay; (2) low water in the *esteros* is higher than in the bay; (3) high water in the *esteros* is always lower than in the free bay; (4) at a point near mean tide, the level of water in the bay and in the *esteros* is equal; (5) it can be assumed that during the dry season the water in the esteros is wholly tide water; (6), the velocity of water in the *esteros* is therefore small, and during this time silting up of the *esteros* is greatest; (7) most of the silting will occur at ebb tide when the hydraulic radius is decreasing. The report also modified the runoff coefficients: 90 percent for heavily built-up sections such as Intramuros; 75 percent for ordinary business and residential sections; and 50 percent for suburban sections. The maximum run in gutters was also reduced from 120 meters to 100 meters.

The drainage design standards and criteria of Manila were echoed in a 1907 transaction-discussion paper of the American Society of Civil Engineers.[12] The street grades were fixed at the absolute minimum of 0.002. It was also ruled that the street surface at no point should be less than 0.75 meter above the highest tide. The minimum cover above the concrete pipe sewers was fixed at 0.60 meter. The sewers had to be designed to fall within the range 1.15 to 1.25 meters above mean low water to avoid the likelihood of silting. Although rainfall intensities of 3.0 inches per hour were not uncommon, the sewers were designed for 2.0 inches per hour, relying on the sewers under pressure to discharge the excess, and allowing for the flooding of the roadways for 15 minutes. The maximum run in the gutters was reduced from 120 meters to 100 meters, following observations of gutter flows. The values of roughness coefficient "n" in Kutter's formula were 0.011 for cement plaster finish, 0.013 for clean bricks and glazed pipe, and 0.015 for local stone. A velocity of 3.0 feet per second was sought whenever possible, so as to lessen the likelihood of silting. All drainage areas were kept completely separated, and the connection with the old sewers of the Spaniards was stopped in order to make the direction of flow definite. The same revision of runoff coefficients was reported: 90 percent for heavily built-up areas; 75 percent for ordinary business and residential areas; and 50 percent for suburban areas.

In 1929, a scientific paper[13] mentioned that Manila had a satisfactory sewage disposal system, even though sewage was being discharged into Manila Bay without treatment. The report also indicated that studies of several river control projects had been made, of which the most important was the comprehensive scheme of flood control for the Great Luzon Valley. There was no mention of the *esteros*. The paper extolled instead the achievements of the American regime in building roads, bridges, transportation, domestic water supply, and irrigation.

A Comparison of Images

Figure 1 provides an 1898 map of Manila and its suburbs at the close of the Spanish era. Compared to more modern map in figure 2, which was taken from the 1:10,000 scale maps of Manila (North and South) in the Edition-1 1987 series of the BCGS-JICA (Bureau of Coast and Geodetic Survey-Japan International Cooperation Agency) maps, the earlier map shows the extensive network of *esteros* which ran through the city. The inland lagoon linked with the Tondo tributary of the Estero de Binondo that is in the 1898 map is no longer in the more recent map, and has been replaced by the Tutuban railyards of the Philippine National Railways. Most of the upstream branches of the Estero de San Miguel which used to drain the site of the present campus of the University of Santo Tomas and other parts of the Sampaloc district have also disappeared. Perhaps not surprisingly, this district is known for developing flash floods during sudden downpours.

The *esteros* have been altered in form and diminished in length, owing to encroachment or reclamation done in order to give way to roads, railyards, and buildings. In their

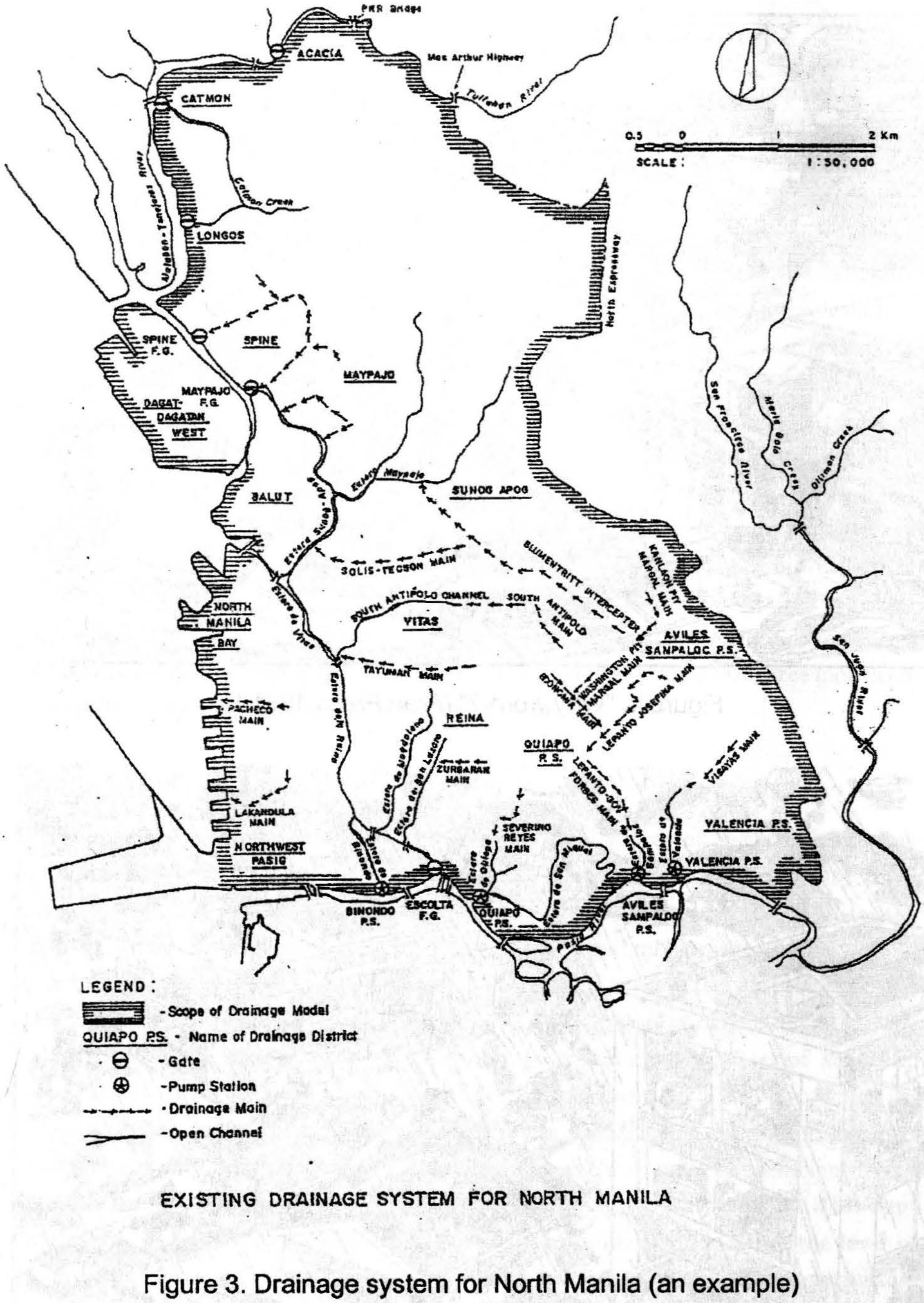


Figure 3. Drainage system for North Manila (an example)

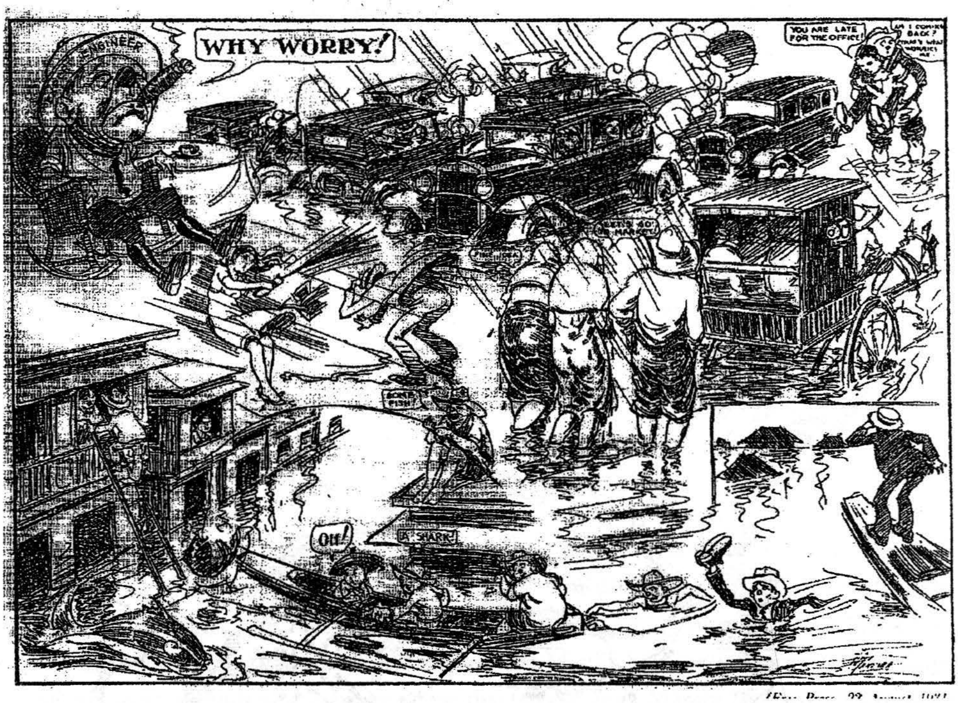


Figure 4. "Why worry?" (*Free Press* 1931.)

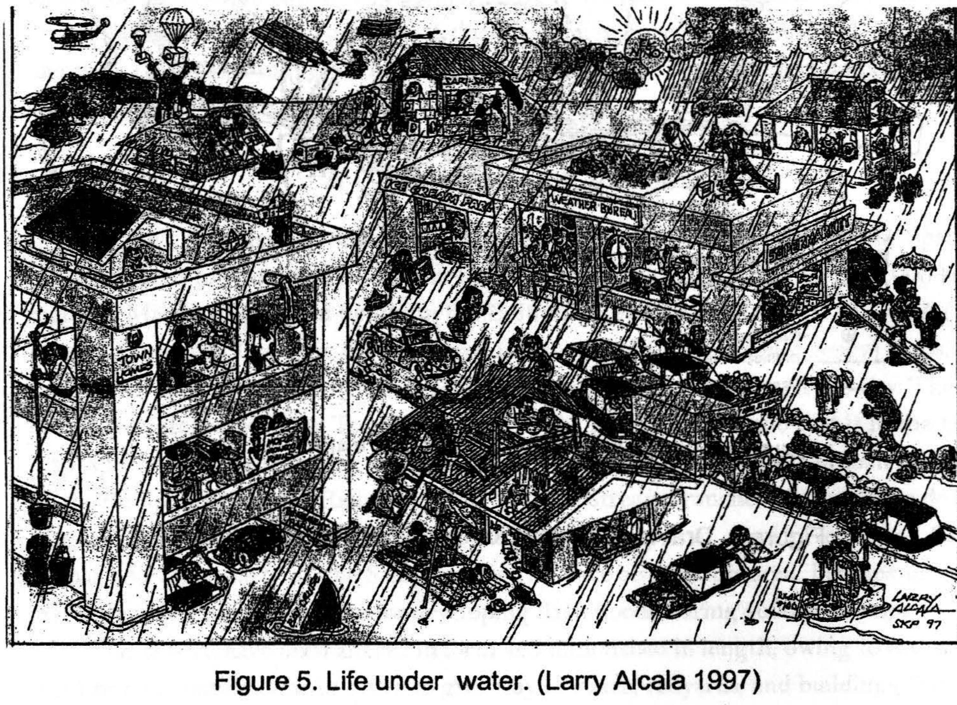


Figure 5. Life under water. (Larry Alcala 1997)

place, underground pipe drains have been installed to catch and convey the stormwaters coming from the surface, as shown in figure 3 for northern Manila. Interestingly, the pipes drain into the existing *esteros*. Where the *esteros* enter the Pasig River, pumping stations and floodgates are in place for pumping out the water even during high tide in Pasig River and Manila Bay. The *esteros*, now diminished, have at least retained their ultimate function of conveying storm water to the Pasig River, assisted by pumping stations and floodgates.

Figures 4 and 5 constitute another comparison of images. Figure 4 is a political cartoon about city flooding that appeared in the August 22, 1931 issue of *Free Press*. It depicts human behavior in the midst of floods during the American regime: those of the American "expert engineer," office workers, lovers, boaters, fishers, and young and older ladies alike. Figure 5 is a similar cartoon about floods by Larry Alcala that appeared in a Sunday issue (August 31, 1997) of the *Philippine Star*. It satirizes human behavior in current times: weather forecasting by playing darts, singing in the rain on the roof tops, road excavations becoming instant swimming pools, etc. Outward forms and appearances may differ in the two caricatures, but the pictures seem to point out that human behavior has remained basically the same: for instance, the implied ability of the population to adjust to and weather the difficulties of flooding, the idea of fun in the midst of floods, and the expectation of sunny days ahead represented by the El Niño sun shining in the horizon of the 1997 cartoon. As a matter of fact, the El Niño did spawn a dry spell peaking globally in the last three months of 1997 and continuing through the first semester of 1998.

Conclusion

This article presented a short historico-technological survey of the Manila *esteros*. Through time, the *esteros* have undergone physical transformations, but have retained their most basic function of providing the ultimate or most downstream waterways for the drainage of Manila. The Spaniards, in the persons of the Jesuit meteorologists, had started to master the vagaries of the tropical climate and weather, such as the typhoons. Proper road drainage had been recognized as a necessary adjunct of road construction late in the Spanish era. It took American engineers, however, to introduce the full set of scientific principles and practice of flood control and drainage engineering. These principles include analysis of rainfall, fixing of minimum elevations and street grades, maximum runs in gutters, minimum flow velocities to avoid silting, the right roughness coefficient in the design formulas, and, very important, the adjustment of the runoff coefficient. This runoff coefficient, which is the ratio of surface runoff to rainfall, increases as the level of urbanization (in terms of areas of road pavements and other concrete or impermeable surfaces) rises. These scientific criteria are still valid today; the shortfall of planners and engineers is in applying and implementing these technical ideals. The blame is commonly laid on lack of budget, time, manpower, right-of-way, and public acceptance.

Acknowledgment of the important role of Filipino engineers and technicians is characteristically absent in the reports written by colonial administrators and engineers. The only exception was a reference (cited earlier) to the flow monitoring work of 24 Filipinos in gauging stations along the *esteros*. This seems to have yielded very valuable scientific findings about the flows, which speaks well of the abilities and dedication of the Filipinos who undertook the measurements.

Comparisons of images (maps and cartoons) have indicated the essential constancy of human behavior in the midst of floods despite changes in outward appearances of the physical structures. The *esteros* themselves continue to function as part of the city's drainage system.

Notes

1 La Compañía de Jesús. *El Archipiélago Filipino. Colección de Datos.* Tomo I y II. (Washington D.C., Imprenta del Gobierno, 1990).

2 A series of Annual Reports of the Philippine Commission, Washington D. C., from 1900 to 1907.

3 Algué, Jose, S. J. *The Cyclones of the Far East* (Manila: Bureau of Public Printing, 1904)

4 Rizal, Jose. *Noli Me Tangere* (1887). Offset printed edition (Manila: National Historical Institute, 1978) and *El Filibusterismo* (1891). Offset printed edition (Manila: National Historical Institute, 1990).

5 *Third Annual Report of the Philippine Commission, 1902,* Part 1 (Washington, D.C.: GPO, 1903), p. 328.

6 Philippine Bureau of Public Works. *Philippine Highways.* (Manila: Highway Planning Survey, June 1950).

7 *Report of the Philippine Commission to the President,* Vol. IV (Washington, D.C.: GPO, 1901), p. 27.

8 *Third Annual Report of the Philippine Commission, 1902,* Part 1 (Washington, D.C.: GPO, 1903), p. 331.

9 *Guia Oficial de las Islas Filipinas para 1898* (Manila, 1898).

10 *Fifth Annual Report of the Philippine Commission 1904.* In Three Parts (Washington, D.C.: GPO, 1905), pp. 126-129.

11 *Sixth Annual Report of the Philippine Commission 1905.* In Four Parts. Part 1. (Washington D.C.: GPO, 1906). p. 408.

12 Robert G. Dieck, *Discussion: The Sewer System of San Francisco.* (Transcripts of the American Society of Civil Engineers, LXV, December 1909), pp. 385-390.

13 A. D. Williams. *Public Works, Past, Present, and Future, in the Philippine Islands,* Paper no. 811 (Tokyo: World Engineering Congress, 1922).

FLOODING ISSUES AND CONCERNS IN METRO MANILA: AN OVERVIEW

Guillermo Q. Tabios III, Leonardo Q. Liongson and Peter P. M. Castro

In 1995 and early 1996, a series of consultative meetings and conferences organized by UP-CIDS with the support of the National Academy of Science and Technology was held to discuss the perennial problem of flooding in Metro Manila. The goal was to formulate long-term solutions to the flooding problem. (Liongson et al. 1996, 1998) These meetings examined the flooding problem mostly from a technical point of view since most of the participants had technical and engineering backgrounds. This article revisits the flooding problem of Metro Manila and attempts to set a new tone for tackling this issue. It hopes to expand the discussion of flooding from a technical point of view to one that considers social, economic, cultural, and institutional issues. It is hoped that through discussions encompassing the different aspects of the flooding problem, we can increase our success in developing and implementing long-term, viable means to reduce flooding in streets and houses, minimize risk of flood damage to private and public property, and to prevent or minimize loss of life.

FLOODING SCENARIO

As shown in figure 1, Metro Manila is situated in a semi-alluvial fan formed from thousands of years of sediment flow from the Meycauayan and Malabon-Tullahan river basins in the north and the Marikina river basin in the east. The foot of the semi-alluvial fan opens to Manila Bay on the west and the Laguna de Bay on the southeast. The metropolitan area is about 20 kilometers (km) long along a south to north direction. The width varies from about 15 km in the north, to more than 22 km in the middle, then about 8.0 km in the southern part. The Marikina River runs along the eastern boundary and joins the Pasig River in the middle part before turning west towards Manila Bay. The Manggahan floodway, which is connected to the Marikina River, can convey floodwaters for temporary storage in Laguna de Bay. The Napindan Channel is a small river that connects Laguna de Bay to the Pasig River and can convey water from Manila Bay to Laguna de Bay during high tide. Due to urbanization, Metro Manila has become a typical, urbanized drainage basin, which acts like a reservoir for rainwater runoff from the Meycauayan, Malabon-Tullahan and Marikina river basins. The waters are routed through the natural overland flow planes and urban watersheds, and flows out from the reservoir through storm drains, creeks, and other natural or man-made channels into Manila Bay.

Through the years the city has experienced floodings from overflowing rivers and stormwaters inundating low lying areas. To alleviate these flooding problems, canals and esteros were used to contain flood flows but rapid urbanization, the accumulation of urban solid waste, and overburdened capacities have rendered these drainage systems inadequate. Despite the risk of floods, residential homes, industries, and commercial buildings continue to rise in flood-prone areas in the city. Flood-related destruction thus has risen through the years.

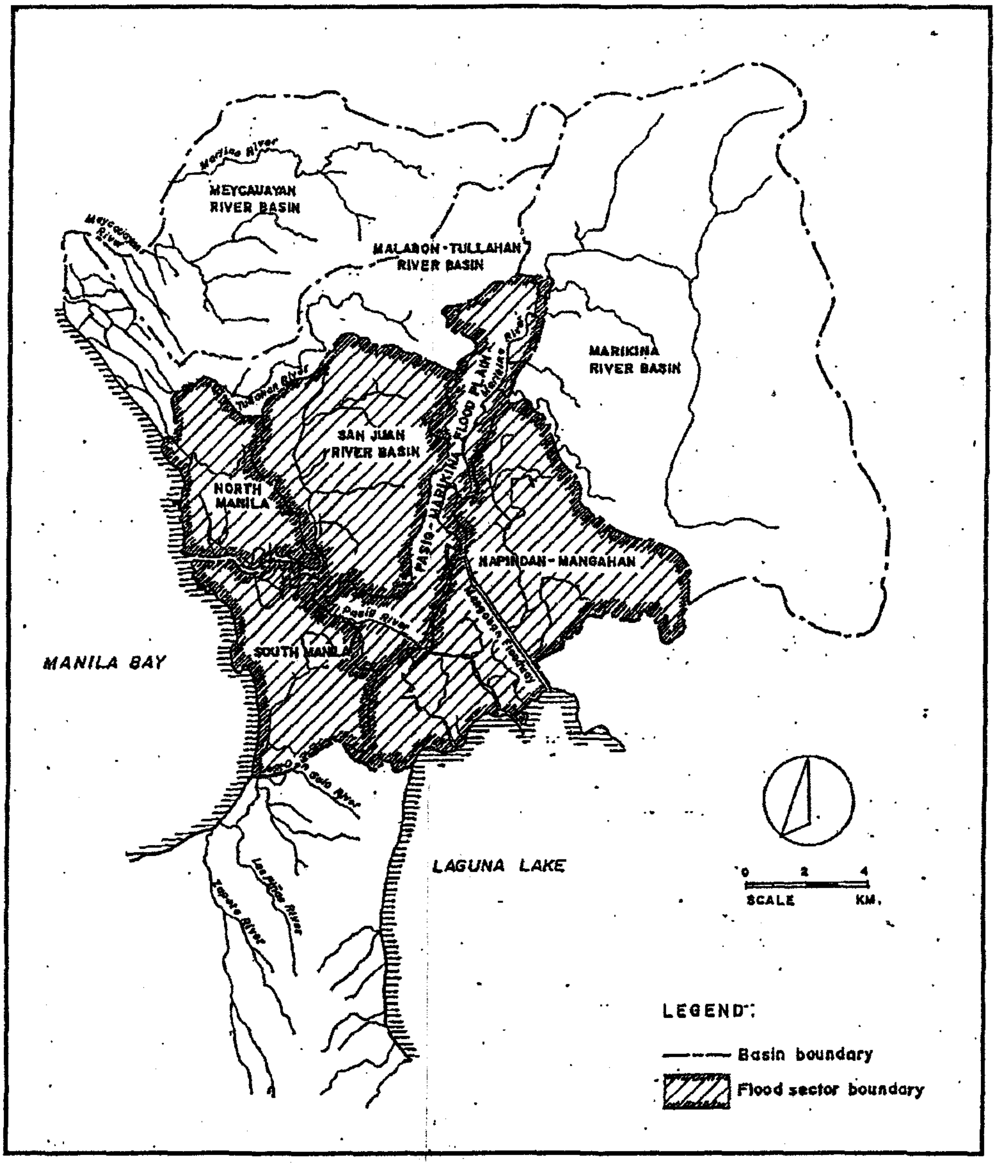


Figure 1. Flood sectors of Metro Manila.

TYPES OF FLOODING

Liongson and Castro (1996) classify the Metro Manila floodings into three types, namely: *local street* floods, *moderate* floods, and *regional* floods.

Local Street Flooding

This type of flood is caused by intense thunderstorms, which occur in sudden bursts, and inundates an area of about one or two streets or city blocks. The flooding, at depths of 20 to 50 centimeters (cm) (about knee-deep for an average person), subsides after a few hours. Local street flooding can result in light property damage, but it can cause huge traffic jams that can paralyze several city blocks for a few hours. This, in turn, means lost productivity and economic opportunities.

Typically, local street flooding is caused by the inability of curb inlets, drainage culverts or natural upland ditches to drain away the rainwater (fig. 2.). Improper design and clogged inlets or culverts due to soil, garbage and other urban debris are the usual culprits. Inadequate design capacities would mean replacement of these drainage facilities while clogging problems can be avoided by regular maintenance and cleaning as well as innovations towards self-cleaning designs.

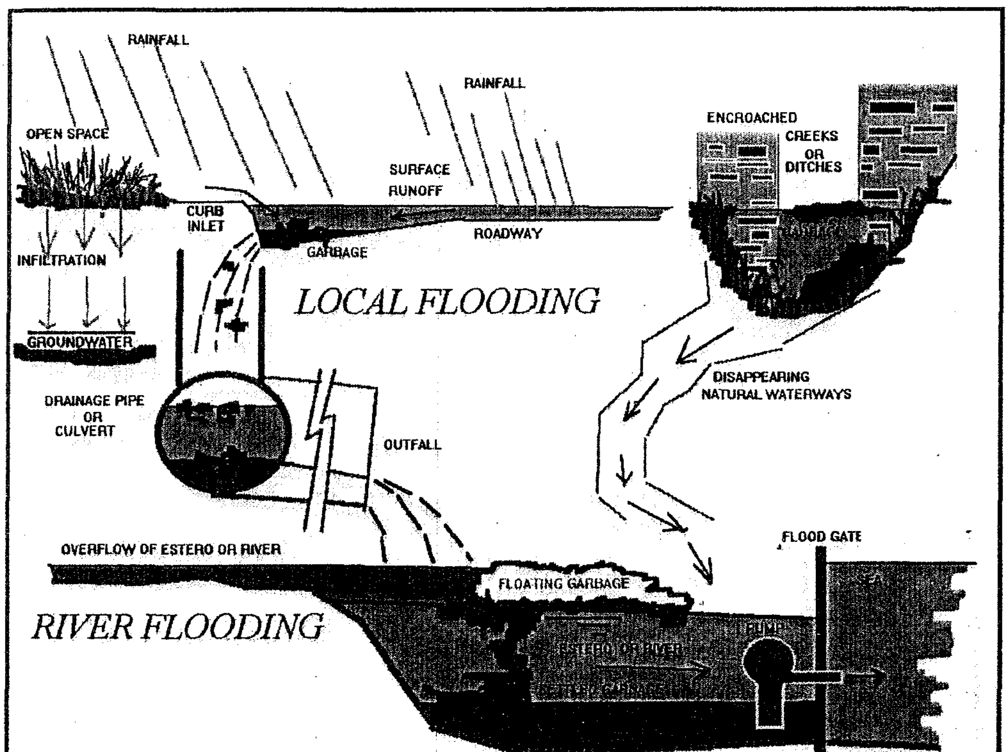


Figure 2. Local street flooding, and overflow of rivers and *esteros*.

In Metro Manila, flooding of this type is prevalent in the low-lying areas of the Metropolis but it can also occur at some high places such as Quezon City.

Moderate Floods

Moderate flooding is caused by intense rainfall of at least an hour's duration, usually associated with tropical cyclones, and inundating a wide area of the city, resulting in flooding depths of more than 30 cm. Flooding of this magnitude can cause considerable damage to public and private property, possibly isolated cases of injury or loss of life, and major traffic problems with whole districtsbecoming impassable to vehicular traffic.

The conveyance of floodwaters from moderate floods requires major drainage networks that connect local street drainage to major sub-mains (drainage pipes), creeks and *esteros* and pumping stations that move the floodwaters from sea outfalls to Manila Bay or the Manggahan floodway to Laguna de Bay. Elaborate design and operations and maintenance procedures go into major drainage networks so that correcting the inadequacy of the major drainage system requires serious, costly and long-term measures.

Moderate flooding mostly occurs in the low-lying areas of Metro Manila such as Malabon, Navotas, Manila, Pasay, Makati, Pasig, Taguig, and Pateros.

Regional Floods

Regional flooding is a large-scale condition resulting from heavy rainfall and runoff associated with typhoons, covering several river basins and paralyzing activities of several cities or towns for a day or so. In coastal towns and cities, this flooding can be aggravated by high tide and storm surges. In Metro Manila, this particular type of flooding can cause a tremendous rise in the Marikina and Pasig River flood stages with floodwaters overloading the major drainage system and requiring a major operation to divert floodwaters into the Manggahan floodway for temporary storage in Laguna de Bay.

FLOODS: WHOSE RESPONSIBILITY?

Responsibility for addressing flooding problems in Metro Manila (fig. 3) depends on whether they are *local drainage* problems or *flood control* problems. Local drainage problems are associated with floods from drainage basins of a few square kilometers, mostly those served by municipal and private local roads. Local drainage problems are typically handled by city or municipal governments with the construction of street gutters, inlets, and storm drains that collect and direct the floodwaters into major creeks and channels. Flood control problems, on the other hand, are associated with major floodwaters flowing into the major creeks, natural channels as well as man-made channels and structures that collect from local drainage storm drains and nearby natural watersheds. This major flood control system is under the jurisdiction of the Department of Public Works and Highways (DPWH). Large-scale projects of the DPWH include the Manggahan floodway to channel Marikina River floodwaters for temporary storage in Laguna de Bay and the Napindan flood control gates for controlled release of stored floodwaters.

In Metro Manila, in particular, the Metropolitan Manila Development Authority (MMDA) is mandated to play a role in the planning and coordination of projects and activities related to flood control, drainage, and sewerage systems. Other agencies that are directly or indirectly involved in flood control are the National Economic Development Authority (NEDA) on funding allocations, the Laguna Lake Development Authority (LLDA) on flood-related impacts on Laguna de Bay, and the Philippine Atmospheric, Geophysical and Astronomical Services (PAGASA) on flood prediction and warning.

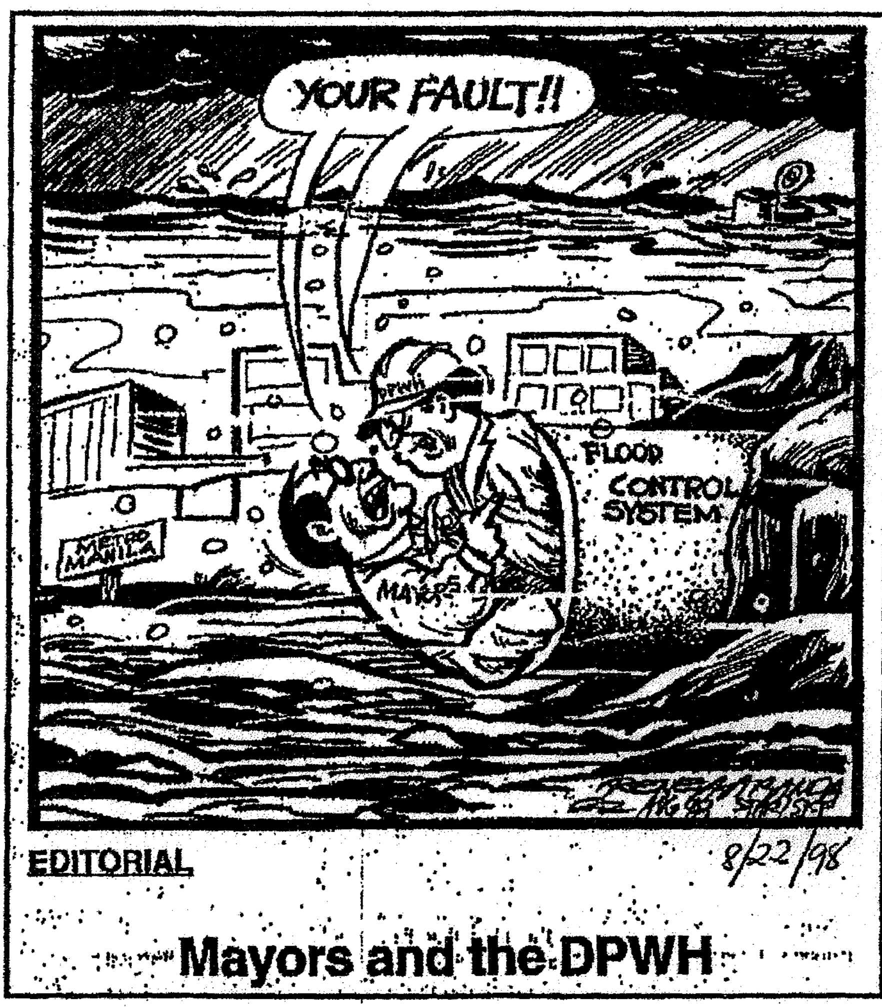


Figure 3. Local and national governments, in media's opinion (source: *Philippine Star*).

Being forced to cope with floods has become an urban ordeal for the people living in Metro Manila (fig. 4). Individuals, and the private sector in general, can play a very important role in promoting awareness and elevating the issue of flooding in the political agenda. The flooding problem is not solely the government's responsibility. The many working and school hours lost, the lost business opportunities, the health hazards and possibly loss of lives due to floods should raise the clamor for more long-term solutions.

ISSUES AND CONCERNS

For a megacity such as Metro Manila, we recognize that the flooding problem encompasses social, cultural, and institutional dimensions that go far beyond the standard practice of viewing floods from purely technical and economic perspectives.

Technical Dimension

A technically oriented person such as a flood hydrologist or hydraulic engineer may view the flooding problem as caused by one or more of the following items:

- improper estimation of design storm and flood magnitudes;
- lack of consideration for risks and uncertainties associated with flood design;
- poor planning or design of flood control system;
- lack of funding to build an adequate system;


20 SATURDAY, MAY 30, 1998 PHILIPPINE DAILY INQUIRER

FLOODWATERS submerge the clogged Edsa-Shaw Boulevard underpass, the cause of yesterday's monstrous traffic jam.

With rains come Metro traffic jams

Figure 4. Urban flooding (source: *Philippine Daily Inquirer*).

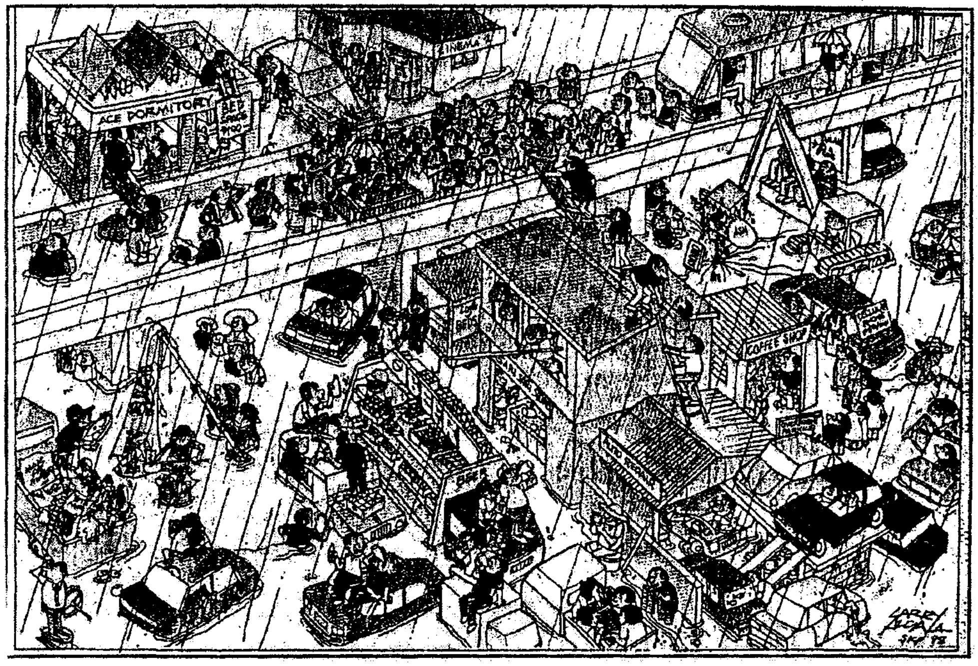


Figure 5. Larry Alcala's Floods 1998 (source: *Sunday Star*).

- deterioration of system due to poor maintenance, age, or neglect;
- system failure due to clogging by garbage and other urban debris; and
- insufficient capacities of downstream receiving flood control system to relieve the upstream floodwaters from local drainage networks.

Nowadays, and especially with the advances in hydrologic and hydraulic computer-aided technologies, the planning, design, and management of flood control systems could be far easier compared to 10 or 20 years ago. But the continued severity of the problem forces us to conclude that solutions need to go beyond purely technical and engineering considerations.

Economic Dimension

Unfortunately, it is quite difficult to properly assess the economics of flooding. In Metro Manila, for instance, the local street flooding scenario causes traffic delays for several hours covering two to three city blocks, resulting in a significant amount of lost working hours or forgone sales opportunities. Based on this flooding scenario, a series of questions can be asked, as follows: How much economic loss results from these floodings every year? How much should we really spend on flood control projects? Who gains from these flood control projects? How willing are people to spend money for flood control if they realize no gain from such projects?

A similar flooding problem scenario could occur in a private housing development causing minor to moderate destruction of infrastructure and personal property in addition to major disruptions in daily activities. If it can be shown that the flooding is caused by an inadequate local drainage system, can the housing developers be held responsible and accountable for such flood-related losses?

Social-Cultural Dimension

The ability of the people to tolerate and cope with floods (fig. 5) seems to project an image that we can still live and be happy despite the inconveniences, the economic losses, and possible loss of lives. Is this a good attitude or not?

One major cause of the deterioration and failure of flood control works is the accumulation of debris or garbage (fig. 6) leading to blockage of flood conveyance systems and floodwater-relief pumping stations. Garbage generation can be overwhelming especially for a rapidly growing urban area such as Metro Manila. Indiscriminate dumping of garbage appears to be a common practice. What social and cultural dimensions are evident in our flooding problem?

Institutional Dimension

In Metro Manila, the administrative units responsible for flood control works starts with the DPWH in planning, implementation, and operation of the major flood control systems to relieve floodwaters from local drainage networks. The city or municipal governments are responsible for the planning and design of the local drainage networks. The MMDA, on the other hand, also plays a role in coordinating flood control plans. It appears that there is an adequate institutional framework for the overall planning and management of flood control works. Is there an overlap of responsibilities and a problem of coordination among the various institutional units involved in the planning and management of floods and flood control systems?

Another agency is the Housing and Land Use Regulatory Board (HLURB) which is the approving authority for municipal zoning plans and for subdivision developments. This agency can play a major role in flood plain zoning which is an important component of the control of floods. For instance, along some of the urban creeks and *esteros* in old Manila, Malabon, Pasay, and Caloocan, makeshift dwellings have been built thereby significantly reducing the conveyance capacities of these flood channels. Are there adequate flood zoning policies established for these areas?

NEEDED: A HOLISTIC APPROACH

This article has attempted to promote awareness and raise the level of discussion of the flooding issues and concerns of Metro Manila. It is recognized that the flooding problem encompasses technical, economic, social, cultural, and institutional dimensions. We

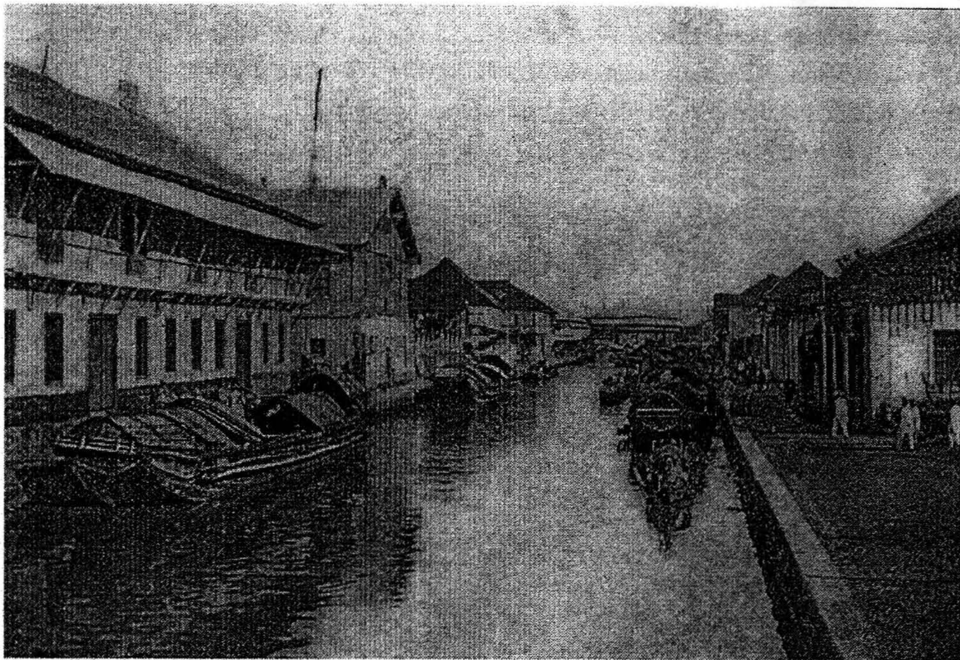


Figure 6. Estero de Binondo: then and now

believe that through a multidisciplinary framework, we can increase our success in developing and implementing long-term, viable solutions to solve the flooding problems of Metro Manila in particular and other urban centers in general.

Figure 7. Floods and Presidents (source: *Philippine Star*).

REFERENCES

Liongson, L. Q. and P. P.M. Castro. 1996. NAST/UP-CIDS Conference Series on Flood Control: A Discussion Paper, presented at the First Consultative Group Meeting on Flood Control, Executive House, UP Diliman, Quezon City, January 26.

Liongson, L. Q., P. P.M. Castro, and G. Q. Tabios III. 1998. NAST/UP-CIDS Conference Series on Flood Control: Capsule Accomplishment Report, a paper presented in the 1998 UP-CIDS Directors/Convenors Planning Workshop, Institute of Forestry Conservation Training Center, UPLB, March 6-7.

CLIMATE, HYDROLOGY, AND FLOOD CHARACTERISTICS

Alan L. Pineda

CLIMATE

General Climatology

The Metro Manila Area (MMA) belongs to Type I of the four Philippine climatological regions, which is characterized by a dominant rainy season from May to October and a dominant dry season for the rest of the year. The annual rainfall distribution shows the total amount of rainfall over the Marikina River's mountainous basin-head area where the high Sierra Madre Mountain range is found to be 3,000 millimeters (mm). On the other hand, the annual rainfall over the rainfall zone from the Manila Bay area to the Laguna Lake Basin is approximately 2,000 mm.

The total rainfall from May to October accounts for about 80 percent of the annual rainfall, and is brought mainly by the wet southwestern monsoon, plus the occasional typhoons. The monthly rainfall distribution over the western area of Laguna Lake shows a longer rainy season that lasts up to December. This is because of the Sierra Madre ranges bordering the first and the second climatological zones.

Topography

When viewed from the air, the MMA is situated in the innermost reaches of the natural harbor of Manila Bay. It is fringed immediately to the east by Tanauan, Kanumay, and Purro mountains; to the southeast by Mts. Subrano (743 meters [m]) and Banahaw (2,180 m above sea level); and to the west and northwest by the high rolling Mariveles and Natib mountain ranges of Bataan and Malasimbo mountain of Zambales. These topographical features around MMA influence the formation of its distinctive climatic fields. Since the tracks of tropical cyclones in the northern hemisphere are usually from east to west or northwest, these mountain ranges shield or protect MMA from devastating typhoons either by decreasing wind velocity, or by diverting typhoon movement downward or upward from MMA.

Temperature

April is the warmest month with a monthly average of 34.2°C. January is the oldest month with an average monthly minimum temperature of 21.3°C, about 38 percent cooler than that of April.

Over the last three decades, the maximum mean temperature differences showed an increase of 0.20°C. Meanwhile, the minimum mean temperature differences increased by 0.40°C from 1961 to 1980, and by 0.20°C between 1971 to 1990.

Relative Humidity

April is the driest month with 65 percent relative humidity while August and September are at 83 percent. April being the warmest month brings about dry air in the free atmosphere, whereas the high relative humidity of August and September coincides with the abundant rainfall during these months. This period is also characterized by the frequent occurrence of cloudy skies.

Surface Wind Direction and Speed

A weak northeasterly wind blows from November to January, the months when the northeast monsoon prevails. It becomes a weak easterly to southeasterly wind from February to May as an influence of the prevailing easterly wind flow. A southwest wind flow prevails from June to September becoming westerly towards October. These are the months when the southwest monsoon is intense.

Cloudiness

Cloudiness tends to vary from November to January, when easterly winds and the northeasterly monsoon predominate. The wind system from the Asiatic mainland moving towards the islands is usually cold and dry. As it crosses the Cordilleras, it loses more of its moisture content leading to less condensation. The months of February to April are about 45 percent less cloudy that the months of August and September.

Sky cover becomes cloudy to overcast from May to September, the months of the southwest monsoon. The warm moist maritime air masses give rise to humid atmospheric conditions and induce heavy rains.

Rainfall

Rainfall is at a maximum during August, the height of the summer monsoon season, with 464.90 mm of accumulation. This is followed by July and September with 415.90 and 354.87 mm, respectively. The August rainfall is 37 to 38 times greater than the equivalent rainfall during the dry months with 5.27 mm in February, the lowest average in a year. June to October are the months when the southwest monsoon is prevalent, typhoons are frequent, and the intertropical convergence zone is active in the northern hemisphere. On the other hand, February is the driest month, followed by January and March.

Rainfall is thus not evenly distributed throughout the year. Two distinct regimes are noticeable: six to seven months (usually November to May) are dry; the rest are wet.

Tropical Cyclones

An analysis of the frequency of tropical cyclones over MMA from 1961 to 1990 shows that *nine typhoons and one tropical depression passed over or very close to MMA*; four typhoons, six tropical storms, and nine tropical depressions passed within 50 kilometers (km); and seven typhoons, five tropical storms, and seven tropical depressions passed within 50 to 100 km of MMA. Tropical cyclones are most frequent from July to September.

Among the 20 typhoons that affected MMA, typhoon *Saling*, which battered the country between October 9 and 11, 1989, was the strongest with 275 km per hour sustained winds near the center. Typhoon *Saling* left behind 575 dead, 1,593 injured, and 193 persons missing. Typhoon *Bening* in 1988 was the most financially damaging with PhP74.4 million in property losses.

The following thus describes the climate of the MMA:

1. The mountain ranges to the east and west of MMA shield or protect the area from tropical cyclones' strong winds either by decreasing the wind velocity or diverting its movement toward the north or south. They likewise exert considerable influence on the area's distinctive climate.

2. The temperature ranges from 20°C to 34°C throughout the year, being highest in April and lowest in January. During the last 30 years, the temperature has increased by 0.20°C.

3. Relative humidity generally follows the rainfall trend and temperature changes. It is usually high during rainy months and low during summer months.

4. Local surface wind direction is greatly influenced by and tends to follow the general wind circulation systems affecting the Philippines.

5. Cloudiness does not only fascinate us with its changing shapes and color, but also enables us to make short-term local weather predictions. Skies are cloudy from May to October, becoming partly cloudy the rest of the year.

6. MMA belongs to the Type 1 Climate Classification. It has two distinct rainfall regimes, being dry from November to April and wet the rest of the year.

7. By virtue of its geographical setting and physical environment, MMA will always experience tropical cyclones of varying intensities. Tropical cyclones or typhoons passing over or near MMA will cause damage to the area either through flooding or strong winds.

HYDROLOGY

The Pasig-Marikina River flows through the City of Manila to the Manila Bay. Its total catchment area is estimated at about 635 square kilometers (sq km), about 20 percent of which is situated in Metro Manila. At the confluence with the Napindan, the river is known as the Marikina River in the upper reaches and the Pasig River in the lower reaches. The San Juan River, one of the tributaries with a catchment area of 91 sq km, joins the Pasig River at its meandering section in the central city area.

The Manggahan Floodway was constructed to divert floodwaters from the Marikina River into Laguna Lake. Its design discharged is 2,400 m^3s^{-1} with the regulated flood flow at the proposed Marikina Control Gate Structure (MCGS).

Laguna Lake is situated in Region IV (Southern Tagalog) at 14°11.6' to 14°32.2' north latitude and 120°2.7' to 121°28.7' longitude. The northwestern portion of the Laguna Lake Basin is flanked by the National Capital Region and the northeast-southeastern borders are bounded by the provinces of Bulacan, Rizal, and Quezon. Its south and southwestern portions are bordered by the provinces of Laguna, Batangas, and Cavite. The basin encompasses a total area of nearly 4,000 sq km. The lake has a total surface area of about 90,000 ha and an average depth of 2.8 m. It has a total volume of 3.2 billion cubic meters (cu m) with a shoreline of 220 km.

There are three tributaries draining into the lake: 21 percent of the freshwater comes from Pagsanjan River and seven percent from Sta. Cruz River, including the flood diversion of Marikina River through the Manggahan Floodway.

FLOOD CONTROL CHARACTERISTICS

The MMA flood situation may then be summarized as follows:

1. Of the total 63,600 hectares (ha) of MMA, 10,600 ha (one-sixth of total) is flood-prone.

2. Of the flood-prone areas, some 6,000 ha are served by pumping stations. The rest of the flood-prone areas are served by the Mobile Flood Mitigation teams. There is a need to add more equipment to the Mobile equipment fleet.

3. There is a need for a massive information campaign to free the drainage networks, e.g., pipes, culverts, creeks, *esteros*, and streams free of debris and garbage.

4. Some areas where work should be intensified are:

   a. Continuation of planning and implementation of flood infrastructure (LGUs)

   b. Regulation of construction to keep waterways clear (LGUs)

   c. Garbage disposal, development of dumps, etc. (LGU, MMDA,HUDCC)

   d. Organization of flood reaction teams (LGUs).

TABLE 1

Three Decades - Maximum Temperature
Mean Differences (1961-1990)

YEAR	T Max (°C)	YEAR	T Max (°C)	YEAR	T Max (°C)
1961	30.9	1971	31.2	1981	31.0
1962	31.2	1972	31.7	1982	31.3
1963	30.8	1973	31.9	1983	32.0
1964	31.3	1974	31.0	1984	31.3
1965	31.2	1975	31.6	1985	31.7
1966	31.7	1976	31.3	1986	31.3
1967	30.9	1977	31.8	1987	32.4
1968	31.5	1978	31.3	1988	32.2
1969	31.9	1979	31.4	1989	31.7
1970	31.8	1980	31.7	1990	31.8
Mean	31.3	**Mean**	31.5	**Mean**	31.7
		Mean Diff.	0.20	Mean Diff.	0.20

TABLE 2

Three Decades - Minimum Temperature
Mean Differences (1961-1990)

YEAR	T Min (°C)	YEAR	T Min (°C)	YEAR	T Min (°C)
1961	22.7	1971	23.3	1981	22.8
1962	22.7	1972	23.2	1982	23.2
1963	22.4	1973	23.9	1983	23.1
1964	22.9	1974	23.5	1984	23.4
1965	22.8	1975	23.5	1985	23.1
1966	23.3	1976	22.6	1986	23.1
1967	22.8	1977	23.6	1987	24.0
1968	22.7	1978	23.7	1988	24.0
1969	23.3	1979	23.0	1989	23.5
1970	23.5	1980	23.0	1990	24.2
Mean	22.9	**Mean**	23.3	**Mean**	23.5
		Mean Diff.	0.40	Mean Diff.	0.20

TABLE 3

5 Year Cumulative Running Average of Rainfall For NAIA and Science Garden Stations

Period	NAIA Rainfall (mm)	Science Garden Rainfall (mm)
1961-65	1832.22	2415.86
1962-66	1820.52	2405.34
1963-67	1817.74	2465.56
1964-68	1778.70	2412.76
1965-69	1684.14	2207.54
1966-70	1803.54	2282.60
1967-71	1735.52	2180.16
1968-72	2018.44	2386.48
1969-73	2020.46	2383.86
1970-74	2148.04	2628.80
1971-75	2066.98	2541.74
1972-76	2144.34	2149.00
1973-77	1816.48	1844.42
1974-78	2116.14	1972.54
1975-79	1981.00	1791.08
1976-80	1933.38	1794.04
1977-81	1815.28	2228.20
1978-82	1678.72	2185.70
1979-83	1317.90	1991.62
1980-84	1374.28	2072.90
1981-85	1461.44	2177.28
1982-86	1676.84	2447.16
1983-87	1770.06	2378.84
1984-88	1957.82	2100.52
1985-89	1915.30	2579.18
1986-90	1989.54	2675.90
	Average 1833.65	Average 2257.66

TABLE 4

Summary of Damaging Typhoons Passing over/near, within 50 km, and within 50-100 km of MMA and their Corresponding Estimated Cost of Damages (1961-1990)

Date of Occurrence	Name of Tropical Cyclone	Direction of Passage) (from MMA	Maximum Wind Speed/Station kph	Estimated Cost of Damages (PhP million)	Number of Casualties		
					Dead	Injured	Missing
1. June 24-28, 1960	Olive	NE	185 Legaspi	1	10	0	0
2. June 26- 30, 1964	Dading	S	127 Infanta	3	0	0	0
3. Nov 1-5, 1967	Welming	SE	185 Masbate	8	13	67	0
4. Oct 10-15, 1970	Sening	S	275 Virac	460	575	1,593	193
5. Nov 17-20, 1970	Yoling	S	200 MIA	115.8	230	1,756	381
6. May 25-27, 1971	Herming	S	150 Legaspi	3.8	13	3	14
7. Jun 23-25, 1972	Konsing	SE	205 Legaspi	100	131	0	0
8. Nov 24-29, 1974	Bidang	N	141 Baguio	42.8	1	0	0
9. Nov 10-17, 1977	Unding	NE	175 Baguio	457	40	165	0
10. Sept 24-28, 1978	Weling	SE	200 Virac	64	32	20	25
11. Oct 25-27, 1978	Kading	NE	125 Virac	1,021.3	444	474	280
12. Oct 11-14, 1978	Yaning	N	145 Virac	88	24	2	29
13. Nov 21-27, 1981	Anding	NE	260 Daet	649.9	280	116	129
14. July 12-16, 1983	Bebeng	S	165 MIA	44.8	18	8	21
15. Jan 14-18, 1988	Asiang	S	140 Legaspi	No reported damage			
16. Oct 21-26, 1988	Unsang	N	215 Virac	5,635.9	157	316	60
17. May 15-19, 1989	Bening	S	100 Romblon	7,435.30	16	3	40
18. Oct 9-11, 1989	Saling	SE	135 MIA	1,406.30	58	105	14

Source: Weather Branch PAGASA

FLOOD LANDSCAPES OF METRO MANILA

Doracie B. Zoleta-Nantes

This article is about the changing flood landscapes of Metro Manila, and provides information about some events that characterize the flood history of the city. At the same time, it seeks to answer the following questions: Which areas are more vulnerable to flood hazards? Where have floods occurred most often in Metro Manila in the past 40 years and why? What makes these places flood-prone?

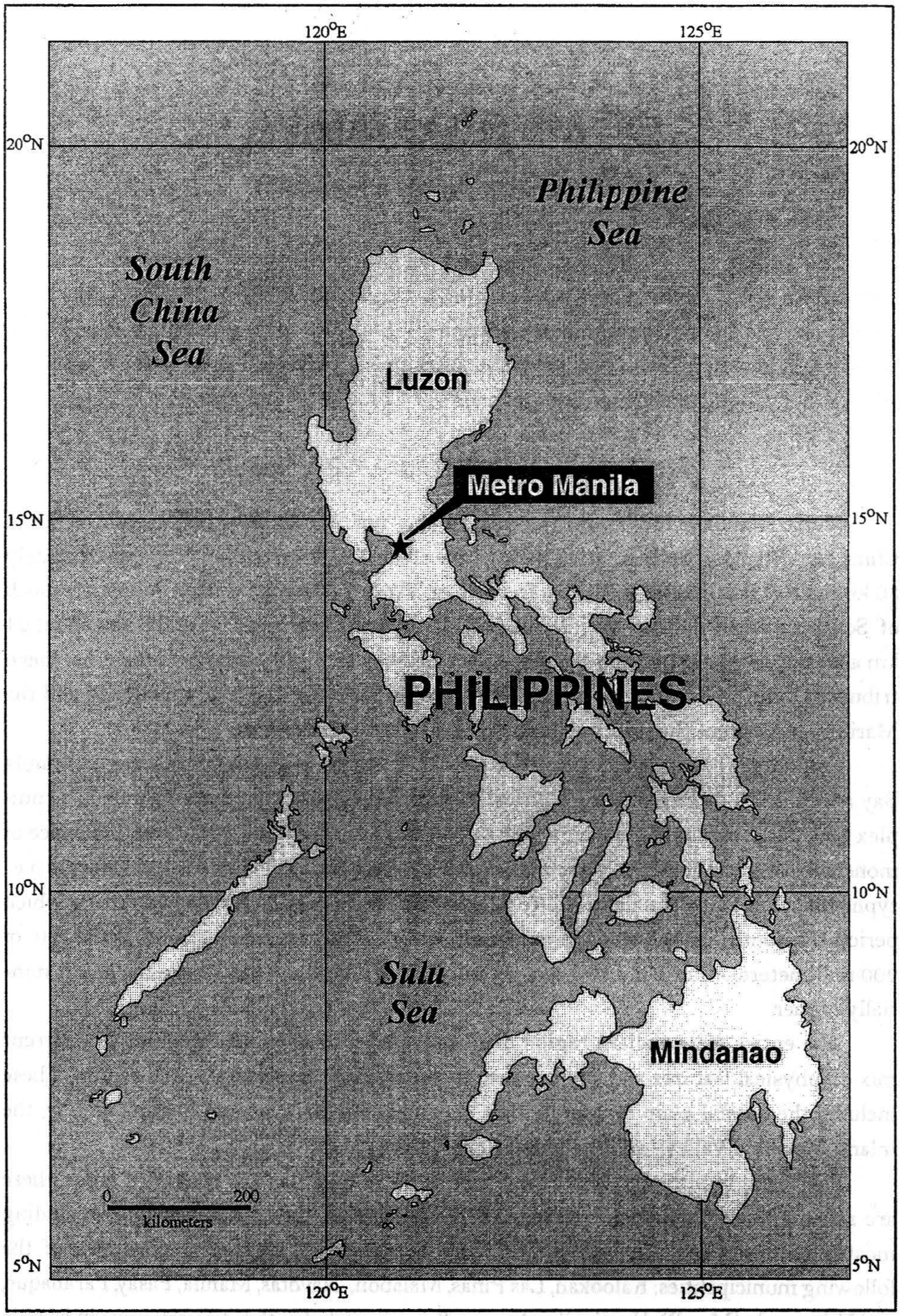
The flood landscape of Metro Manila

Metro Manila is located on the eastern shore of Manila Bay, an arm of the South China Sea (Map A). Built-up areas parallel the shore and stretch inland for approximately 30 kilometers (km). A large, shallow freshwater lake—the Laguna de Bay—supports much of Southern Manila. The Pasig (Napindan) River issues from the lake and flows about 24 km across the coastal plain to the sea. About halfway along its course, its main northern tributary—the 35-km long Marikina River—joins the Pasig. Together the Pasig and the Marikina constitute the principle rivers of the Metro Manila area.

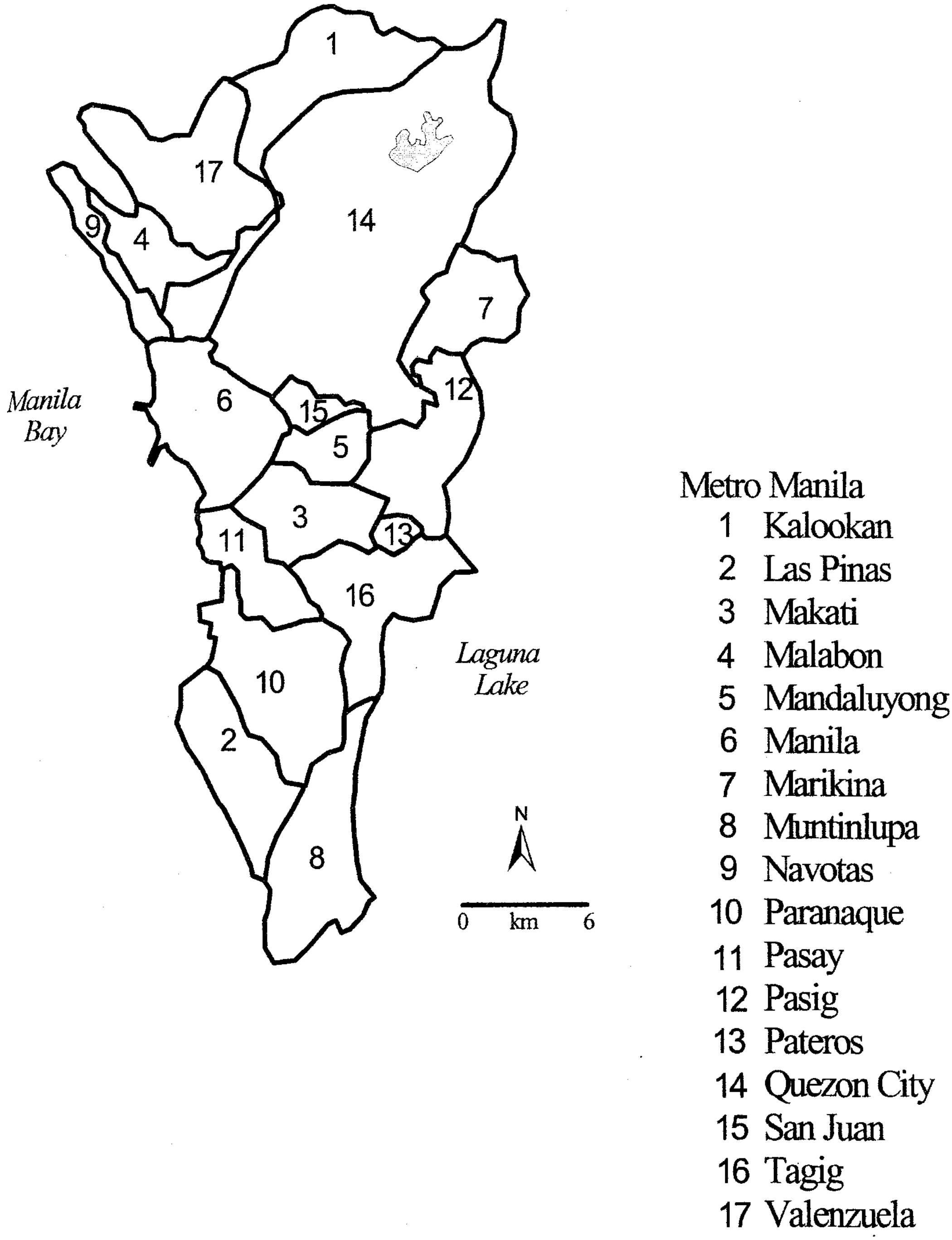
Flooding is common along both major rivers, as well as around the shores of Manila Bay and Laguna de Bay. From a physical standpoint, flooding in Metro Manila is a complex process. Its main components include rainwater runoff, tidal variations, incidence of monsoon rains and changes in groundwater hydrology and periodical tropical storms (i.e., typhoons). The rainy season in Metro Manila lasts from May to November, during which period the southwest monsoon is dominant, and rainfall occurs sometimes at the rate of 200 millimeters or more in a two-day period. During a typhoon this figure can be substantially higher.

The entire metropolitan region can be divided into several subregions. A different mix of physical features and environmental constraints characterizes each region. These include the coastal plain of Manila Bay; a companion plain around Laguna de Bay; the inland Marikina Valley; and the Guadalupe Plateau (Map C).

Surprisingly, although many land parcels on Manila Bay are reclaimed areas, these are not the most flood-prone. Other low-lying parts of the coastal margin—including most lands along the Pasig—are subject to frequent floods. This area includes parts of the following municipalities: Kalookan, Las Piñas, Malabon, Navotas, Manila, Pasay, Paranaque, and Valenzuela (Map B). Herein, flooding is often associated with tidal variations in Manila Bay. Daily tidal movements can inundate lands up to 0.3 meter (m) above mean sea level. In



Map A: Metro Manila, Philippines


1
17
14
9
4
7
6
15
12
5
3
13
11
16
10
2
8
Manila Bay
Laguna Lake
N
0 km 6
Metro Manila
1 Kalookan
2 Las Pinas
3 Makati
4 Malabon
5 Mandaluyong
6 Manila
7 Marikina
8 Muntinlupa
9 Navotas
10 Paranaque
11 Pasay
12 Pasig
13 Pateros
14 Quezon City
15 San Juan
16 Tagig
17 Valenzuela

Map B:

recent years the problem of rising water has been compounded by land subsidence of up to 0.33 m throughout much of Central Manila. The low flat shores of Laguna de Bay are fringed with deep soils that have high water tables (or water levels).

Further inland lies another flood-prone area—the Marikina Valley. The Marikina Valley alluvial plain is on the east of the Guadalupe Plateau and west of the Sierra Madre Range. It covers the towns of Marikina, Pasig, Pateros and Tagig. Its slope is less than one percent. It has poor soil drainage, a shallow water table, low soil stability and is prone to earthquake and flood hazards. The Marikina Valley widens to the South as it stretches out to the shores of Laguna de Bay, whose average depth is about three meters.

The Guadalupe Plateau is an area of resistant volcanic rocks that rise up to 40 m—and sometimes 70 meters—above sea level. It contains Metro Manila's best building sites. Flood risks, though not insignificant, are lower in this area; also, it has a low probability of experiencing damage caused by earthquakes. The Plateau includes all or parts of the following municipalities: Quezon City, San Juan, Makati, Mandaluyong, Pasig, Paranaque, Las Pinas and Muntinlupa.

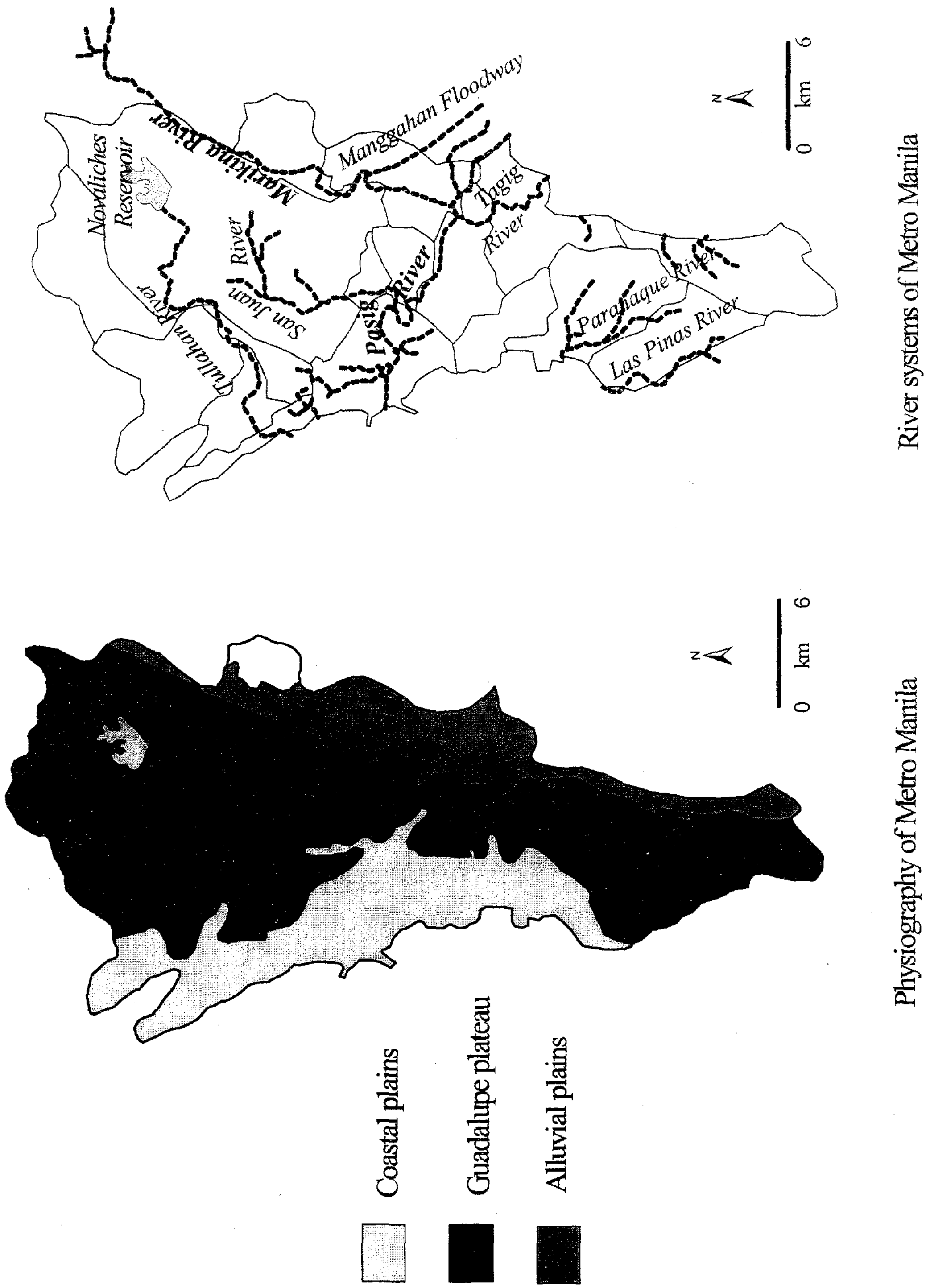
Urbanization and floods

Flash floods occurred in Manila even during the Spanish colonial period. After heavy downpours, the paved streets of ancient Manila contributed to the amount of rainwater that stays on the road surface. At the beginning of the 20th century, Manila had approximately 2,000 hectares (ha) of urbanized areas (Cammayo 1990). Metro Manila's urbanized portion in the 1990s has expanded into a 30-km radius from the City of Manila (op cit., 4). The rapid expansion of concrete surfaces in Metro Manila has created more impervious areas.

Rapid urbanization has encouraged massive movement of rural dwellers to urban centers and has led to overcrowding of poor urban settlements in the metropolis. This unplanned and uncoordinated urban growth has adversely deteriorated the condition of the city's drainage system.

The number of reclamation projects lined along the coast of Manila Bay reflects the need for additional urban space. The reclaimed areas generally have a higher elevation (two to three meters) than the mainland coastal plains. The difference in elevation has lessened the flow gradient of water in adjoining sewer and drainage systems in mainland coastal plains. The reclamation sites are blamed for the obstruction and retardance of the natural seaward flow of water from mainland streams and have increased flooding incidences in Baclaran and Maricaban districts in the cities of Paranaque and Pasay.

Land-use changes in the hills and mountains surrounding the National Capital Region influence flooding patterns in the metropolis. The Marikina Watershed was classified as 28,000 hectares (ha) of forestlands in 1904 (JOFCA 1993). The forestlands in the watershed area had been transformed into paddies, grasslands, fruit orchards or dry fields,



Map C: Physical Characteristics of Metro Manila villages, residential subdivisions and extensive pig farms. According to the National Water Resources Council, 25 to 50 percent of the topsoil in the watershed had already been eroded (JOFCA 1993). The eroded topsoil has silted most of the river systems, most particularly the Marikina and Pasig River systems, has decreased the flow capacity and has led to faster overflowing when water levels are high.

Population growth, sewage and floods

Metro Manila's population stood at 200,000 at the turn of the 20th century (NCSO 1990). The National Capital Region (NCR), of which Metro Manila is part, had a population of 9.454 million as of September 1995, an annual growth rate of 3.3 percent and a doubling time of 21 years (NCSO 1996) (see table 1). At current projected rates of growth Metro Manila will have a population of 19 million in the year 2016. Population density in the megacity varies from 10,717 persons per square kilometer (sq m) in some areas of Quezon City, to 50,042 persons per sq km in the more congested areas. The congestion is due to high natural increase of population and massive rural to urban migration (Pernia 1991). Approximately 300 families have migrated to Manila each month since the 1980s (Cammayo 1990). This process has propagated the expansion of poor squatter colonies (Armstrong and McGee 1985 and Porio et al., 1994). It has taken its toll on the quantity and quality of urban services and mass transport in the metropolis. In particular, the high population density strains the existing sewage and drainage infrastructure.

There are two major sewerage systems in Metro Manila. The Central Manila Sewer on the north and south banks of the Pasig River was constructed during the first decade of American colonization of the Philippines, from 1904 to 1911. It covers 1,850 ha and has a total length of 240 km. It was designed to serve half a million people. At present, however, the Central Manila Sewer system services more than a million people. The isolated sewer systems of Quezon City and Makati measure approximately 140 km in length. They are designed to serve 350,000 individuals. At a conservative estimate they now serve half a million people.

Table 1:
POPULATION DATA ON METRO MANILA FROM 1903 TO 1995.

Name of political division	1903	1939	1960	1980	1995
National Capital Region*	328, 939	993, 889	2, 462, 488	5, 925, 884	9, 454, 040
Kalookan	7, 847	38, 820	145, 523	467, 816	1, 023, 159
Las Pinas	2, 767	6, 822	16, 093	136, 514	413, 086
Makati	2, 700	33, 530	114, 540	372, 631	484, 176
Malabon	20, 136	33, 285	76, 438	191, 001	347, 484
Mandaluyong	4, 349	18, 200	71, 619	205, 366	286, 870
Manila	219, 928	623, 492	1, 138, 788	1, 630, 485	1, 654, 761
Marikina	8, 187	15, 166	40, 455	211, 613	357, 231
Muntinlupa	3, 128	9, 288	21, 893	136, 679	399, 846
Navotas	11, 688	20, 861	49, 262	126, 146	229, 039
Paranaque	6, 507	21, 125	61, 898	208, 552	391, 296
Pasay	8, 201	55, 161	132, 673	287, 770	408, 610
Pasig	11, 278	27, 541	62, 130	268, 570	471, 075
Pateros	4, 105	7, 160	13, 173	40, 288	55, 286
Quezon City	-	39, 013	397, 990	1, 165, 865	1, 989, 419
San Juan	1, 455	18, 870	56, 861	130, 088	124, 187
Tagig	6, 829	12, 087	21, 856	134, 137	381, 350
Valenzuela	8, 183	13, 468	41, 473	212, 363	437, 165

Other information

Population Density (per square kilometer)	517.20	1, 562.72	3, 871.84	9, 317.43	14, 864
Growth Rate (%)	-	3.72	3.83	3.58	3.3

* It was created on November 7, 1975 under Presidential Decree Number 824.

Source: National Census and Statistics Office, 1995

Residential communities in Metro Manila are primarily responsible for about half of the metropolis' total solid wastes. The waste generation rate in Metro Manila is 0.5 to 0.6 kilogram (kg) per capita per day (Passe 1993). As of 1999, the nine million residents of the NCR generate approximately 6,000 tons of garbage each day. Yet, only 71 percent of this is collected by trucks (Perez et al. 1995), and disposed of by the government's waste collection agencies in the San Mateo Sanitary Landfill in Antipolo. The remaining 1,800 tons of garbage is not collected regularly. They are dumped on street corners, vacant lots, or thrown in storm drains and other waterways (Alibutud 1990; Passe 1993). Table 2 shows the usual ways by which garbage is disposed of in Metro Manila. Residents who have no access to or are not served by sewer systems expel their wastes into private septic tanks or throw their garbage into the megacity's storm drains, creeks and rivers. Along with sewage leaked from septic tanks and other hazardous materials, these kinds of solid waste seriously clog the network of drainage canals, aside from posing serious risk to the populace's health conditions. The situation is aggravated during the flooding season.

The Department of Public Works and Highways (DPWH) is responsible for dredging tidal streams or drainage canals. Only 10 percent of the drainage facilities, that is, a total of 50 km, is dredged, declogged and maintained each year in Manila (JICA 1990), and only 14 m every day.

Table 2.
MANNER OF GARBAGE DISPOSAL IN METRO MANILA*

Means\Age-group	< 30	30 - 39	40 - 49	50 - 59	60 +
Pick-up by truck	67.6	67.9	72.5	75.4	80.4
Dumped in pit	8.2	7.1	5.8	5.4	4.6
Burned	19.0	20.7	18.1	15.9	12.6
Composted	0.5	0.6	0.5	0.2	0.7
Buried	1.0	1.0	0.7	0.9	0.3
Fed to animals	1.0	1.0	0.9	0.9	0.5
Thrown in *esteros*	2.6	1.8	1.6	1.4	0.9
Total in percent	99.9	100.1	100.1	100.1	100.0
Total in number	3196	5268	3681	2345	1758

*Information derived from the data of Perez, et al., 1995.

Indiscriminate dumping of trash has seriously clogged the *esteros*, which are modified systems of natural channels and brackish water from coastal lakes that were intended to relieve flooding and improve water-borne transportation. The *estero* system worked well in the 19th and 20th centuries (Kolb 1978). But as the channels were filled in to provide building sites and refuse dumps for a rapidly growing urban population, the *esteros* gradually became unable to serve their original purpose. Encroachment by adjacent private property owners on the formerly protected banks of *esteros* has been reported since the beginning of this century. It would now be difficult to reopen these waterways because of the accumulated changes that have taken place (e.g., landfills, squatter settlements, emplacement of major roads and prominent buildings, deterioration of water quality, etc.) Thus, rapid urbanization, encroachment of squatters on riverbanks, silting of waterways, and lack of sewerage and drainage facilities worsen the situation of Metro Manila.

Trends in flooding, 1953-1998

Since 1953 floods have affected Metro Manila on many occasions; they drew extensive coverage in the local mass media at least a dozen times: August 28, 1953; September 7, 1956; May 28, 1960; July 7, 1961; July 27, 1962; July 14, 1964; June 23, 1967; June 27, 1967; August 31 to September 1, 1970; July 1972; October 1988; August 9, 1997. Figure 1 shows the most frequently affected areas through the decades, from the 1950s to the 1960s.

1. The 1950s

In the 1950s, floods often devastated Tondo, Sta. Cruz, Sampaloc and Sta. Mesa, Manila. The *barangay* of San Francisco del Monte in Quezon City and the low-lying portions of San Juan and Mandaluyong were also frequently flooded (*Sunday Times Magazine*, August 30, 1953). These areas had elevations lower than the flood line of 12.5 m above mean sea level. Other low-lying areas in Pasay, Makati, Paranaque, Taytay, Cainta, Angono and Marikina likewise underwent the same experience. Floods were mostly attributed to nature, for example, the city's flat terrain, high rainfall intensity, tropical depressions or typhoons and high tide events in Manila Bay.

Floods destroyed agricultural crops and infrastructure. They resulted in loss of profit among commercial establishments and industries and fewer work hours among workers, losses in private property and public infrastructure, increased transportation costs, food and medical expenses.

Activities resulting from modernization have affected the city's flooding patterns in the late 1950s (Leuterio 1956). Numerous structures now blocked water flow in the Pasig River. The tidal channels became shallower with increased silt deposition. The widths of tidal channels narrowed down from 12 to 20 m to about 3.6 m. The hills on the east of Manila became more urbanized. Government offices, mass housing complexes, exclusive villages and commercial establishments mushroomed all over the place. Members of the private sector from time to time showed interest in flood control programs by donating private parcels of land that housed flood control infrastructure, but the government, particularly the Congress, paid little attention to the flood problems of Manila.

2. The 1960s

In the 1960s, the areas inundated by floods increased. Almost 70 percent of the city of Manila was often covered with floodwater, which did not spare the floors of Malacanang Palace. Flood depths ranged from 3.6 m to 4.5 m. The back lot of University of the East-Ramon Magsaysay Memorial Hospital in Sta. Mesa, Manila—where urban poor neighborhoods conglomerated—was flooded yearly (Lacaba 1967). Floods often washed away shanties in the congested neighborhoods on the banks of Diliman Creek and Sampaloc Bridge, San Francisco Del Monte and the squatter colonies on the riverbanks in Roxas District. Floodwaters rose to almost 6.1 m in Tatalon, a squatter community near Espana Boulevard Extension and Quezon Boulevard Extension. Such magnitude was common in Pasay (Malibay), San Juan (Riverside Street), and Kalookan (in *Barangay* Obrero and Maligaya).

While the southwest monsoon rains, storm surges and the high tides of Manila Bay were the primary causes for overbanking in the Pasig River, urbanizing activities worsened the situation. The number of paved roads and building complexes had contributed to increased flash flood events. For example, low-lying areas from Epifanio De Los Santos Avenue (EDSA) to Harrison Boulevard, which used to be swamps, were frequently flooded (Lu 1970). The Pasig River used to have a mean depth of about 4.8 m to 5.5 m. Due to silt accumulation, the mean depth had been reduced to 3.6 m to 4.3 m (Pope 1967). Reclamation projects by private firms on the Pasig River had decreased its capacity to accommodate floodwaters. The makeshift houses of squatters on riverbanks were also blamed for widespread floods.

In the meantime, the Manila City Council attributed the floods in the 1960s to massive deforestation initiated by members of Congress in the Marikina and Montalban watersheds. On the other hand, Congress blamed the city government's poor maintenance of the drainage system (Rodriguez 1967). Twenty-one kilometers of *esteros* had disappeared. The tidal stream banks had become extensions of residential backyards. Many 20-m wide *esteros* had been transformed into 0.6-m sludge canals.

The 1960s saw the construction of flood control infrastructure such as river walls, floodgates, main interceptors and outfall. However, insufficient funds, misspending or mismanagement of funds, and piecemeal allocation of resources hampered flood control programs. There was also need for massive reforestation, declogging of *esteros*, resettlement of squatter colonies, and outright prohibition of encroachment on the banks of waterways. Save for relief provision by the Red Cross and other civic organizations, and rescue operations by the Armed Forces, however, inaction among elected government officials regarding the flood control problem prevailed in the 1960s.

Annual damages on private property during this decade ranged from P13 million pesos to 100 million pesos, excluding losses in business profits, loss of work hours among workers and employees, and reduction in real estate values. More outbreaks of respiratory and gastric-intestinal diseases were also observed. Upsurges of pneumonia, diphtheria, gastroenteritis, influenza, bronchitis and chicken pox were also common due to widespread lack of safe drinking water, contamination of foods and worsening sanitation.

3. The 1970s

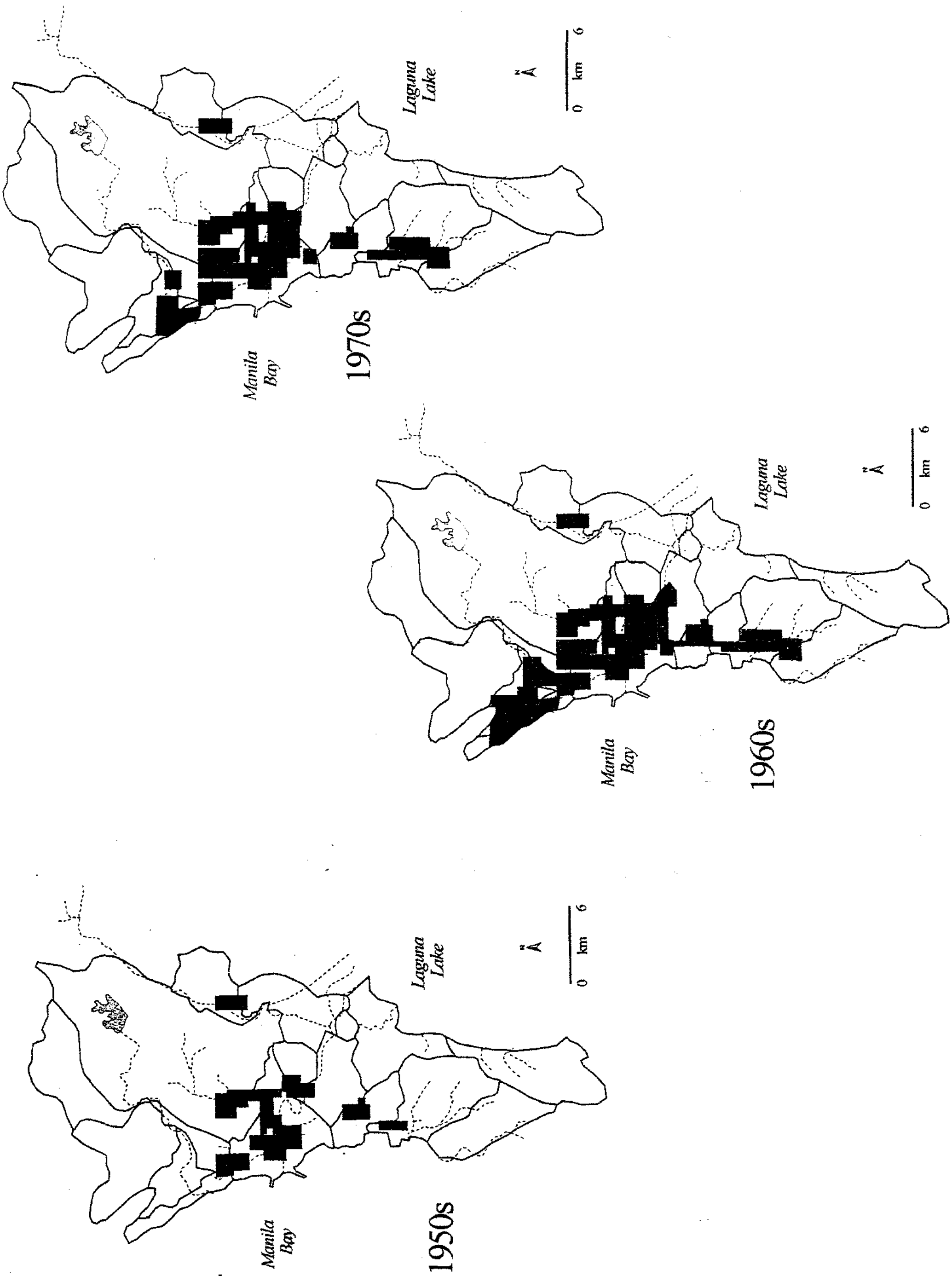
The network of rainfall and evaporation gauging stations was insufficient to meet the data requirements of flood forecasting. Public outcries for an effective flood warning system for Metro Manila had become more evident in the 1970s (see fig. 1). Pasay, Manila, Quezon City, San Juan and the perennially flooded towns of Malabon and Navotas had suffered the most floods in the 1970s. The most interesting observation in this decade pertained to the color of floodwater. While it was not exactly crystal-clear before, it now had become brown and murky due to soil erosion upstream and amount of pollutants dumped on waterways. The Pasig River, its tributaries and the network of *esteros* in the metropolis had been choked with garbage and its banks had become the sites of illegal dwellings and other structures.

City officials blamed supernatural forces for widespread flooding during this decade. They attributed floods in the early 1970s to the theft of the 400-year old image of the Holy Child, the patron saint of Tondo that was brought by a galleon ship from Mexico in 1571 (PACE 1972). Made of ivory and solid gold, the image of the Holy Child was stolen a month before the floods. The unceasing rains and constantly rising floodwaters which subsequently occurred were supposedly divine punishment for the theft. Practical logic and commonsense pointed to watershed deforestation, uncompleted dike constructions, heavy silting of waterways, drying-up of *esteros* and utmost lack of comprehensive flood control programs as the primary causes of floods in the 1970s. Nevertheless, the public joined the city officials in condemning the incident for causing the widespread floods.

Thousands of families were usually left homeless after heavy floods. During this decade, there were even more breakdowns in communication, power and transportation facilities. In one flooding incident alone, 25,000 phone installations were impaired and railway services were disrupted. Delays in domestic and international flights and closures of government offices and private establishments were common. Prices of commodities rose by 100 to 300 percent; transportation costs increased by 10 percent on flooded days. People increasingly resorted to rafts and small boats as modes of transportation on flood-prone streets.

The Armed Forces, the Red Cross, the Girl Scouts, the Social Welfare Administration, and private doctors and business corporations were involved in relief and rescue operations. International assistance from the US, Australia, Indonesia, Japan and the Vatican poured in.

A notable development during this period was the provision by the national government of a formal appropriation for flood control infrastructure in Metro Manila.


Laguna Lake
0 km 6
Manila Bay
1970s
Laguna Lake
0 km 6
Manila Bay
1960s
Laguna Lake
0 km 6
Manila Bay
1950s

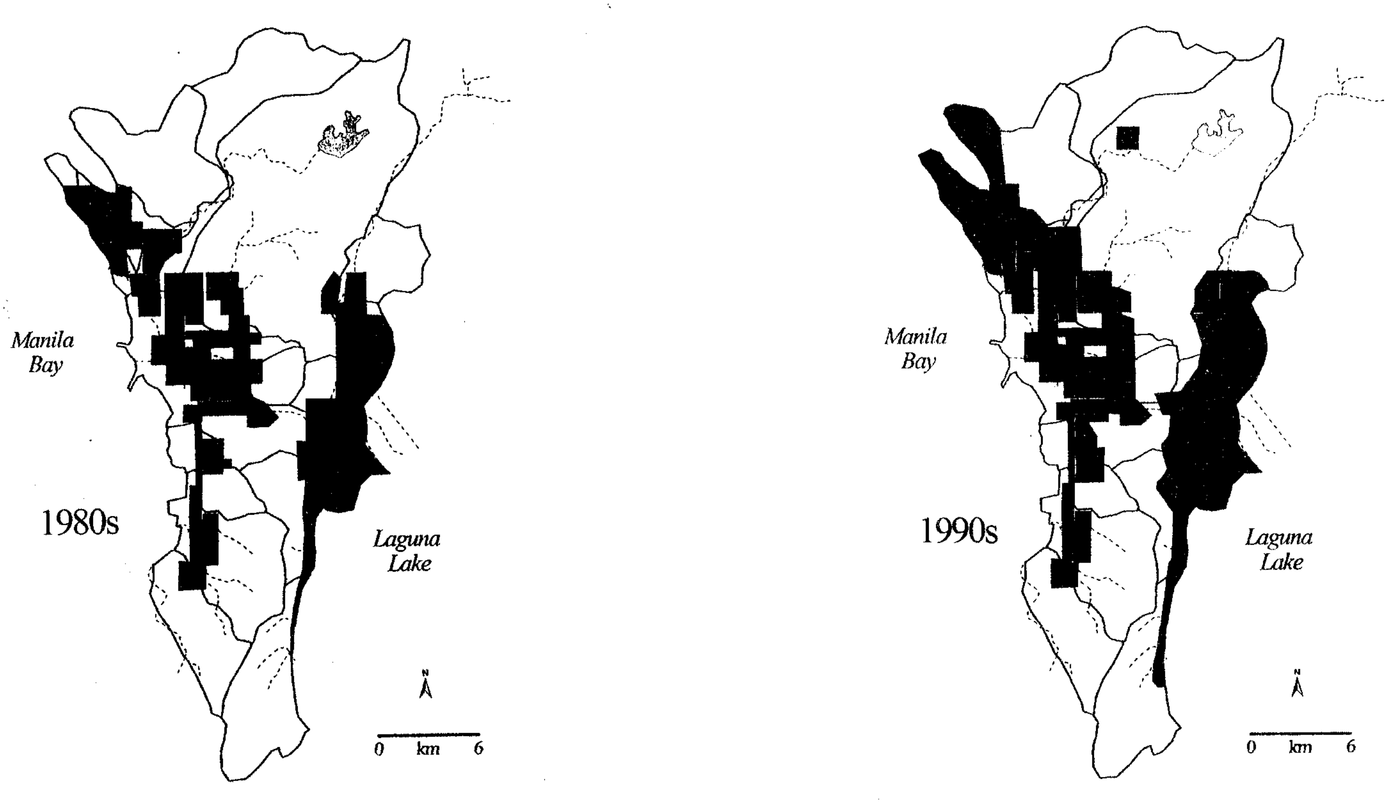


Figure 1. Flooded areas in the 1950s, 1960s, 1970s, 1980s and 1990s

4. The 1980s

The 1986 and 1988 floods wreaked havoc in Marikina Valley and on the shores of Laguna de Bay. Newly developed residential subdivisions on former agricultural paddies in Marikina, Cainta, Pasig, Pateros and Tagig were inundated. Floodwaters in these areas had risen to as high as 1.8 to 2.4 m. Flood-related losses amounted to hundreds of millions or billions of pesos in damage to property and decrease in values of real estate especially in exclusive residential communities.

Residents of low-lying communities denounced the installation of two flood control infrastructure (the Mangahan Floodway and the Napindan Floodgate) and the heavy silting of Laguna de Bay and its tributaries. Silt deposition had reduced the water-holding capacity of Laguna de Bay by 64 percent (Resurreccion-Sayo 1988). Surface runoff from denuded watersheds had raised the lake's water level by 2.7 m. The number of platforms and fishpen structures on the lake also obstructed water flow to the Pasig River.

In the 1980s, millions of pesos were appropriated for relief goods distribution, evacuation operations, and in supporting livelihood projects for rehabilitation of flood victims.

5. The 1990s

In the 1990s, the depths of floodwaters in subdivisions with substandard drainage and sewer facilities increased. This was widely observed in Paranaque, Marikina, Cainta, Pasig, and in Kalookan, Malabon, Navotas and Valenzuela. The number of squatter families devastated by flooding increased, too. Hundreds of thousands of people were evacuated to higher places. Traffic congestion in the megacity had worsened; for example, what usually took a leisurely two-hour drive could easily be transformed into a 10- to 16-hour horror when one is trapped inside a stalled vehicle on a flooded street. This experience commonly affects commuting office workers and school children. Others who dared brave the floodwaters risked encountering swimming rodents and snakes or falling into uncovered manholes or diggings. After heavy flooding, there were usually outbreaks of contagious diseases, for example, *cholera* and *leptospirosis.* There were also more power outages which paralyzed industrial and manufacturing operations. Annual property loss due to floods was estimated at P900 million (Duenas 1991).

In the 1990s, however, the national government became more responsive to flood-related concerns. It provided more transportation assistance to stranded commuters or flood victims. Some local government units initiated local and internal squatter relocation programs such as in Marikina. Radio and TV stations became more accommodating of requests for assistance and information. The bulk of government response, however, still lay on the construction of flood control infrastructure and relief goods provision.

TRENDS AND GENERALIZATIONS

Several trends may be observed in the flood events from the 1950s to the 1990. Flooded areas had spread from the low-lying areas in the coastal parts of Manila, Navotas and Malabon, and along the banks of San Juan and Pasig Rivers in the 1950s to the suburban areas of Manila, Quezon City, Pasay, San Juan and Kalookan in the 1960s and 1970s (see fig. 1). The squatter areas that mushroomed along the banks of *esteros* and rivers and in other marginal locations were regularly inundated several times each year. Flood incidence had expanded in the 1980s in the increasingly urbanized low-lying areas in Pasig and Marikina and along the shores of Laguna de Bay, most particularly in Taguig and Pateros. Expensive subdivisions built on former agricultural lands were not spared from the consequences of flooding. Indeed, flooding had became prevalent even in relatively high places in Quezon City, Makati, Manila, Paranaque, Muntinlupa, Pasig and San Juan in the 1990s mainly due to substandard housing infrastructure. The depths of flooding had also increased through time.

Incomes lost due to floods likewise rise with the frequency of their occurrence and the degree of devastation they cause. Illnesses such as dengue fever and diarrhea have become more prevalent because of unsanitary conditions and water contamination due to ineffectual flood control measures.

What worsens the structural conditions is the lack of attention by elected local government officials and members of the Philippine Congress, which has been evident during the past 50 years. For example, the plan that was drawn in the early 1950s was implemented partly in the 1960s and carried out very slowly in the 1970s; it is still being done up to the present. Problems of funding and efficient handling of whatever little was available were also evident through the years, but it seems that nothing had really been done to correct the inefficient management and corrupt practices associated with the construction of flood control measures.

REFERENCES

ADB. 1993. *Water Utilities Data Book. Asian and Pacific Region.* Manila, Philippines: Asian Development Bank Information Office.

ADB. 1994. *Climate Change in Asia: Philippines Country Report: Regional Study on Global Environmental Issues.* Manila: ADB.

ADB. 1996. Country Paper of the Philippines (Proceedings of the regional consultation workshop towards effective water policy in the Asian and Pacific Region, 2). Manila, Philippines: Asian Development Bank.

Alejandrino, A. (n. d.) *Problem Areas in Flood Control: Metro Manila and Laguna Lake Region.* Quezon City: NWRC, UP.

Alibutud, J. 1990. Flood and trash. *Philippine Graphics,* pp. 4-5, 17. September.

Armstrong, W. and McGee, T. G. 1985. *Theatres of Accumulation, Studies in Asian and Latin American Urbanization.* New York: Methuen, Inc.

Banzon-Bautista, M. C. 1993. Disaster in Metropolitan Manila: preliminary notes on the socio-psychological preparedness of the population, In *Disaster Prevention and mitigation in Metropolitan Manila.* pp. 109-118. Quezon City, Philippines: Department of Science and Technology and Philippine Institute of Volcanology and Seismology.

Cola, R. 1993. The needs of children following a disaster: the 1990 earthquake in the Philippines. *Disasters,* 17 (3): 248-254.

Delica, Z. 1993. Citizenry-based disaster preparedness in the Philippines. *Disasters* 17 (3): 239-247.

Duenas, M. 1991. A year of calamities: storms, floods and drought. *Philippine Free Press* 83 (34): 6. August 24.

JICA. 1990. *Study on Flood Control and Drainage Project in Metro Manila, Supporting Reports* (2 vols.). Manila: Department of Public Works and Highways, Republic of the Philippines.

JOFCA. 1993. *A Atudy of the Marikina Watershed Development Project in the Philippines: An Interim Report.* Republic of the Philippines: JICA and the DENR.

Kolb, A. 1978. *Gross-Manila. die individualitat einer tropischen millionenstadt..* Hamburg: Verlag Ferdinand Hirt in Verbindung mit dem Institut fur Geographie and Wirtschafts geographie der Universitat Hamburg.

Lacaba, E. A. F. 1967. After the flood. *Philippine Free Press* (60): 99-101. June 24.

Leuterio, M. 1956. Why we have floods. *This Week Magazine (Manila Chronicle),* 31-32. September 23.

Lu, N.T. 1970. Manila registers highest rainfall in 103 years. *Sunday Times Magazine,* 22-23. September 20

NCSO. 1990. *Census of Population and Housing* (Report No. 3-58M - NCR socio-economic and demographic characteristics). Manila: National Statistics Office.

NCSO. 1996. *Philippine Yearbook 1995.* Manila, Philippines: National Census and Statistics Office.

NDCC. 1988. Calamities and Disaster Preparedness Plan. Quezon City: NDCC- Department of Defense, Camp Gen. Emilio Aguinaldo.

Passe, J. S. 1993. Metropolitan Manila: issues and future prospects of solid waste disposal. *Regional Development Dialogue* 14 (3): 178-187.

Perez, A., M. J. Baltazar, M. E. Esquivias, and F. Arguillas. 1995. *Waste management differentials in Filipino households.* Manila: National Statistics Office.

Pernia, E. 1991. Some Aspects of Urbanization and the Environment in Southeast Asia (Report no. 54). Manila: Asian Development Bank.

Platt, R. H. 1999. Origins of nonstructural mitigation 1965-1983. In *Disasters and Democracy: the Politics of Extreme Natural Events,* ed. R. H. Platt, pp. 74-79. Washington, D.C.: Island Press.

Pope, J. 1967. After a cruel flood, Manila has a nervous breakdown. *Sunday Times Magazine,* pp. 18-22. June 25.

Porio, E., L. Moselina, and A. Swift. 1994. Philippines: urban communities and their fight for survival. In *Urban Children in Distress,* ed. C. Szanton Blanc, pp. 101-159. UNICEF, Switzerland: Gordon and Breach.

Punongbayan, Raymundo. 1987. Disaster preparedness systems for natural hazards in the Philippines: an assessment. In *Geologic Hazards and Preparedness Systems,* pp. 77-101. Quezon City: Department of Science and Technology-Philippine Institute of Volcanology and Seismology.

Resurreccion-Sayo, B. 1988. After Unsang, the deluge. *Philippines Free Press.* December 10.

Rodriguez, J. F. 1967. The Manila flood control program. *Graphic* 33, pp. 6-7. June 28

UN-HSC. 1977. *Composite vulnerability analysis. a methodology and case study of the Metro Manila.* Geneva: Office of the United Nations Disaster Relief Coordinator.

UN-ESCAP. 1990. *Urban Flood Loss Prevention and Mitigation.* (Water resources series No. 68). New York: UN-ESCAP.

* This article is an excerpt from a chapter of Dr. Nantes' Ph.D. dissertation submitted to Rutgers University.

FLOOD CONTROL AND DRAINAGE NETWORK/OPERATIONS/PLANS IN METRO MANILA

NONITO F. FANO

HISTORY OF FLOOD CONTROL IN METRO MANILA

One of the souvenir pictures published in a major daily newspaper in connection with the centennial celebration of our independence sometime in the later part of May 1998, if I recall it right, is a flooded Binondo District in the City of Manila during the rainy season of 1898. It could therefore be safely assumed that the flooding problem of Metro Manila has persisted for at least a century.

We do not seem to have records of what were done to control floods in Metro Manila from 1898 to 1942. The first study on how to address the problem was undertaken in 1942 shortly after the unprecedented flood in November of that year, which inundated the City of Manila for several days, attaining flood heights much higher than any previously recorded. World War II cut short the study and data painstakingly compiled in 1944 were almost completely destroyed during the Battle of Manila. The study was resumed in 1947 and completed in 1952.

The study covered the North Manila Watershed (fig. 1) with an area of 2,176 hectares (ha) and the South Manila Watershed (fig. 2), an area of 2,908 ha. The total area coverage was 5,084 ha, about 8 percent of the Metro Manila Authority (MMA) which is 63,600 ha. The estimated total investment required to build the structures and facilities identified in the said study was PhP67.70 million.

After the completion of the 1952 study, nothing was done due to funding constraints. It was only after the 1972 massive flooding that earnest effort was pursued with financial assistance from the Overseas Economic Cooperation Fund (OECF), covering a four-year construction period from 1974 to 1978.

The major facilities constructed under this program were the first seven pumping stations, two independent floodgates, and four drainage mains. Later, under another OECF loan, the Mangahan Floodway was constructed and likewise the Napindan Hydraulic Control Structure under Asian Development Bank (ADB) financing. An additional five pumping stations, three independent floodways, and three drainage mains were also built.

Due to the deteriorating flooding problem which was spreading to other areas in Metro Manila, an expanded study was conducted in 1984 under World Bank assistance. This was the Metro Manila Integrated Urban Drainage and Flood Control Master Plan.

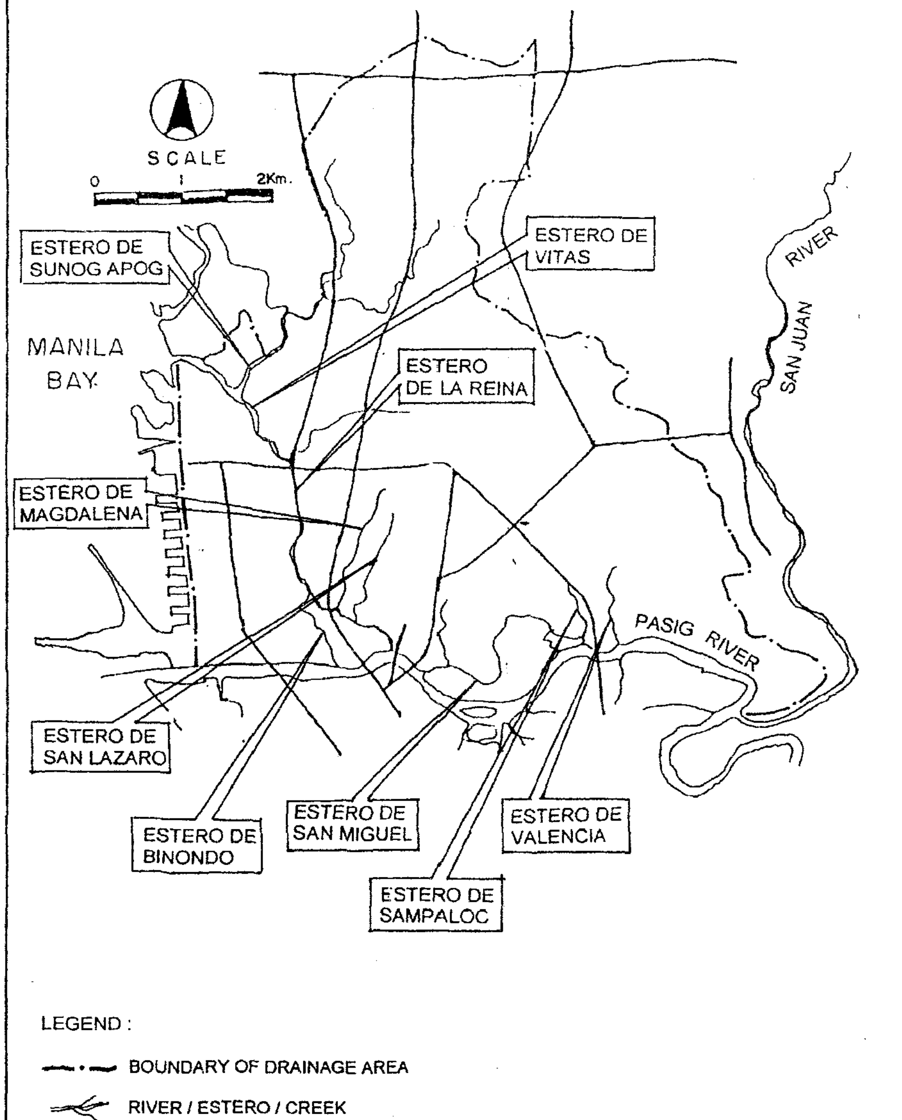


Figure 1. North Manila Watershed

The study covered 66,100 ha including the Laguna de Bay Watershed. The estimated cost for the priority projects identified in the study was PhP1.108 billion. The proposed construction program was interrupted by the EDSA Revolution, however, and was not pursued.

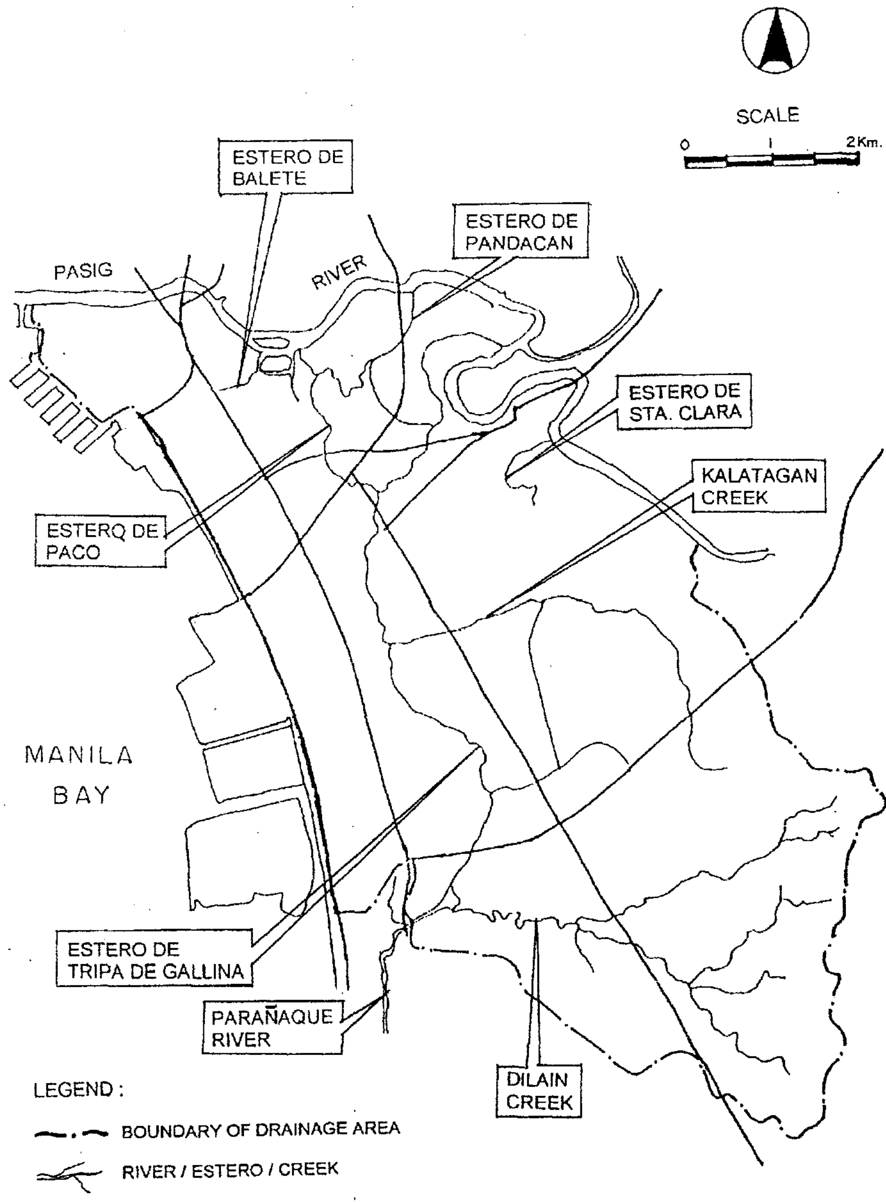


Figure 2. South Manila Watershed

In 1988-1990, the Japan International Cooperation Agency (JICA) provided technical assistance for the Study on Flood Control and Drainage Project in Metro Manila (fig. 3).

This covered the whole of MMA. After the study, three priority areas for immediate implementation were recommended for development, namely:

a. Malabon-Navotas-Valenzuela-Caloocan Area
b. Pasig-Marikina River System Improvement Project
c. Taguig-Pateros-Pasig-Cainta-Taytay Area

The feasibility studies for these three projects were completed in March 1990. As of this writing, however, the feasibility studies for Malabon-Navotas-Valenzuela-Caloocan

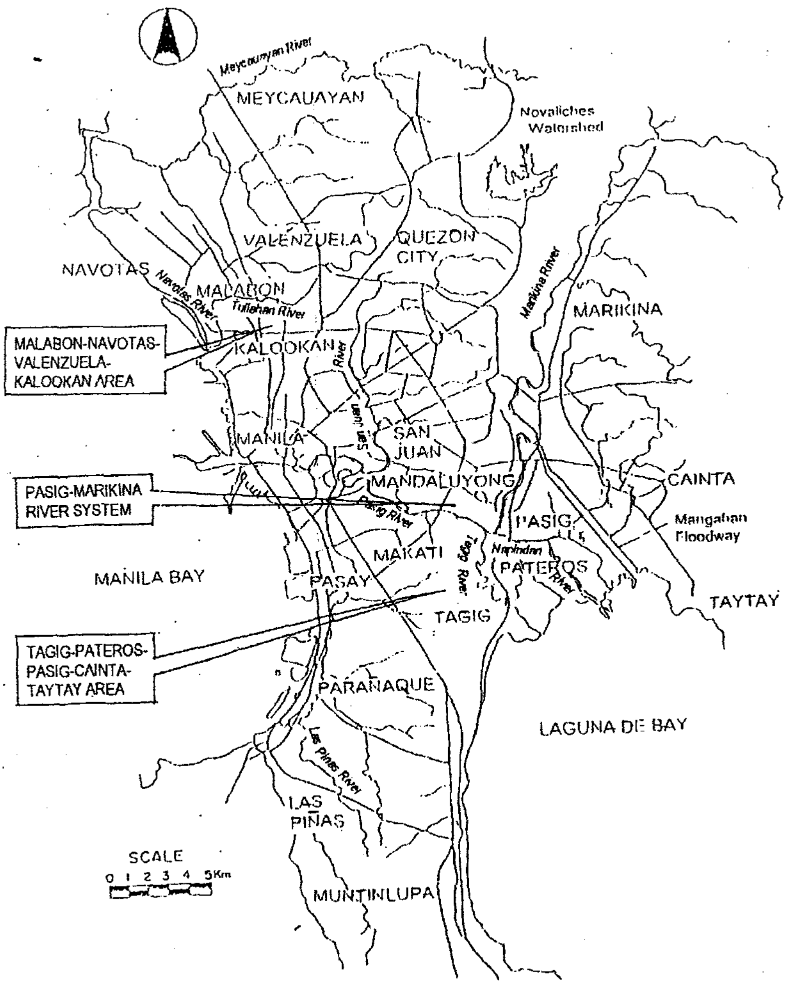


Figure 3. Studies on Flood Control Project in Metro Manila (Technical assistance provided by JICA)

Area under OECF and Pasig-Marikina River System under OECF-SAPROF are being reviewed. Construction of the West of Mangahan Floodway (fig. 4) in the Taguig-Pateros-Pasig-Cainta-Taytay Area was expected to begin in early 1999.

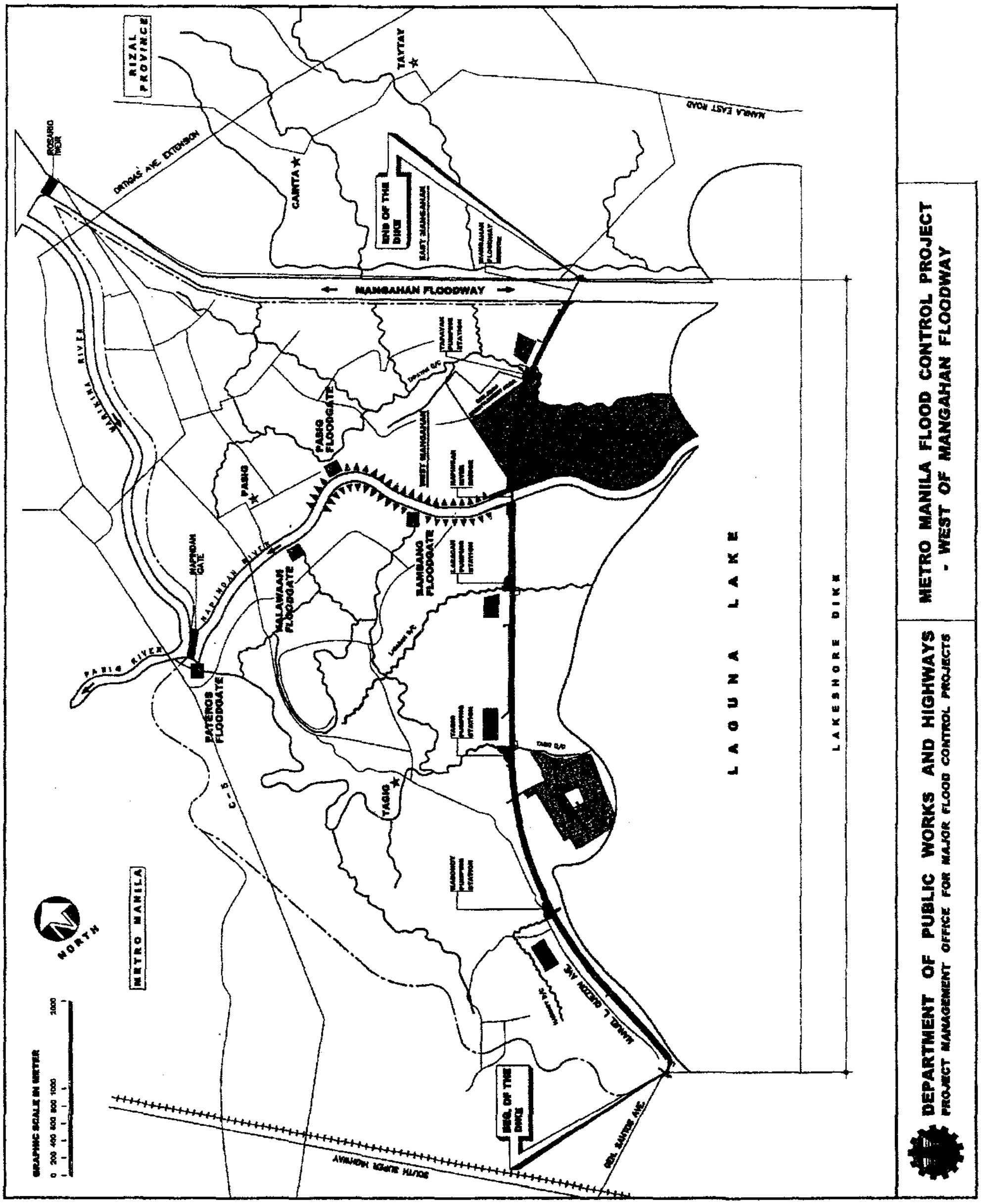


Figure 4. West of Mangahan Floodway Project

The following tabulation summarizes the major studies undertaken for Metro Manila Area.

STUDIES	YEAR CONDUCTED	YEAR CIVIL WORKS IMPLEMENTED	PROJECT COST (PhP)
1. North and South of Manila Drainage Areas	1942 - 1952	No records	68 million
2. Metro Manila Integrated Urban Drainage and Flood Control Master Plan	1982 - 1984	None	1,108 million
3. Mangahan/ Napindan System	1980 - 1982	1984 - 1988	317.4 million
4. Effective Flood Control Operation System (EFCOS) for the Pasig-Marikina River-Laguna Lake Complex	1984 - 1986	1989 - 1993	109 million
5. San Andres, Vitas-Balut Pumping Stations and appurtenant structures	1984 - 1986	1989 - 1998	2,200 billion
6. MANAVA Flood Mitigation	1987 - 1989	1992 - 1993	110 million
7. Retrieval of Flood Prone Areas (Mobile Equipment)	1988 - 1989	1990 - 1993	202 million
8. Study on Flood Control and Drainage Project in Metro Manila	1988 - 1990	1991 - 2020	21.4 billion

These studies are continuing as we gain additional information from facilities already built, from results, and from updated hydrology, meteorology, and physical field data.

In the meantime, Metro Manila has continued to experience serious and worsening floodings, especially during the years 1942, 1948, 1966, 1967, 1970, 1972, 1986, 1992, and 1997.

WHY IS METRO MANILA FLOOD-PRONE?

Natural Causes

The Philippines is subject to an average of 19.6 typhoons or cyclones each year, many of these passing over or at least affecting the MMA. These weather disturbances induce some 2,000 millimeters (mm) of rain each year in the Manila Bay area and 3,000 mm over the Marikina Mountain ranges which feed the Marikina River that, in turn, drains through MMA. This is one of the highest rainfall incidences among metropolitan areas of the world.

These rains feed two main rivers that go through MMA—Marikina River and Pasig River—and other smaller, but frequently overflowing rivers—San Juan, Malabon, Tullahan, and Parañaque Rivers.

Another natural feature of MMA which contributes to flooding is the low elevation of some of its land areas with respect to the high tide water level of Manila Bay. These are the KAMANAVA areas (Kalookan, Malabon, Navotas, Valenzuela), Tondo, Sta. Cruz, Taguig, Pateros (fig. 6). These low-lying areas, which constitute one-sixth of the total MMA, frequently experience flooding during high tide, even when there are no rains.

Human Factors

With the economic development of the MMA, what used to be agricultural and forested lands are now built-up areas, most of which are paved over. Pavements prevent water from percolating into the soil. Instead, rainwater is immediately converted into surface runoff which converges rapidly and fills the drainage systems and other waterways to overflowing, and thus results in floods within a short time.

Land development has resulted not only in increasingly wide paved areas that prevent percolation, but also in the reduction and, in many cases, the closure of natural waterways. Many of what were formerly creeks and esteros have either been reclaimed or built over. An estimated 40 kilometers (km) of original *esteros* and creeks in MMA have been built over or filled.

Another by-product of development that has contributed to flooding in MMA is garbage. Runoff is collected by a network of canals, pipes, ditches, esteros, and rivers that ultimately drain into Manila Bay. This network must be kept clear and unblocked if it is to function effectively. The banks of our *esteros* and streams are now occupied mostly by shanties and, in many cases, by illegally-built structures, including multistory concrete buildings. Our latest count of squatter families dwelling along the banks of MMA waterway is 27,300 families or some 164,000 people. Their presence has two distinctly adverse effects:

1. The shanties occupy the easement areas which serve as the access of personnel and equipment from the Department of Public Works and Highways (DPWH) for clean-

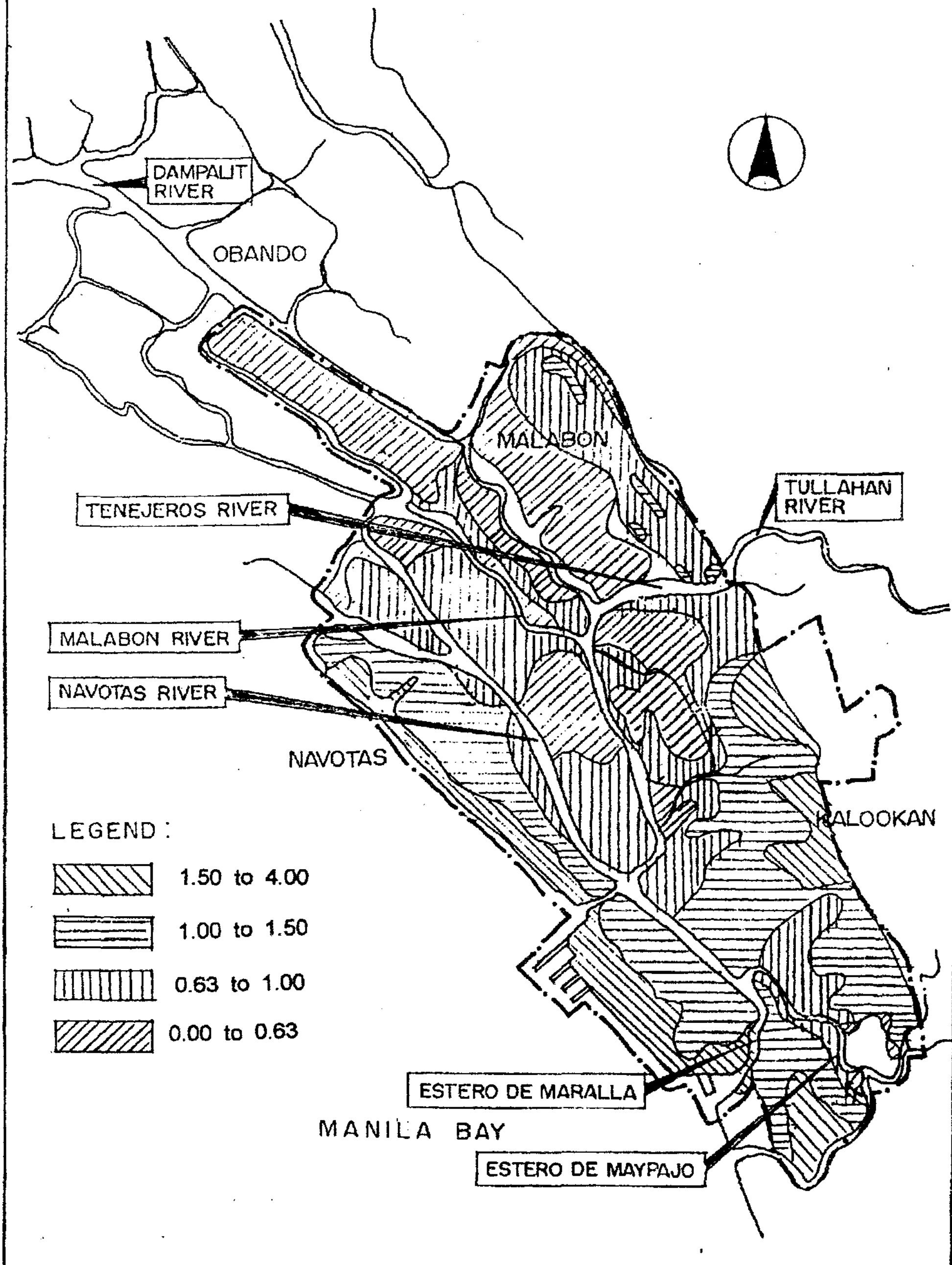


Figure 5.
Land Subsidence - Variation in Gound Elevation in Study Area

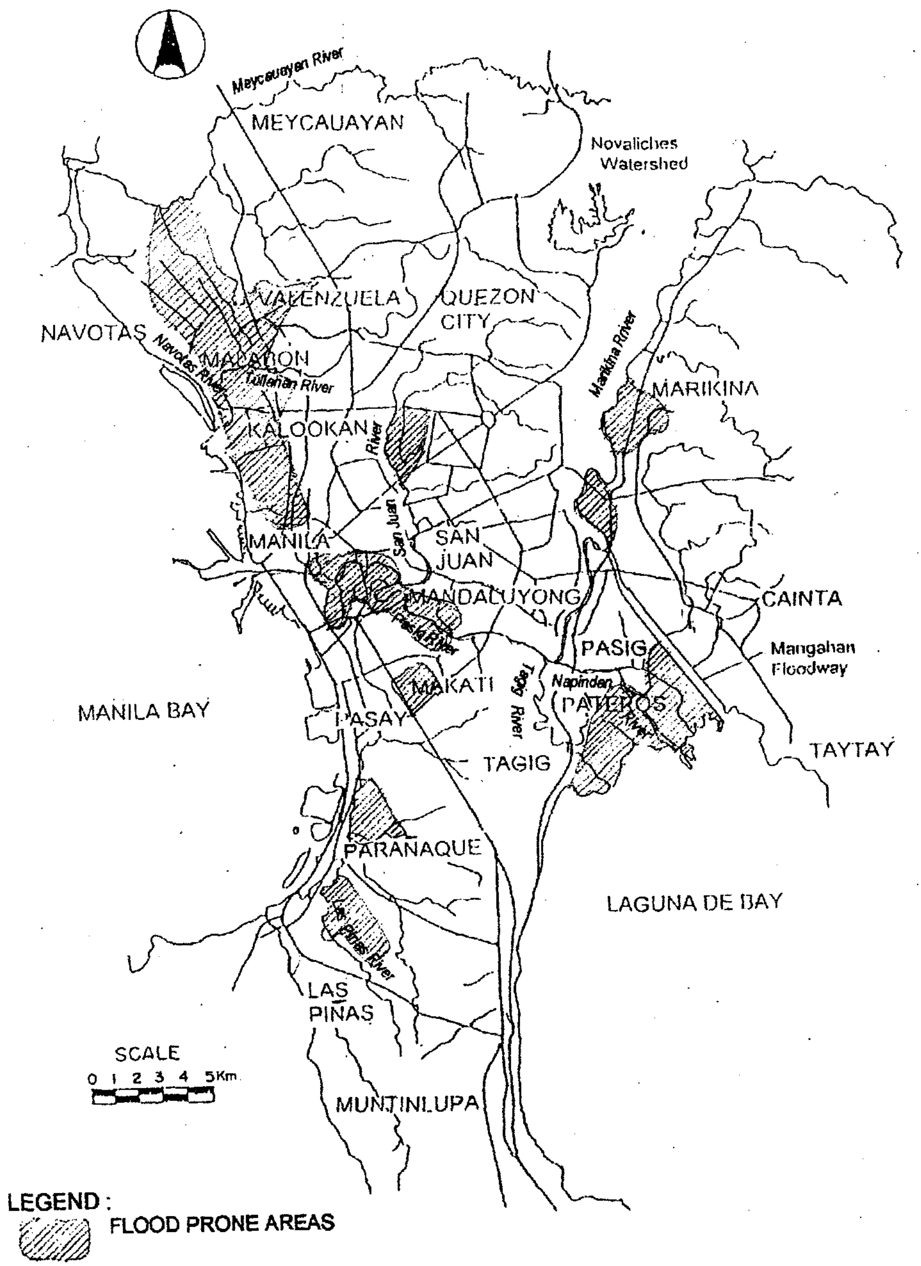


Figure 6. Flood-Prone Areas

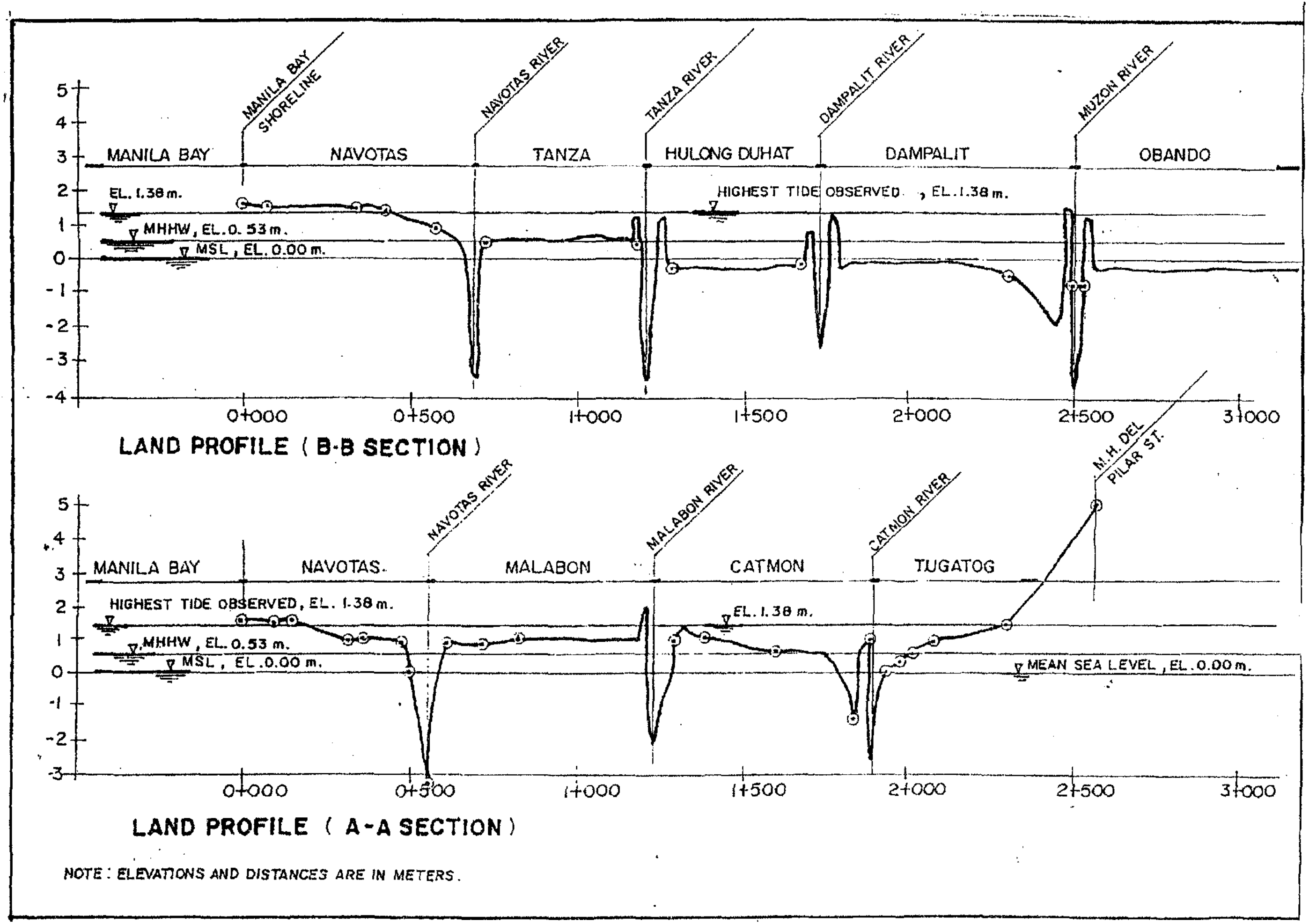


Figure 7. Land Profiles

ing and maintaining of waterways. The maintenance works on these waterways have become very difficult and in many cases impossible.

2. The families living in these shanties use the waterways as their latrines, trash boxes, and garbage dumps. The volume of trash deposited daily into these waterways is estimated at 3,000 cubic meters (cu m). To haul away this garbage requires some 600 dump trucks daily with an average capacity of 5.0 cu m. Unless this trash is removed from the waterways, the flow of floodwaters can become seriously impeded and cause flood pumps to foul up, contributing considerably to the flooding of MMA.

GOVERNMENT'S RESPONSE

Networks/Operations

1. The operation of Mangahan Floodway/Napindan Hydraulic Control Structure in coordination with the Effective Flood Control Operation System (EFCOS) (fig. 8)
2. Flood Pumping Stations and Floodgates (fig. 9)
3. Drainage Network
4. Maintenance and Rehabilitation Programs/Activities
5. Bantay *Estero* Teams
6. Mobile Flood Mitigation Equipment

The Mangahan Floodway/Napindan Hydraulic Control Structures

The Marikina and Pasig Rivers are the two largest contributors to flooding in the MMA. If the Marikina River floodwaters were allowed to flow into the Pasig River unimpeded during the rainy season, wide areas in MMA would be under water many more times and for longer periods than they are at present. Flooding has been minimized now with the construction and operation of the Mangahan Floodway/Napindan Hydraulic Control Structure in combination with the EFCOS (a system of stream gauging stations in the upper reaches of Marikina River and at selected points along the Pasig River and Mangahan Floodway, connected by radio telephones to Mangahan and Napindan).

When the Marikina River flow is at flood level, the Mangahan floodgates are opened. This allows the Marikina floodwaters to be diverted into and temporarily stored in Laguna de Bay (instead of flowing directly to the Pasig River). These waters are later allowed to exit to Manila Bay through the Pasig River by opening the Napindan Locks. By temporarily storing Marikina River floodwaters in Laguna de Bay, frequent overbank flooding along the lower reaches of the Marikina River and along the Pasig River is avoided.

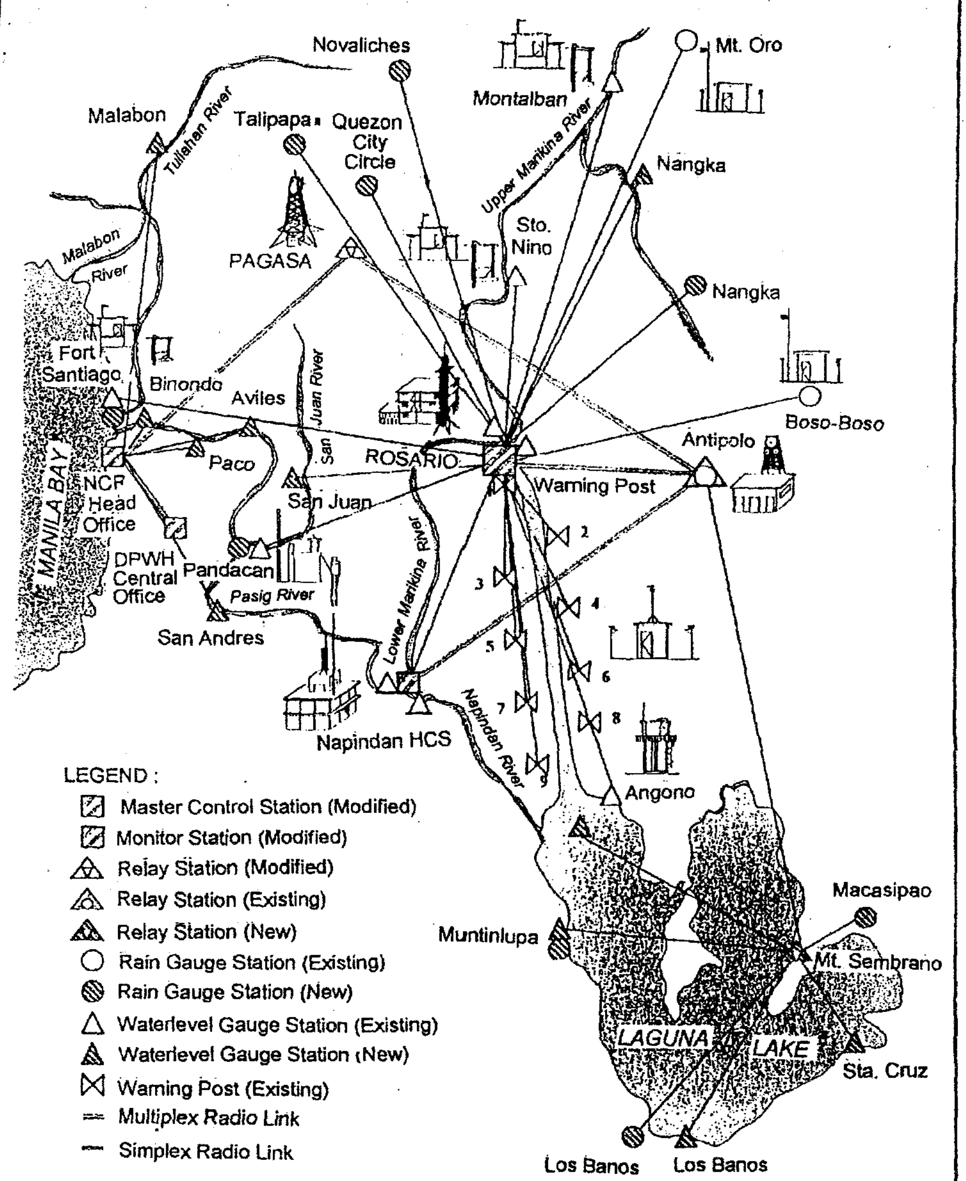


Figure 8. EFCOS Configuration

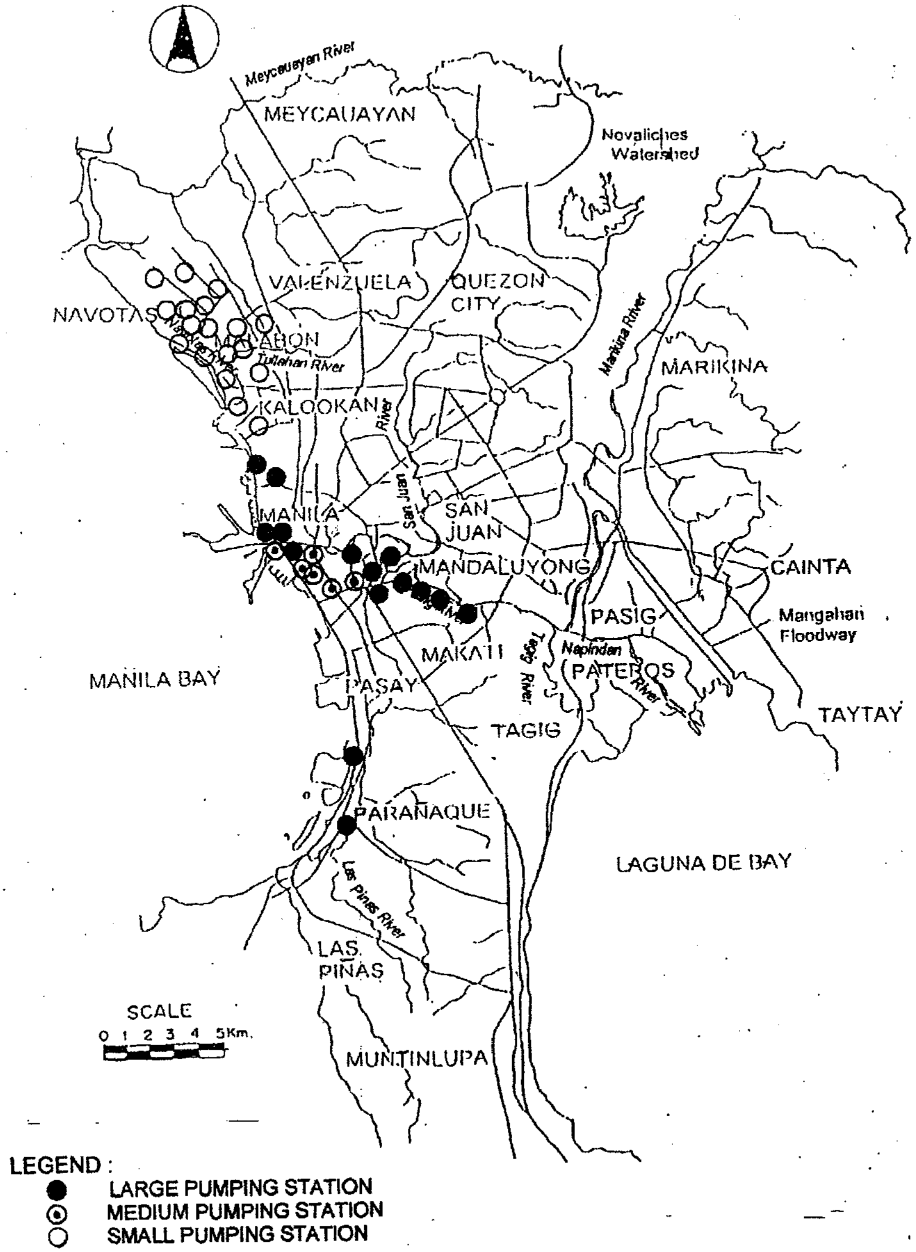


Figure 9. Pumping Stations

Flood Pumping Stations

The DPWH operates 15 large and 29 small stations to help drain the flood-prone areas of MMA. These pumps have a total discharge capacity of approximately 241 cu m per second (see attachment no. 1 and 1-A).

As often happens, floods occur at the same time that Manila Bay is at high tide. When this situation occurs, floodwaters cannot flow by gravity into Manila Bay, especially from those areas where the elevations are lower than high tide level at Manila Bay. This is when the flood pumping stations operate, whose large pumps work in coordination with floodgates. When Manila Bay water is at levels higher that the flood level in the canals and esteros, the floodgates are closed, thus preventing Manila Bay water from flowing inland. The pumps are able to drain about 6,000 ha or 60 percent of the total 10,600 ha of flood-prone areas in the MMA (see attachment no.2).

These stations are provided with automatic trash removal screens which take out the garbage and prevent them from fouling up the pumps. An idea of the volume of garbage that we have to contend with is shown in attachment no. 3.

Drainage Network

The core of the DPWH flood mitigation works is the network of drainpipes (mains and laterals), canals, *esteros*, and rivers that convey the flood waters to Manila Bay. This network consists of:

44 km of mains
1,200 km of laterals
290 km of *esteros* and canals
153 km of river and major streams

All have to be kept free of debris and blockages if they are to function effectively.

Contrary to common public perception, DPWH cleans this network not only during the rainy season, but during the dry season as well when the network is repaired, rehabilitated, enlarged, and extended as available resources allow. It must be kept in mind that large volumes of water are required to flush out the pipe network, so that much of the flushing has to wait for the first heavy rains of the year. It is only when these first heavy rains of the season fall that we can tell if there are any remaining blockages.

In areas occupied by squatters hardly any maintenance work can be done. An example of this is the Maricaban retarding pond. The pond is completely surrounded by squatter shanties, preventing DPWH personnel from regularly dredging it to preserve its storage capacity. The 1994 chest-deep flooding of Magallanes Village resulted from the backflow from the Maricaban pond.

MAINTENANCE AND REHABILITATION PROGRAMS/ACTIVITIES

The DPWH allocates in its yearly budget the average amount of about PhP152 million for the maintenance and rehabilitation of existing flood control structures/facilities. This amount is distributed among the six District Engineering Offices of the National Capital Region. The usual activities undertaken are: declogging/cleaning of drainage systems; dredging of rivers/creeks; rehabilitation/repair of damaged structures/facilities; and emergency flood control activities.

Under this program, the flood control retrieval equipment donated by JICA is used.

Bantay *Estero* Teams

Our major *esteros* are characterized by serious garbage deposition. In many *esteros* near market places and those heavily occupied by illegal dwellers along their banks, the situation seems impossible to deal with: three to four weeks after cleaning these waterways of garbage, they are again clogged with rubbish.

To respond to this, the DPWH has organized Bantay *Estero* Teams. Each is comprised of five to seven laborers whose main job is to regularly clean these *esteros*.

This program has had very encouraging results. Now on its second year, it is being replicated in the municipality of Malabon. The *esteros* where Bantay Estero Teams are assigned are shown in attachment no.4.

Mobile Flood Mitigation Equipment

As mentioned earlier, the flooding pumping stations can cover only 60 percent of the MMA flood-prone areas. The remaining 4,000 ha of flood-prone areas have to be serviced by the DPWH Mobile Flood Equipment which are out in the streets as soon as flooding build-up is noted. The members of these teams are the unsung heroes who work in dirty waters and often in the rain to remove the blockages from the storm drains, the pipe networks, the canals, and *esteros* in order to reduce flood incidence.

FLOOD CONTROL PLANS

After each flood, the media often blames government for its lack of planning. This is not correct. We have existing flood mitigation facilities as a result of deliberate planning. We have completed studies that are awaiting the availability of funds so that projects can be implemented.

The Department's ongoing plans involves the following:

Foreign-Assisted Projects

- Malabon-Navotas-Valenzuela-Caloocan Flood Control and Drainage Project. This was one of the three priority areas identified in the 1988-1990 study. Review of feasibility study is ongoing under OECF and will be completed by the end of September 1998. Detailed design will be in 1999 and construction will be from year 2001 to 2003. Proposed under the twenty-third Yen Loan Package.

- Pasig-Marikina River Improvement System. Detailed design completed in 1999 and construction to take place from year 2001 to 2006.
- Expansion of the Effective Flood Control Operation System (EFCOS). Under JICA.
- Study on the internal drainage laterals in Metro Manila. Under JICA.
- Flood Control and Sabo Engineering Center project. Under JICA.

Locally-funded Projects

- 1998 Flood Control Program; estimated cost - PhP250 million; major works for implementation include construction of RCBC along Sumulong Highway (ongoing), improvement of Marala River bank (ongoing), and construction of RCBC along NIA Road.
- Flood Control Program for the period 1999-2003; estimated cost - PhP1.75 billion; major works for implementation include construction of diversion box culverts that will directly convey floodwaters into major drainage system, replacement of existing old and insufficient drainage laterals, and improvement of banks of rivers and creeks
- Drainage plan for the PEA Reclaimed Area along Roxas Boulevard; to be funded by and jointly implemented with the Public Estates Authority

Relevant Issues

There is concern that overpumping of groundwater will lead to subsidence of land in the city. It is also widely recognized that communities along *esteros* and waterways have to be relocated to reduce garbage and lessen blockage of floodwater. Coordination and cooperation regarding the various programs and projects for drainage, sewerage and flood control have to be delegated to local government units (LGUs) so that they can address local problems more efficiently. Working together (national government, LGUs, and non-government organizations), much can be done to improve the situation and considerably mitigate flooding in the near future.

ATTACHMENT NO.1

A. CAPACITIES OF MAJOR PUMPING STATIONS IN METRO MANILA (CONSTRUCTED BY DPWH UNDER FOREIGN-ASSISTED FUNDS)

NAME OF PUMPING STATION	PUMP CAPACITY	DRAINAGE AREA	LOCATIONS
1. TRIPA DE GALLINA P.S.	56.00 cms (cu m/sec)	1,769 ha	ESTERO TRIPA DE GALLINA & PARAÑAQUE RIVER JUNCTION
2. LIBERTAD P.S.	42.00 cms	779 ha	RECLAMATION AREA, ROXAS BLVD.
3. VITAS P.S.	32.00 cms	578 ha	ESTERO DE VITAS, TONDO
4. SAN ANDRES P.S.	19.00 cms	356 ha	INVIERNES ST., STA. ANA
5. AVILES P.S.	14.10 cms	356 ha	ESTERO DE SAMPALOC, SAMPALOC
6. BINONDO P.S.	11.60 cms	279 ha	ESTERO DE BINONDO, BINONDO
7. VALENCIA P.S.	10.50 cms	246 ha	ESTERO DE VALENCIA, STA. MESA
8. QUIAPO P.S.	9.50 cms	225 ha	ELIZONDO ST., QUIAPO
9. PACO P.S.	7.59 cms	182 ha	ESTERO DE PACO, PACO
10. MAKATI P.S.	7.00 cms	151 ha	CORNER ZOBEL & OSMEÑA STS., MAKATI
11. STA. CLARA P.S.	5.30 cms	133 ha	ESTERO DE STA. CLARA, STA. ANA
12. PANDACAN P.S.	4.40 cms	180 ha	ESTERO DE PANDACAN, PANDACAN
13. BALETE P.S.	2.50 cms	52 ha	ROMUALDEZ ST., ERMITS
14. BALUT P.S.	2.00 cms	49 ha	RODRIGUEZ ST., TONDO
15. ESCOLTA P.S.	1.50 cms	Included w/ Binondo	ESTERO DELA REINA, STA. CRUZ
	224.99 cms	5,335 ha	

ATTACHMENT NO.1-A

B. CAPACITIES OF SMALL PUMPING STATIONS IN METRO MANILA
(CONSTRUCTED BY DPWH UNDER LOCAL-ASSISTED FUNDS)

NAME OF PUMPING STATION	PUMP CAPACITY	DRAINAGE AREA	LOCATIONS
1. MALACAÑANG P.S.#1 (EXECUTIVE HOUSE)	0.66 cms	about 1.5 ha	MALACAÑANG PALACE GROUND, SAN MIGUEL
2. MALACAÑANG P.S.#2 (ADM.BLDG.SIDE)	0.76 cms	about 2.0 ha	MALACAÑANG PALACE GROUND, SAN MIGUEL
3. ARROCEROS P.S.	0.66 cms	about 6.0 ha	ARROCEROS, ERMITA
4. LUNETA PARK P.S.	0.42 cms	about 15.0 ha	BESIDE MANILA HOTEL, LUNETA PARK
5. CENTRAL POST OFFICE P.S.	0.56 cms	about 3.0 ha	CENTRAL POST OFFICE, COMPOUND
6. JONES BRIDGE UNDERPASS P.S. (SOUTH SIDE)	0.26 cms	about 1.0 ha	BACK OF NPOC BLDG. RIVERSIDE DRIVE, INTRAMUROS
7. JONES BRIDGE UNDERPASS P.S. (NORTH SIDE)	0.36 cms	about 1.0 ha	ESCOLTA
8. RELIEF PUMPING STATIONS (22 UNITS)	12.32 cms 16.0 cms	about 200.0 ha about 229.5 ha	MANAVA AREA

ATTACHMENT NO.2

METRO MANILA AREA FLOOD NEEDS AND RESPONSES

TOTAL METRO MANILA AREA .... 63,600 ha
FLOOD-PRONE AREAS .... 10,600 ha
KAMANAVA .... 4,000 ha
CENTRAL METRO MANILA .... 5,500 ha
UPPER MARIKINA .... 600 ha
NORTH LAGUNA LAKESHORE .... 500 ha

COVERAGE OF FLOOD MITIGATION FACILITIES:
PUMPING STATIONS
15 LARGE AND 6 MEDIUM .... 5,300 ha
18 SMALL PUMPS .... 200 ha
(KAMANAVA)

FLOOD CONDUITS/WATERWAYS
ESTEROS AND CREEKS .... 290 km
DRAINAGE MAINS .... 44 km
DRAINAGE LATERALS .... 1,200 km
MOBILE FLOOD EQUIPMENT .... 130 ha
MOBILE FLOOD WATCH TEAMS .... 4,970 ha

ATTACHMENT NO.3

ANNUAL AVERAGE VOLUME OF GARBAGE COLLECTED/DISPOSED FROM PUMPING STATIONS FOR THE PAST TWO (2) YEARS

NAME OF PUMPING STATION	VOLUME OF GARBAGE COLLECTED/DISPOSED (cubic meters)
1. BINONDO P.S.	1,302
2. QUIAPO P.S.	800
3. AVILES P.S.	210
4. VALENCIA P.S.	614
5. PANDACAN P.S.	728
6. PACO P.S.	692
7. STA. CLARA P.S.	324
8. MAKATI P.S.	28
9. LIBERTAD P.S.	3,922
10. TRIPA DE GALLINA P.S.	3,200
11. BUENDIA P.S.	2,118
12. ESCOLTA P.S.	74
13. BALETE P.S.	93
14. VITAS P.S.	670
15. SAN ANDRES P.S.	162
	14,934

The average collection of garbage per day is 40.92 cu m.

ATTACHMENT NO.4

LIST OF PROJECTS UNDER THE BANTAY ESTERO PROGRAM
FOR CY-1998 (BY ADMINISTRATION)

NAME OF ESTEROS	ALLOCATION (PhP)	NO. OF PERSONNEL
1. ESTERO DELA REINA	851,877.30	14
2. ESTERO DE CALUBCOB	580,404.46	5
3. ESTERO DE KABULUSAN	580,404.46	5
4. ESTERO DE BINONDO	580,404.46	5
5. ESTERO DE MAGDALENA	580,404.46	5
6. ESTERO DE SAN LAZARO	698,892.60	8
7. NORTH & SOUTH ANTIPOLO OPEN CANAL	595,402.96	5
8. ESTERO DE PANDACAN	797,882.72	150
9. ESTERO DE SAN ANTONIO ABAD	617,900.72	5
10. MALIGAYA CREEK	580,404.46	5
11. TRIPA DE GALLINA (VITO CRUZ-BUENDIA)	580,404.46	5
12. TRIPA DE GALLINA (BUENDIA-EDSA)	580,403.56	5
13. TRIPA DE GALLINA (EDSA-RETARDING POND)	580,404.46	5
14. ESTERO DE ALIX	580,404.46	5
15. ESTERODE PACO	580,404.46	5
TOTAL	**9,375,000.00**	**92**

ATTACHMENT NO.5

MALACAÑANG
MANILA

MEMORANDUM FROM THE PRESIDENT
TO : The Secretary, Department of Public Works and Highways
The Secretary, Department of Interior and Local Government
The Secretary, Department of Budget and Management
The Chairman, Housing and Urban Development and Coordinating Council
Mayors of Cities and Municipalities in Metro Manila
SUBJECT : RELOCATION OF SQUATTERS FROM ESTEROS AND WATERWAYS
DATE : 10 JULY 1997

Pursuant to the recommendations arising from the Flood Summit on 10 July 1997, you are hereby directed to jointly undertake the coordination and the relocation of squatters locate along danger zones of esteros, canals, and other waterways in Metro Manila.

You are further directed to undertake the following:

1. The Mayors of Cities and Municipalities in Metro Manila to take the lead in the relocation of the squatters in danger zones/waterways. In this regard, you are further directed to formulate your respective action plans on the relocation of the squatters and prevention of the entry of squatters thereat. The relocation of the squatters along said danger zones/waterways shall be undertaken immediately.

2. The Chairman, HUDCC to ensure the provision of adequate and suitable relocation sites, including the provision of roads, water, electricity, health services, schools, and other basic necessities.

3. The Secretary, DBM and the Chairman, HUDCC to source the funds necessary for the relocation of said squatters and the development of relocation sites.

Submit a status report on the actions taken on the above activities to my Office through the Executive Secretary, copy furnished the Head, Presidential Management Staff not later than 30 July 1997 and every quarter thereafter.

For compliance.

President Fidel V. Ramos

cc: Exec. Secretary
Head, PMS

MALACAÑANG
MANILA

MEMORANDUM FROM THE PRESIDENT

TO : Chairman, MMDA (lead)
Secretary, DPWH
All City and Municipal Mayors of Metro Manila
SUBJECT : LOCAL GOVERNMENT DRAINAGE, SEWERAGE, AND FLOOD CONTROL PROGRAM
DATE : 10 JULY 1997

Pursuant to the recommendations arising from the Flood Summit held on 10 July 1997 at the Heroes Hall, Malacañang Palace, you are hereby directed to undertake the following:

1. MMDA and City and Municipal Mayors to ensure the continuous planning, implementation, and rehabilitation of local drainage, sewerage and flood control projects, in close coordination with the DPWH;

2. City and Municipal Mayors to lead in the cleaning and declogging of waterways (esteros, canals/ditches, etc.) on a regular basis to avoid accumulation. For this purpose, the Mayors are further directed to organize "Bantay Estero" Teams at the barangay level, which shall maintain the cleanliness of and ensure the smooth flow of esteros, canals, and other waterways. The secretary of the DPWH shall provide technical assistance in the organization and operations of the "Bantay Estero" Teams; and

3. MMDA and City and Municpal Mayors to conduct the appropriate information campaign on the drive to clean esteros, canals, and waterways at the barangay level.

Submit a status report on the matter to my Office, through the Executive Secretary, copy furnished the Head, Presidential Management Staff not later than 30 July 1997.

For compliance.

President Fidel V. Ramos

cc: Executive Secretary
Head, PMS
CORD-NCR
Secretary, DILG
Chairman, HUDCC

FLOODS AND GOVERNANCE: SOME CONSIDERATIONS

Simeon A. Ilago

The Metropolitan Context

The concept of a metropolis connotes a large, heavily populated urban area that transcends the borders of numerous governmental units such as cities and towns. It is a highly interactive environment, comprising urban communities and political jurisdictions that are contiguous to one another. Compared to most parts of a country, a metropolis can be characterized by an intensive concentration of the population, an economy sustained by advanced trade and specialization, and a complex social and economic relationship.

The metropolis is an evidence of urban primacy, which involves the concentration of a significant share of the population and economic activity in one or several large cities (Pernia 1988). In the Philippines, such primacy is enjoyed by Metro Manila: a special administrative and development region (RA 7924) made up of seventeen cities and municipalities. Metro Manila functions as the political, administrative, economic, educational, and cultural center of the country. It accounts for the majority of the manufacturing firms operating in the country, is credited with a substantial share of the national industrial production, and is responsible for a large portion of the country's gross domestic product. As of 1995, the region's population has increased to 9.45 million, and is predicted to reach 10.4 million by the year 2000. As the metropolis occupies a mere 0.05 percent of the country's total land area, it is the most densely populated region with 12,498 persons/ square kilometer.

The expansion and the resulting excessive concentration of population in the metropolis have spawned interrelated problems that are common to urban centers, especially in the developing countries. Rapid urbanization has contributed to distortions of urban functions, intensifying the tensions between the demand for and supply of services such as health, sanitation, housing, transport, water supply, sewerage, drainage, waste management, in addition to employment and income generation.

Flooding as a Governance Problem

Flooding is one of the major, recurrent problems in Metro Manila. Every year the metropolis experiences flash floods and inundations especially during the rainy season. According to estimates, this flooding affects 1.9 million people and inflicts yearly losses of about PhP900 million (DPWH 1998). About 4,400 hectares of Metro Manila are prone to floods (Aquino Administration 1992).

There are several reasons for the increasing intensity of the flooding problem in Metro Manila. The natural elevation of the metropolis is significantly lower than the sea level. Thus several areas are susceptible to overflows of Metro Manila's major rivers, the reduced ability of remaining *esteros* to drain away excess waters, and high tides in Manila Bay. Rapid urbanization has led to an increase in built-up and developed areas, to the conversion of land from agricultural to residential, commercial and industrial uses, and to the widespread use of permanent materials such as concrete. These have contributed to greater impermeability of the ground, making it more difficult for storm waters and surface runoffs to drain efficiently or to penetrate the soil layer. The denudation of the forest cover of mountains near Metro Manila has reduced the retention rate of its watersheds. As a result, the volume of water rampaging down the plains has increased from an estimated 3,300 cubic meters per second to 4,700 cubic meters per second (cms). (*Philippine Daily Inquirer,* May 27, 1997).

These problems are exacerbated by other factors. The capacities of rivers and creeks as well as existing drainage facilities have been reduced by siltation and by the rampant use of these channels for garbage and waste disposal. Remaining natural channels are increasingly encroached upon by the urban poor, businesses, and residential houses. Others disappear in the course of property development. Drainage facilities are poorly maintained. Declogging and retrieval activities are not enough to reclaim their original capacities or to stem the illegal use of these facilities. Institutional and financial constraints limit the effectiveness of the various agencies in finding solutions.

The above reasons and their aggravating factors have both technical and governance dimensions. The technical dimensions lie in the search for modern solutions to retrofit an antiquated drainage system, for tools to model the behavior of the flooding phenomenon, and technical solutions to mitigate its hazards. Governance dimensions come in the sense that flood mitigation responses must also deal with organizations, institutions, and other administrative structures, and must consider as well the mobilization and participation of the community.

The Institutional Framework

Department of Public Works and Highways (DPWH)

Flood management in Metro Manila is the concern of several agencies at the national local levels. However, the principal office with direct responsibility for the planning, construction, operation and maintenance of flood control and drainage facilities in the metropolis is the Department of Public Works and Highways (DPWH). Its mandate over the metropolis is part of its nationwide responsibility for flood control and drainage systems under Executive Order No. 124.

In Metro Manila, DPWH's authority and responsibility for flood control and drainage projects are carried out by its regional office (DPWH-NCR) and the project management offices (PMOs) of the various major flood control projects. The NCR office provides administrative and technical supervision over the operation and maintenance of completed flood control and drainage projects. Although the regional office has overall jurisdiction over the entire Metro Manila area, specific projects are carried out, operated and maintained by various PMOs. For example, the Mangahan Floodway System is operated by the PMO for the Mangahan Floodway Project. The EFCOS (Effective Flood Control Operation System) Project was conceptualized and implemented by the PMO for major Flood Control Projects. EFCOS is now under the supervision of the PMO for Mangahan Floodway Project, a project administratively under the jurisdiction of the NCR office.

The Department also extends technical assistance to local governments in the design, planning, and implementation of food control projects within their localities.

From the above description, we can surmise that overlapping jurisdictions and authority exist among various agencies within the DPWH. It is not clear if such organizational redundancies were planned as part of system stability and control, but such overlaps may have an effect on operations and maintenance functions, especially during emergency situations.

Metropolitan Manila Development Authority (MMDA)

If DPWH has the nationwide mandate for all flood control and drainage systems including those in Metro Manila, the Metropolitan Manila Development Authority (MMDA) has a similar mandate for the metropolis by virtue of Republic Act No. 7924. The act designates Metropolitan Manila as a "special development and administrative region," where certain metro-wide services could be more efficiently and effectively planned, supervised and coordinated by a development authority.

The present MMDA is the successor institution of the previous Metropolitan Manila Commission and the Metropolitan Manila Authority. It represents the latest innovation of a continuing search for a functional metropolitan government (or body) to plan for and address metropolitan problems. Under RA 7924, MMDA is vested with broad planning, implementing, monitoring and coordination functions, as well as regulatory and supervisory authority over metrowide development planning, transport and traffic management, solid waste disposal and management, flood control and sewerage management, *urban renewal, health and sanitation, urban protection and pollution control, and public* safety. These services are considered to "transcend local political boundaries or entail huge expenditures." For flood control and sewerage management, MMDA's responsibilities include the formulation and implementation of policies, standards, programs and projects for an integrated flood control, drainage, and sewerage system.

Municipal and City Governments

Local governments are empowered under the Local Government Code of 1991 (RA 7160) to be responsible for the efficient and effective provision of basic services and infrastructure facilities within their areas of jurisdiction that are funded by the local budget. These projects may include the construction and maintenance of seawalls, dikes, flood control, drainage, sewerage, and other related infrastructure.

Local governments are also responsible for the construction and maintenance of flood control and drainage facilities of city and municipal roads that are under their jurisdiction. They are also responsible for the issuance of permits, and the coordination and monitoring of flood infrastructure projects done by the DPWH within their localities.

Under the Local Government Code also, local governments are given the regulatory power to process and approve plans for residential, commercial, industrial and other real estate development purposes. This has serious planning implications since this regulatory function would involve reviewing drainage and flood mitigation plans and their conformity with the overall drainage plan of the government. This function, formerly exercised by the Housing and Land Use Regulatory Board, is now part of the powers and functions of the local *sanggunian*.

Other Institutions and Agencies

Other agencies interact with the institutions mentioned earlier and in the process become indirectly involved in flood management activities. The National Economic and Development Authority (NEDA) is involved in the setting of priorities for the programming of fund allocations, especially those to be funded by foreign financial institutions. The Laguna Lake Development Authority (LLDA) regulates and monitors all activities that have impact on Laguna de Bay. PAGASA operates runoff gauging stations in major river basins as part of its flood forecasting network, and coordinates with other agencies in tide-gauging and storm warnings. The Office of Civil Defense (OCD)—a government agency under the Department of Defense—oversees disaster management activities that may be required as a result of flooding. It relates with the PAGASA and PHILVOLCS for the technical aspects of flooding.

Expanding the Governance Framework

The above institutional framework merely tells us the governmental institutions and agencies that are concerned with flood management. Both national and local governments are involved in the various phases of planning, implementation and monitoring of flood control projects and initiatives. The framework needs to be expanded to take into account the private sector and the individual citizens, or their families, and nongovernmental institutions.

The private sector has a stake, since flooding has opportunity costs and can cause losses in productivity. However, private sector participation in the planning, design, implementation or financing of flood infrastructure is nonexistent.

Decisions and choices of private individuals can affect the effectiveness of any flood mitigation efforts, from the mundane decisions of how and where to dispose of wastes to the more serious decision of where to put down stakes. On a larger scale, patterns of settlement and movements of families and populations, and the participation of these families in community affairs can influence flood management responses. As cited previously, among the causes of flooding are the clogging of drainage by solid waste and the encroachment on natural waterways and channels of residences and commercial establishments. The individual and the community are part of the causes as well as the solutions to the flooding problem.

Governance Considerations

Given the above interrelationships and institutional framework, what challenges need to be addressed to manage the impact and consequences of flooding as an urban problem?

Flood control and mitigation can be viewed as a program that is continually being implemented. It is important to note the influence of various factors on the implementation process. For instance, it has been noted in the literature on program management that complex institutional arrangements tend to increase the risks of failures in implementation. The greater complexity extracts higher costs in coordination and monitoring. On the other hand, chances of success are enhanced when several conditions are present: the availability and sufficiency of resources as they are needed; complete understanding by implementors and administrators of their roles and functions in relation to the objectives of the program; and understanding and awareness by program beneficiaries.

In the context of the above premises, several challenges need to be addressed to enhance the effectiveness of flood management programs. *These are the challenges of coordination, financing, capability-building, and community participation.*

Coordinating Flood Plans and Responses

The nature of flooding as a phenomenon and its complexity as an urban problem calls for a high degree of coordination among agencies that plan, implement, and maintain flood control infrastructure. Coordination is a persistent issue primarily because of the institutional arrangements now existing for flood control and management. Coordination is essential in the setup within DPWH in which PMOs and the regional office are authorized to plan, implement, and maintain infrastructure parallel to one another. The activities of the district engineering offices under the regional office also require coordination since the effects of flood control and drainage structures may extend beyond the boundaries of the districts and even the political boundaries of Metro Manila.

Coordination is also required to streamline and harmonize the flood control and drainage projects of other agencies with the master plan prepared and implemented by DPWH. Not doing so may prove disastrous as evidenced by the case of the PhP600 million airport drainage improvement program of the Manila International Airport Authority. The program increased the volume of runoff waters drained from the airport premises. This, however, has led to flooding of nearby areas (*Manila Chronicle*, October 24, 1996).

Local governments also need to synchronize decisions involving land development and subdivision plans with the DPWH. Among the concerns raised is the practice of some private developers to proceed with their drainage plans without adequate consultation with the department. Such practice could strain the capacity of existing flood and drainage facilities.

The interrelatedness of flooding with other urban problems such as waste disposal and housing/shelter also raises the issue of coordination. Flood management to be effective must be complemented by an effective solid waste management system.

As it is now, solid waste management functions are divided between the MMDA, which is concerned with disposal functions, and the local governments, concerned with collection. The DENR and DPWH are also involved by way of policymaking and providing necessary infrastructure.

Flood mitigation efforts must also be coordinated with the efforts to relocate informal occupants from high-risk areas such as *esteros*, canals, and floodways. Again, this means coordinated efforts among DPWH, the National Housing Authority, HLURB, and local governments.

Developing the Capacity of MMDA and Local Governments

The issue of coordination must be linked with the development of the capacities of local governments and MMDA in planning, implementation and monitoring of flood control programs and projects. Under RA 7924, MMDA is mandated to provide the overall integrated metropolitan response to the problem of flooding. However, its technical capabilities need to be strengthened. The bulk of the responsibilities are still carried out by the DPWH.

The present manpower staffing of MMDA precludes the development of technical capabilities through recruitment of technical personnel in the short term. As seen from the table below, most of the personnel of the Authority are with the Environmental Sanitation Center, who work as Metro Aides. The majority of the personnel hold permanent positions which limits the ability of the Authority to hire more technically-oriented people.

The Engineering Operations Center, under which flood control and management falls, has a total of 128 personnel who are assigned to the following functions:

Manpower Distribution of MMDA

Office	Career Permanent	Career Others	Total	Non-career	Total
General Manager	96	3	99	29	128
AGM* for Finance and Administration	190	11	201	81	282
AGM for Planning	34	1	35	1	36
AGM for Operations	363	2	365	785	1150
Environmental Sanitation Center	6532	26	6558	385	6943
Total	7215	43	7258	1281	8539

* Assistant General Manager

Administrative - 10
Road asphalting and patching - 34
Cleaning of waterways - 32
Drainage cleaning/declogging - 11
Others - 41

From the breakdown, only 43 are involved in activities directly related to flood control and management, pitifully inadequate relative to Metro Manila's need.

Technical assistance schemes may have to be developed to effectively diffuse technology and information from national government agencies such as DPWH and academe to both MMDA and local governments. A coordinating group involving DPWH engineers, local engineers and other interested groups or individuals could serve as a resource and referral institution for local governments and the MMDA.

As part of flood management also, MMDA and the local governments must continually enhance their development planning capabilities. Among the lessons learned from the flood-induced tragedy in Ormoc, Leyte was the need to include "institutionalization of risk and vulnerability analysis and mapping" in the preparation of socioeconomic profiles, and the "inclusion of disaster preparedness and mitigation programs" in development plans (de Leon and Laigo 1993: 334-335). The flooding problem has to be regarded as a major threat rather than just merely a seasonal aberration.

Financing Flood Control Programs and Projects

Flood infrastructure require massive investments. Financing of infrastructure projects for urban flood control and drainage is shouldered primarily by the national government. Available data in 1995 show that 75 percent of the total PhP779 million spent for MOOE was provided by the national government. Of the total capital investments amounting to PhP1,793 million in the same year, almost 77 percent was provided by the national government and the rest by the various local government units (Pardo 1996). Private investments, either on MOOE or capital investments, have not been tapped. For 1999, the proposed infrastructure program of DPWH-NCR for flood control and drainage in Metro Manila amounts to PhP200 million, allocated among the six engineering districts and the regional office.

It has been estimated that the current fiscal capacity of national and local governments is not enough to sustain the investment and maintenance requirements of urban infrastructure, including that of flood control and drainage (Pardo 1996). The table below shows how much investment is required for flood control. Alternative measures to finance the investment requirements need to be explored, such as private sector financing. This requires that opportunity losses, economic costs, health risks, and other costs imputed to the problem of flooding be quantified in order to provide an encompassing cost-benefit basis for such massive financing.

Estimated Investment Requirement for Flood Control
Infrastructure for the Long Term, 2000-2020 (in PhP billion)

Year	Total Nationwide	Metro Manila
1995	2.57	0.643
2000	49.36	12.34
2005	40.02	10.00
2010	51.69	12.93
2015	60.02	15.00
2020	83.37	20.84

Source: Pardo 1996. Projections were based on a JICA study. Metro Manila represents 25 percent of total sector requirements.

Mobilizing the Community

In the discussion of the institutional framework, the involvement of the barangays has not been considered. However, barangays should be an important part of any flood management program, specifically in the aspect of solid waste management and the monitoring of illegal structures that encroach on flood channels and waterways. Where possible, barangays should be tapped for cleaning and declogging of drainage systems within their respective jurisdictions as part of their functions to protect the environment and to promote the general welfare of the community.

Aside from the barangays, the participation of homeowners' associations and community organizations should be encouraged as well for the same reasons cited above. These associations can also function as advocacy groups to influence policy-making by local officials and to identify problems that could aggravate the flood situation in the metropolis.

In Cainta, for example, an advocacy group called the Metro-Rizal Flood Control and Environmental Council was established in late 1997. Among the activities conducted by this group was an information awareness campaign culminating in a protest march against a hardware manufacturing firm. The firm built a warehouse that encroached on a portion of Buli River, causing the river to overflow easily during the rainy season (*Philippine Daily Inquirer*, April 3, 1998).

Other Considerations

Apart from the considerations mentioned above, there are other governance dimensions of flooding that need to be explored, such as the potential of inter-local government cooperation in the financing and provision of flood infrastructure and the linkage between flood forecasting, disaster, and flood information dissemination.

Concluding Remarks

As noted in the earlier discussion, flood control and mitigation has governance dimensions. These governance dimensions are essential to complement the technical efforts of government to understand flooding as a phenomenon and to minimize its disruptive consequences. These governance dimensions also point out the interrelatedness of the flooding problem with other urban issues, the existence of various institutions which deal with the problem within the same metropolitan context, and the need for coordinated efforts, no matter that the calls for coordination have become repetitious and tiresome. The enormous amount of investment required to carry out the projected plans and programs for flood control also raises the issue of private sector involvement in financing and the need to develop a reasonable valuation of the cost of the havoc that flooding brings. Finally, flood control efforts must emphasize the participation not only of the private sector but also of the barangay and the community since decisions made at these levels have significant impact on the effectiveness of flood control.

REFERENCES

Aquino Administration. Major Development and Project (1986-1992): National Capital Region, 1992.

"Airport Drainage Causes Flooding." *Manila Chronicle*, October 24, 1996.

Department of Public Works and Highways. Flood Control Projects: National Capital Region, 1998. Photocopy.

De Leon, Corazon Alma and Lina Laigo. "Flood Relief and Rehabilitation in Ormoc: Experiences and Insights of Administrators." *Philippine Journal of Public Administration*. Vol.37, No. 4 (October 1993), pp.327-335.

Pardo, Erlito. "Financing Urban Infrastructure." Country Discussion Paper: Philippines. Manila: Bureau of Local Government Finance. 1996.

Pernia, Ernesto M. "Urbanization and Spatial Development in the Asian and Pacific Region: Trends and Issues." *Asian Development Review*. Vol.6, No.1 (1988), pp.86-105.

"Relief from Floods." *Philippine Daily Inquirer*. May 27, 1997.

Republic Act No.7924. An Act Creating the Metropolitan Manila Development Authority.

Republic Act No.7160. The Local Government Code of 1991.

"Warehouse under Fire." *Philippine Daily Inquirer*. April 3, 1998.

METRO MANILA FLOODING: THE SOCIOCULTURAL DIMENSION*

Joy B. Page

Saying that flooding has affected the lives of Metro Manila residents in every possible way is an understatement. Possibly still fresh in our memories are traumatic incidents brought on by past floods. Monstrous traffic jams and painful muscles from having to walk home are common complaints. All of us have our woeful tales. Floods have become part of our accepted reality and that is the every reason why it is important to study the different dimensions of flooding.

The focus of this article is the social dimension of flooding, specifically what may be called "flood culture." The objectives are the following: (1) to identify the social causes of flooding; (2) to identify its social effects on life and property and also the different forms of what may be called "social disruptions;" and (3) to identify the ways by which Filipinos cope with flooding and analyze these in the context of Filipino culture.

In line with the objectives, the article has four major sections namely, a dimension on flood as a social issue, its social causes, social effects, and finally, the flood culture of Filipinos.

Flood As A Social Issue

It is disturbing when people begin taking floods for granted because this means they have become desensitized to a social issue. That is what flooding has come to—it is no longer just an environmental or meteorological problem, and not just in terms of its effects but also of its causes. It is no longer just a matter of taking the flood problem as a natural environmental phenomenon, but also as a social phenomenon where even matters of politics, demographics, and economics are involved.

---

*Much of the data presented in this article came from secondary documents taken from government agencies, namely the National Disaster Coordinating Council (NDCC) of the Office of Civil Defense and the Field Epidemiology Training Program (FETP) of the Department of Health; the Citizen's Disaster Response Center (CDRC) and various newspaper reports. The reports collected focused on major flood incidents from 1995 to presents. Primary data from interviews with residents and barangay officials of some flood-prone areas proved to be particularly important in providing accounts of firsthand experiences about floods.

An "issue," according to the Sociologist C. Wright Mills, as opposed to a "private trouble," "often involves a crisis in institutional arrangements..." (Mills 1959). Metro Manila flooding is an issue because a great number of people are affected and because social organizations and institutions may be the cause of floods just as much as they are victims.

Figure 1 shows the distinctive effects of floods by way of their effect on the population. (The data come from the Citizen's Disaster Response Center, an NGO.)

Figure 1

DISASTERS IN THE PHILIPPINES
POPULATION AFFECTED BY DISASTER TYPE (1991-1997)
Source: CDRC

	Flood/Flashflood
1991	114,295
1992	21,060
1993	361,082
1994	1,248,752
1995	1,013,681
1996	224,556
1997	1,043,556
TOTAL	4,026,985

In most Metro Manila areas, flooding occurs after just half an hour of continuous rains. In some areas, people have come to anticipate knee-deep waters. Who can forget the heavy rains lasting for less than an hour on July 28, 1995 that forced thousands of Metro Manila residents to spend the nights in the streets, either walking or being stuck in vehicles? Or the May 28, 1996 and August 18, 1997 major flooding incidents? The point is that Metro Manila flooding can often be characterized as disastrous.

Social Causes

The common necessary conditions of flooding as stated in news reports are continuous heavy rains, elevation of the affected areas (i.e., low-lying or catch-basin portions of Metro Manila are said to be prone to flooding), high tide, and finally, poor drainage systems. These factors, if taken in combination, will surely cause flooding in certain areas. But at the same time, the problem with the drainage systems cannot be isolated from the garbage disposal problem and the infrastructural aspect of the flood issue, both being grounds for discussing the sociocultural aspect of the issue at hand.

Causes of flooding may be categorized into three types depending on the source. These three types may be labeled as individual- and household-caused floods, industry/business-caused floods, and infrastructure-caused floods.

Floods caused by individuals/households

Individual- and household-caused floods are rooted in improper garbage disposal. In addition to the everyday trash indiscriminately thrown in the streets that end up clogging the drainage, household waste is a major culprit and mostly blamed on people residing near the *esteros* are blamed for it. The June 26, 1998 episode of "Magandang Gabi Bayan" aired on Channel Two featured a segment on the flood problem. A section of the squatter community was shown throwing garbage—ranging from rubber tires to dead animals—.into the *esteros*. To them, the *estero* is an attractive site waste materials since there is no more garbage collection to speak of. It is also common knowledge that *esteros* serve as toilets for many squatter communities. Indeed, on the same program, a DPWH engineer said that the flood problem would never be solved unless squatting itself is eradicated.

Floods caused by industry/business

Industries/businesses may also contribute to flooding when waste is improperly disposed of. On the same TV show mentioned above, some public market vendors were shown dumping their garbage in nearby *esteros*. Also shown was how oil and grease from auto-repair shops in Banawe St. in Quezon City can easily clog gutters and culverts. These are only a couple of examples that illustrate how businesses/industries contribute to flooding through improper waste disposal.

Floods caused by infrastructure

Infrastructure-caused floods speak of two scenarios. Floods may be caused by debris from construction sites that end up clogging the drainage. Such a situation occurred last May 29, 1998, when the EDSA-Shaw Boulevard underpass was submerged in floodwaters, and on June 24, 1998 when Quezon City streets, particularly the Elliptical Road, were flooded. Newspaper reports on both floods cited the presence of loose debris from construction (e.g., loose gravel, sand, and cement) of the MRT, and diggings on highways, respectively, as responsible for the floods.

The other scenario is when floods are caused by the infrastructure themselves that interfere with or block the drainage system. This is a case of "infrastructure" damage. With regards to the May 28, 1996 flooding, then "traffic czar" Romeo Maganto of the MMDA pointed to the concrete fences built by house owners in certain subdivisions as blocking the drainage, turning portions of the South Superhighway into "water basins." Similarly, portions of Sta. Mesa Heights and of the Talayan area in Quezon City have experienced flooding. Residents pointed to the construction of a condominium building in the area that affected their drainage system. Some residents even believed that flooding occurred in their area because the construction turned the drainage into a septic tank. How was this possible? Rumor had it that the building owner had connections in the mayor's office.

Another example is the Skyway project. The DPWH has warned that certain portions of Makati will experience heavy flooding during the rainy season. This is because portions of the underground drainage system at the South Superhighway in Makati were knocked down by the construction of the Skyway.

In discussing individual- and household-caused, industry/business-caused, and infrastructure-caused flooding, a number of sociocultural factors can be identified. One of these is the Filipino's concept of property. For some, the saying "Bakuran ko, sagot ko" holds true all the time. Others have no concept of private property at all and areas beyond the property line are still claimed or perceived as part of a person's "birthright." Thus, with the latter, the term "public property" is misconstrued as "common property."

In both cases, accountability becomes the problem. If one believes that accountability goes only as far as the property line, then maintenance stops there. On the other hand, a sense of extended ownership may have positive results as long as accountability exists. The problem with squatters is that they consider the *esteros* as extensions of their houses where they can dispose of their wastes. And once something is "thrown away," ownership, together with accountability, ceases. Therefore, nobody "owns" garbage. In the case of infrastructure-caused floods, contractors may have no regard for their effect on the surrounding drainage system and other issues of safety and compliance with the law.

It is apparent that people do not acknowledge that each individual contributes, however minutely, to society, and that this society, in turn, affects the individual as well. It is sad to say that most of us do not possess the ability to perceive the interconnectedness of things or events nor the intersections of the various realities we ourselves are parts of.

Social Effects

The social effects of floods may be mostly economic in nature although there are also health-related problems, including loss of lives and other types of social disruptions.

Economic Costs

The economic costs brought about by floods include damages to property and infrastructure. Figures 2 and 3 on the following pages reflect the statistical data on flood damages provided by the NDCC. A limitation is that they are data reflective of statistics on the national level. No statistical data exist exclusively for Metro Manila flooding.

However, a disparity between the two tables in terms of the number of occurrences during 1995 can be observed though both tables came from the same source (figs. 2 and 3).

Figure 2

ANNUAL STATISTICS DATA ON MAJOR FLOODINGS (1970-1995)
Source: Office of Civil Defense

	1970-1972	1973	1974	1975	1976	1977
OCCURRENCES	0	2	1	4	3	6
DEAD	0	3	0	0	18	5
MISSING	0	0	0	0	3	0
INJURED	0	0	0	0	0	0
AFFECTED FAMILIES	0	5,043	1,823	99	14,626	1,529
PERSONS AFFECTED	0	30,234	9,115	495	73,443	9,272
ESTIMATED COST (PhP M)	0	3.31	0.013	0.801	12.322	16.208
ASSIST. EXTENDED (PhP M)	0	0	0	0	0	0
HOUSES TOT. DESTROYED	0	0	0	0	0	0
HOUSES PART. DESTROYED	0	0	0	0	0	0

	1978	1979	1980	1981	1982	1983
OCCURRENCES	2	3	5	4	2	6
DEAD	3	1	336	125	27	41
MISSING	8	0	0	122	1	0
INJURED	0	0	0	95	21	45
AFFECTED FAMILIES	355	16,597	126,528	622	99,623	5,468
PERSONS AFFECTED	1,775	96,867	762,686	3,732	532,602	32,808
ESTIMATED COST (PhP M)	0	5.178	366.287	4.21	115.061	12.577
ASSIST. EXTENDED (PhP M)	0	0	0	4.182	2.045	0.135
HOUSES TOT. DESTROYED	0	0	0	0	0	0
HOUSES PART. DESTROYED	0	0	0	0	0	0

	1984	1985	1986	1987	1988	1989
OCCURRENCES	6	0	1	4	6	13
DEAD	0	59	4	2	2	101
MISSING	0	13	2	2	0	148
INJURED	0	0	4	2	0	79
AFFECTED FAMILIES	1,160	15,004	24,392	286	532	81,152
PERSONS AFFECTED	36,254	82,857	122,051	1,723	3,192	459,730
ESTIMATED COST (PhP M)	2.5	7.334	9.145	0	0	392.203
ASSIST. EXTENDED (PhP M)	0	0.083	0.214	0	0	0
HOUSES TOT. DESTROYED	0	0	0	0	0	0
HOUSES PART. DESTROYED	0	0	0	0	0	0

	1990	1991	1992	1993	1994	1995
OCCURRENCES	7	4	3	26	32	56
DEAD	39	7	28	32	42	127
MISSING	50	3	3	17	7	38
INJURED	50	0	0	4	6	10
AFFECTED FAMILIES	3,072	686	15,405	72,997	62,485	185,588
PERSONS AFFECTED	14,770	3,670	81,478	375,058	298,465	1,111,181
ESTIMATED COST (PhP M)	41.01	30	135	1,085	339.777	586.212
ASSIST. EXTENDED (PhP M)	1.219	1.219	1.219	0	0	5.648
HOUSES TOT. DESTROYED	0	0	0	0	0	0
HOUSES PART. DESTROYED	0	0	0	0	0	0

Figure 3

Natural Disaster Incidents (January-December 1995-1997)
Source: NDCC, Office of Civil Defense

	FLOODINGS		
	1995	**1996**	**1997**
OCCURRENCES	34	33	28
CASUALTIES:			
DEAD	86	20	46
INJURED	2	2	4
MISSING	9	6	0
AFFECTED:			
FAMILIES	133,530	30,098	75,882
PERSONS	736,900	171,472	370,934
HOUSE DAMAGED:			
TOTALLY	941	215	590
PARTIALLY	1,834	1,272	630
COST OF DAMAGE (PM):			
AGRICULTURAL	356.558	159.207	848.779
INFRASTRUCTURE	229.316	88.925	256.681
PRIVATE PROPERTY	0.338	29.641	2.48
TOTAL	PhP586.212	PhP277.773($11M)	PhP1,107.940

The data show that the occurrence of flood is generally increasing throughout the years, although the trend declined from 1995 to 1997 (fig.3). It should be noted that it was in 1997 when the El Niño phenomenon started. Yet, despite the decreasing trend in occurrences, it is interesting to note that the number of families and persons affected from 1996 to 1997 increased markedly, from 30,098 to 75,992, while the number of persons affected increased from 171,472 to 370,934. Two possible factors may be responsible for these results. One is the increase in actual population in the affected areas. The other is that the floodings in 1997, though fewer than in 1996, may have been more disastrous.

Loss of Life and Health-related Problems

Flood occurrences are also associated with a number of health-related problems, including loss of life due not only to the diseases caused by floodwaters, but also directly to the flooding itself. There have been a number of cases of drowning during floods. It is also not uncommon to hear cases of electrocution caused by live wires submerged in the water. In the August 18, 1997 flooding, two people were electrocuted in Malabon and Navotas, while at least two men drowned in Manila and Parañaque while a man last seen sleeping inside the maintenance room of the Lagusnilad underpass apparently drowned as the underpass was inundated by floodwaters.

The DOH has a list of diseases associated with floods. Diseases due to water contamination become common as pipelines rupture and leak and water purification systems break down due to floods. These cause the spread of gastroenteritis, dysentery, typhoid fever, cholera, and hepatitis A.

The DOH also warns people against leptospirosis which may be acquired by wading in water contaminated with the urine of infected animals. Incidents of mosquito bite-related diseases (primarily malaria and dengue fever) also rise in times of flooding since this is when mosquito breeding sites proliferate.

Social Disruptions

Aside from the economic and health-related costs imposed by floods, people are also familiar with the following disruptions in their daily lives: suspension of classes for students, closure of government and private offices, cancellation of flights by the airlines, monstrous traffic jams, and stranded commuters all over Metro Manila. During floods, commuters get stranded because the already limited number of public vehicles get stuck in traffic jams or cut trips to avoid flooded areas. Domestic and international flights may be cancelled, as in the August 18, 1997 flood which submerged runway tarmacs under knee-deep waters.

Flood Culture

The following is an excerpt from an editorial article of the July 29, 1995 issue of the *Philippine Daily Inquirer*.

> "We looked out the window. Checked out the bumpers of vehicles up front. Took a nap for three hours. Sprained our neck, strained our eyes, too, looking for a traffic cop. Wolfed down yesterday's sandwich. Did all we could do to discipline our bladder. Made plans for the children's future. Even renewed our wedding vows. Balanced the national budget...Our whole life practically flashed before our eyes, and still we were stuck in Friday night's "to-die-for" traffic. Reasons: closure of Nagtahan Bridge; heavy downpour; flashfloods; unfinished road repairs by the DPWH; diggings without end by the PLDT, MWSS; flights of traffic policemen at the sign of rain; main streets doubling up as open air markets; streets as parking lots; absence of a rational transport system; lack of discipline among drivers, payday, Friday, etc..."

The excerpt captures the coping mechanisms ordinary Filipinos adopt when faced with a stressful situation such as being stuck in traffic. It should be noted that coping is only one aspect of culture. The flood culture of Filipinos is circumscribed by the general patterns of behavior that can be observed in times of flood.

As a people, Filipinos are said to be quite resilient partly due to the fact that we are used to calamities and other forms of crises. This, of course, is a matter of geography, and not a matter of fate as a people, though some choose to explain such things in terms of "acts of God" in themselves.

Coping

Making Light of the Situation

In stressful situations, as with flooding, Filipinos have a way of making light of the situation. Past flooding incidents have shown to us the truth behind this observation. A newspaper article on August 18, 1997 flooding clearly reflects this attitude of "not letting the situation get to you," of Filipinos trying to make light of the situation. According to the article, at the end of the working day office worker Pamela Capiz boarded a Jam Transit liner at the Landmark terminal in Makati to go home to San Pedro, Laguna. Due to flashfloods that paralyzed traffic on the South Expressway, Capiz arrived at the Pacita Complex at around six o'clock in the morning of the next day. The passengers passed the time watching VHS movies and singing along with videoke tapes.

Humor

In times of stressful situations, it is also quite common to find people turning to humor. In the same news report cited above, some passengers, mostly students and office workers, "made fun of their miseries" by exchanging jokes.

Not Letting Problems Get to Them

Another way of coping with difficult situations is by not letting one's difficulties limit one's activities. The following incidents from the same news report cited above reflect such coping. A certain Dindo Matining, twenty-six years old, waded in floodwaters, walked miles along with other stranded people, and clung to overcrowded buses just to get to his girlfriend's house. A De La Salle guidance counselor said he opted to stay in the office and ended up surfing the net and doing some paperwork. At some offices along Padre Faura in Manila, car owners decided to leave their vehicles in the parking lots and to brave the rising waters on foot. Apparently, most people just wanted to get home even if it meant walking long distances through floodwaters.

Community Spirit

An aspect of Filipino culture that is often manifested in times of calamities/crises such as during floods, is community spirit or "pakikiisa." Critical situations that force people to stay together eventually create a feeling of oneness due to the common experience or difficulty. At this point, one ceases to regard the other person as "ibang tao," and try to alleviate their discomfort as much as possible. One police officer, for example, identified as Mario Garcia of Pasig, approached a group of stranded commuters and volunteered to bring the elderly and pregnant women among them to their respective homes.

Income Generation

It is also common for some Filipinos to take advantage of other people's desperation. During the August 18 flooding, some FX drivers charged PhP100 for every passenger between Quiapo and Ermita. Pedicab drivers were also reported charging PhP30 per passenger for a ride of four blocks. Another instance of entrepreneurship is exhibited by those who build makeshift bridges across flooded streets to allow people to cross for a fee. These examples illustrate not merely the (twisted) "ingenuity" of Filipinos, but more so their poverty and their need to earn that extra peso.

Isolated Incidents

If flood culture were to be taken as the composite of street and traffic incidents, then it is worth mentioning that during the May 28, 1996 flooding, an NBI agent, becoming impatient with the traffic jam, shot a bystander whom he mistook for an MMDA traffic enforcer literally sleeping on the job. The unfortunate bystander just happened to fall asleep in the traffic outpost.

Systematized Coping

Residents who have to live with frequent flooding also develop some form of flood culture. Evacuation centers are easily set up in the parish hall, the barangay hall, a public school, or some elevated area. Those used to evacuating would usually have already prepared the necessary supplies of rice, cooking oil, sugar, coffee, canned goods, and dried fish at the start of the wet season to take along when floods force them out of their homes. It may also be observed that houses, especially those owned by middle- to upper-class residents, located in flood-prone areas are often two- or three-story affairs. Owners admit they no longer attempt to fix or decorate the first floors of their houses. Some have raised electric sockets off the floor in anticipation of the floods. But still, repeated floodings have not deterred people from returning to their inundated houses.

Conclusion

It is important to realize that part of the problem lies in people's perceptions of flooding. There is a tendency to take floods for granted, to think that it is something natural and inevitable, that there is no hope for a feasible solution. We need to acknowledge that we face a social problem and that the issue of flooding would inevitably lead to the large issue of population and poverty and their convergence into the problem of squatting.

The squatting problem in Metro Manila persists as an issue related not only to poverty but also to urbanization. Migrants continue to flock to the city because of the perception that Metro Manila offers opportunities that are absent in the provinces. It is still a reality that many people still perceive urban centers as sites of better opportunities.

The presence of squatter colonies along the *esteros* becomes a problem for waste disposal as well as *estero* maintenance. The DPWH may have the equipment to unclog the *esteros* but they are unable to use them efficiently. In the Magandang Gabi Bayan June 26, 1998 episode, it was mentioned that during the Marcos era, the administration built a service road at the side of one *estero* here in Metro Manila. The problem is that there is now a squatter colony on the said service road and the DPWH maintenance equipment cannot it to get access to the *estero* anymore.

Given the issues associated with flooding in the context of Filipino culture, what then are the possible areas of discourse that may be useful in the efforts to mitigate the effects of flooding?

There are two general areas that may be cited in this respect.

1.There is a need to improve the database on flooding. (Note discrepancies between the data sets of the CDRC and the OCD.) Consistency of data coming from various agencies or organizations is crucial. There also seems to be a need to organize data on flooding per area affected. Most statistics released reflect data on the national level only withouth breaking them down into regions and other necessary categories.

2.There is also a need to identify the concerned agencies or organizations and publicize their activities. This is to encourage greater coordination among them. It has been pointed out that part of the flooding problem is organizational. Data on infrastructure-caused floods reflect that there is a problem as far as accountability is concerned. As in the construction of the MRT that was said to have contributed to the flooding of the EDSA-Shaw Boulevard, it cannot be determined which agency (whether DPWH or the MMDA) should have been held accountable. Other than this, organizations responsible for the release of permits for building constructions and other infrastructure, should be accountable for monitoring such constructions. This is to ensure that no violations are made as far as the drainage system is concerned.

Finally, there is still that basic need to increase the awareness of people with regard to flooding as a social phenomenon. In the process, it can be pointed out that something should and can be done about it.

BIBLIOGRAPHY

Bello, John et al. 1995. "Slides Hike Typhoon's Toll to 240." *Philippine Daily Inquirer.* November 5. p. 3.

Burgonio, TJ et al. 1997. "100,000 Evacuation in Metro." *Philippine Daily Inquirer.* August 20. p. 1.

Contreras, Volt. 1996. "Maganto Theory: Fences for Rich Blamed for Floods." Philippine Daily Inquirer. August 1. p. 21.

Contreras, Volt et al. 1997. "Flooded Metro Manila Stands Still." *Philippine Daily Inquirer.* August 19. p. 1.

Lectura, Lenie. 1998. "MMDA Ready for Floodings." *TODAY.* May 29. p. 2.

Mills, C. Wright. 1959. *The Sociological Imagination.*

Nocum, Armand. 1998. "DPWH Ready for Floodings." *Philippine Daily Inquirer.* July 21, 1998. p. 22.

Ubac, Michael Lim. 1998. "Flashfloods Blames on Garbage in Quezon City." *Philippine Daily Inquirer.* June 26. p. 21.

"Rage, rage." 1995. *Philippine Daily Inquirer.* July 29. p.1.

"Sleepless on the Road: Makati-San Pedro Ride Takes 14 Hours." *Philippine Daily Inquirer.* August 20, 1997. p. 1.

Data from NDCC:
Natural Disaster Incidents (January-December 1995-1997)
Annual Statistical Data on Major Floodings (1970-1995)

Data from CDRC:
Population Affected By Disaster Type (1991-1997)

Conference Highlights
METRO MANILA FLOODS

August 28, 1998

This section presents a summary of the open forum held in the afternoon of the conference proper after all the papers were presented. The open forum was divided into three major topics for purposes of facilitating discusssions:

- Nature of Floods and Flood Control and Management
- Roles of National and Local Governments and the Private Sector
- Coping with Floods and the Social-Economic-Cultural Dimensions

The above topics were in accordance with the subjects of the presentation in the morning session. The open forum generally progressed following the sequence of the topics enumerated above.

At the end of this section, the proposal to organize a Metro Manila Flood Forum is presented, as well as the concept paper for this proposed forum.

(A verbatim transcription of the open forum could have been presented here since it was taped. However, difficulties in transcribing the tapes lead to the decision to present only summaries of the discussion. Only in those instances when the speakers are identifiable are their names mentioned.)

NATURE OF FLOODS AND FLOOD CONTROL AND MANAGEMENT

- Regarding the design of flood control systems in Metro Manila, Engr. Nonito Fano (DPWH) stated that the determination of the sizes of drainages is based on standard engineering formulas. For Metro Manila, for example, the main drainage system is based on a 10-year-return period-storm while the secondary drainage system is based on a five-year-return period-storm. The smallest drainage pipe now specified is 24 inches in diameter, although, there exist drainage pipes of 18- and 12 inch-diameter. He also stated that the design life spans usually of the system were between 8 to 15 years except in the case of the large main drainage which is more than 50 years. According to him, a design life of 25 years is sufficient as long as the systems are adequately maintained and the hydraulic capacities are well monitored.

Dr. Alan Pineda (PAGASA) asked why flooding occurred everytime it rained despite such design parameters. Engr. Fano replied that actual rainfall may exceed the design parameters. He then cited a study conducted in connection with the Retrieval Projects of

JICA in 1994 that indicated that one of the major reasons why there has been frequent flooding even after ordinary rain is the lack of maintenance of the drainage systems. In certain cases, this caused structures that were designed for five years to experience reduced capacities in less than this period. A second reason according to Engr. Fano is the garbage problem. A study conducted by an engineering consultant from California in 1984 showed that garbage enters our drainage systems all the time even during nonrainy days because street sweepers, the Metro Manila Aides, improperly dispose of garbage into the curb inlets. He remarked that this was quite an irritating practice because it drastically reduced the capacity and efficiency of the drainage system.

- Dr. Guillermo Tabios (UP Civil Engineering Department) suggested using open drainage system, as in Singapore, as opposed to closed systems. Open systems are easy to clean and maintain. There is, however, also the hazard of someone falling into them.
- Dr. Leonardo Liongson (National Hydraulic Research Center; UP Civil Engineering Department) mentioned that standards should conform to location. He cited, as an example, Quezon City which is higher in elevation compared to Old Manila. He also said that many of the Manila *esteros* had been reclaimed by commercial and industrial establishments and to ask the DPWH to turn back the clock was touching on a question of land use policy and of land ownership. This was true also for Navotas, Malabon, some portions of Pasay, and Makati.
- Dr. Liongson also mentioned that the design of drainage systems could consider the garbage disposal issue. Normal design standards he said, do not take this into account.
- Ms. Consuelo Sison (vice president, Association of Quezon City Homeowners Association), remarked that in Capitol Hills they were concerned that road and drainage works contractors hired by the government used substandard materials in construction. Thus, government inspectors should seriously perform their duties to check on these contractors. She asked whether performance or insurance bonds can be taken out to ensure that the contracted work and especially the standards required were fully satisfied.
- Engr. Bayani (DPWH) commented that the street diggings seemed like never-ending jobs due to the lack of coordination among utility companies (such as the Philippine Long Distance Telephone Co., water companies, and the DPWH as well).
- Engr. Juan (Phillips Technical Consultants, Inc.) and Dr. Liongson mentioned the importance of curb inlets in conveying floodwaters from the street into the drainage system underneath the streets. There were observations made on the poor design of curb inlets such as their shape, size, and the spacing between them, all of which can have significant flooding impact. Engr. Fano responded that he has asked the DPWH's Bureau of Design not to *misdesign* the curb inlet.
- Dr. Tabios inquired as to how changes in urbanization in the next 50 years are considered in the design. For example, the drainage system in Manila was designed when urbanization was not yet widespread. In response, Engr. Fano responded that as a matter

of policy, the DPWH considers the changes in urbanization on a case to case basis, resulting in piecemeal.

- Prof. Samuel Ilago (National Center for Public Administration and Governance) pointed out that the jurisdiction of Metro Manila may soon extend to as far as Infanta, Quezon, while also covering Subic and parts of Calabarzon and Clark. Thus, planning for Metro Manila, including its flood control system should likewise extend over this expanded territory.
- The secretary of the City Engineer's office of Marikina spoke lengthily about the flood-related laws and programs of Marikina. Recognizing that garbage is a major cause of clogging of drainage systems, she noted that they were fortunate to have an engineer as city mayor in the person of Mr. Fernando. The city has implemented laws against improper garbage dumping with fines and even possible jail terms against violators. The mayor is known to reprimand people himself for indiscriminate garbage disposal. In addition, the city owns dredging equipment to clean waterways such as the Marikina River.
- An inquiry was made about the possibility of UP-CIDS recommending a reduction in the use of plastic materials in Metro Manila in emulation of progressive countries like Singapore, Japan, and Taiwan. It was pointed out though that Taiwan was dumping the machinery to manufacture plastics in Philippines. Ms. Bella Lucas (UP-CIDS) responded that the CIDS Program on Solid Waste Management was doing some studies and may try to get in touch with people in the legislature.
- Another problem mentioned was the proliferation of squatters along urban creeks and floodways (such as the Mangahan Floodway) thereby hampering the capacity of the flood control system. In July 1977, there was a flood summit in Malacañang and one flood-related measure specifically agreed upon was local government removing squatters along floodways. This has not been pursued by the new government.
- It was stated that "the problem of garbage comes from the uneducated or from the squatters and that NGOs (nongovernment organizations) and GOs (government organizations) should educate people on proper handling and disposal of garbage. This immediately solicited a response from Prof. Castro (UP Civil Engineering Department) in defense of the squatters who said that the city did not collect garbage in squatter areas, but only in areas where rich people (including the middle class) lived. Prof. Castro also said that the problem of garbage in squatter areas was not due to lack of education since awareness and proper garbage handling and disposal was part of the school curriculum.

Prof. Ilago said that the urban poor contributed a minimal volume of garbage, about 4 percent of the total garbage collected, and that the bulk of garbage came fom commercial and business establishments. It was, therefore, unfair to blame the squatters for the garbage problem only because they visibly lived along esteros where garbage tends to accumulate.

- Mr. Ramon Balatbat (President of the Association of Quezon City Homeowners) commented that garbage collection is really a multimillion peso business venture. According to him, their subdivision paid about 300,000 pesos a year for the collection of garbage. He said that if you teach people how to manage their garbage properly, the trash collector would lose big money. The association has spoken to Councilor George Banal of the Quezon City Council about alternative garbage disposal systems. One idea was to establish a redemption center were people can bring their garbage and maybe even get money for it. Some of the garbage can be recycled, such as organic materials which can be composted.

- Engr. Fano showed slides of floods, *esteros*, and floodways around Manila, as well as the garbage collected at the pumping stations of the drainage system. He said that the drainage canals and culverts did not conform to the DPWH design standards nor to the overall configuration of the master plan. He showed how the garbage dumped around the inlets of large drainage systms caused the frequent flooding of España and parts of Quezon City. He also showed the enormous piles of garbage that clogged the system at the pumping stations.

ROLES OF NATIONAL AND LOCAL GOVERNMENT AND PRIVATE SECTOR

- Prof. Ilago began the discussion on this topic by making comments about the current government set-up in Metro Manila. He said that the various issues and concerns discussed earlier maybe properly addressed or dealt with if there were an effective and functioning MMDA. Ideally MMDA should be coordinating with the local government units (LGUs) and then relays problems to the national government agencies concerned. This would lessen the LGUs' burden of having to deal with several national government agencies.

- Ms. Rose ______ observed that road construction stopped when it reached the boundary of another city or municipality. Another case she cited was the changes in road or highway design when a national road turned into a local road. She asked whether this was also the case when constructing drainage systems. DPWH claimed that when they construct drainage systems, they develop the drainage network all the way to the downstream end. Problems occur when the local government constructs a local drainage system that can overwhelm the capacities of the drainage system of the national government. There can be incompatibilities between the local drainage system and the national drainage system, including varying maintenance schemes that can lead to build-up of debris or garbage in the system.

Someone said that the government should really be responsible for preventing the dumping of garbage which clog drainage systems. This could mean giving cities special regulatory powers to go after big industrial polluters. This could also be designated a big part of the environmental management functions of the DENR. Also, it was suggested that some form of taxation in addition to regulation should be imposed on illegal garbage dumping. The tax money could then be used to develop infrastructure and to improve the environment.

COPING WITH FLOODS AND THE SOCIAL-ECONOMIC-CULTURAL DIMENSIONS

- Engr. Enrico Gregorio (research fellow, National Hydraulics Research Center), showed some slides of past floods in the Metro Manila, one of which was of Rosario Bridge in Pasig showing squatters along the river banks. The slide was taken right after a flood and showed that the water level reached the lower portion of the houses yet people continued to live there. The other slides showed similar situations in other areas along the city's rivers and floodways.
- Engr. Fano commented that the Mangahan Flood Control Project was an all-in-one project: a flood control project, a relocation project, a housing project as well as a garbage collection project. He said that some people in the area, having been told that the floodway was designed for a 100-year flood thought it was all right to live there because it would take another 100 years or a century for the big flood to happen.
- It was recognized that a missing component in this conference was a paper on the economics of floods. Some said that economic studies would justify spending money on declogging the floodways if it can be shown how many millions were annually lost to floods. Flood economics should definitely be included as a topic in a future conference.

PROPOSAL TO ORGANIZE A METRO MANILA FLOOD FORUM

As with any gathering, the question at the end was: "Where do we go from here?" For this purpose, the organizers of this conference saw the need to continue discussion of Metro Manila floods through a proposed Metro Manila Flood Forum. It is envisioned to be an organization that would be a venue for continuing discussions on flood issues and concerns with the aim of developing long-term solutions. A concept paper was prepared by the organizers, part of which reads thus:

The Forum will be a nonprofit, nonpartisan, "consensus-building" organization. The purposes of the Forum are:

(a) To provide a consensus-building atmosphere on flood problems, control and mitigation in Metro Manila.

(b) To provide an open forum for the exchange, improvement, and pooling of flood-related information, analysis, methodologies and modeling tools as well as any associated professional resources on flood control and mitigation.

(c) To assist in and mediate technical disputes involving flood control and mitigation problems.

(d) To increase the usefulness of analytical techniques, modeling tools and computerized decision-support systems for analyzing and solving flooding problems.

(e) To seek input from various stakeholders and decision makers about their needs in solving flood control problems through the use of analytical techniques and modeling tools.

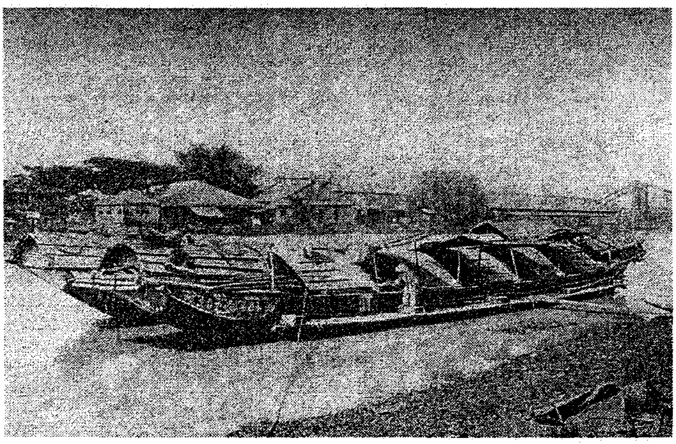
(f) To conduct reviews of various analytical techniques and modeling tools in order to document strengths and weaknesses, suggest improvements and identify appropriate applications.

(g) To provide educational opportunities by conducting technical conferences and workshops on flood-related issues and problems and the use of analytical techniques and modeling tools to solve flooding problems.

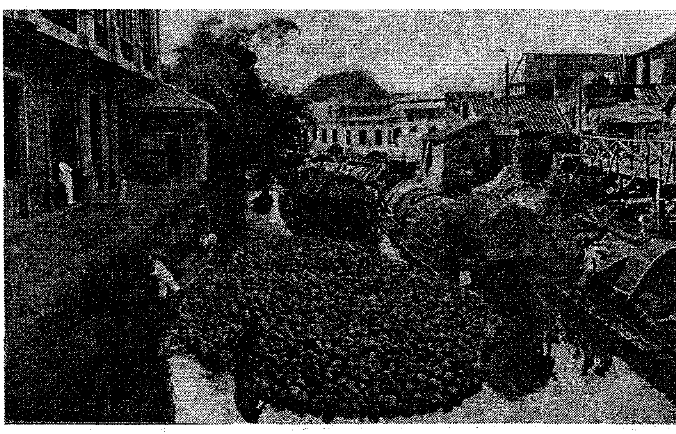
The scope of interest of the Forum includes, but is not limited to: flood events and damages; health-related flood hazards; related flood control infrastructures; benefit-cost-risk factors; hydrodynamics, hydrology, hydraulics, real-time management, system operations, water quality, and water resources planning. In terms of analytical techniques, modeling tools and computerized decision-support systems, the Forum is interested in the following: flood-related information and database such as a GIS and GUI/GIS interfaces; methodologies and tools for analyzing flood-related issues and problems; and computer models which are conceptual and mathematical representations and codes, physical analogues, or combinations of these to represent the natural and managed systems.

(prepared by Guillermo Tabios III)

Washing in an *estero*



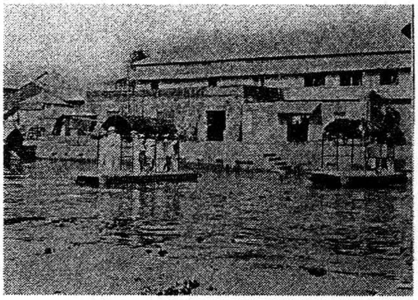
Government boats

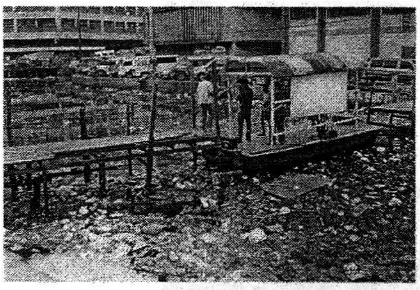


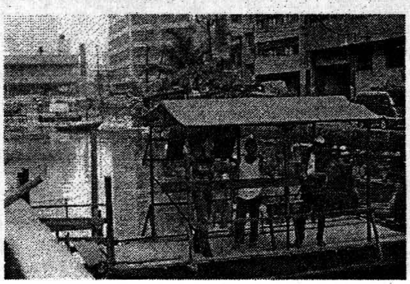
A coconut raft from Laguna in one of the *esteros* of Manila

Source: Reports of the Philippine Commission for the years 1900-1906

NOTES ON THE AUTHORS





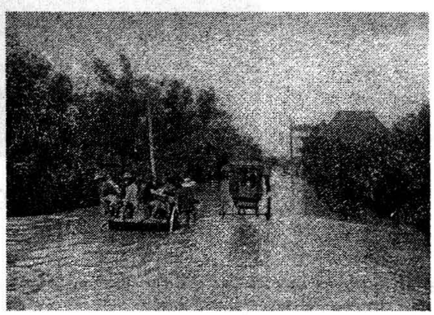


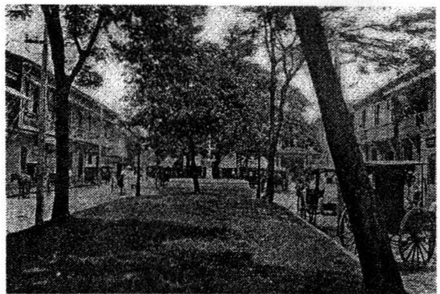
PETER P. M. CASTRO, M ENG'G
Associate Professor
Department of Civil Engineering
Research Fellow, National Hydraulic
Research Center, UP Diliman

NONITO F. FANO
Project Director
Project Management Office
Department of Public Works
and Highways

SIMEON A. ILAGO
Assistant Professor
College of Public Administration,
UP Diliman

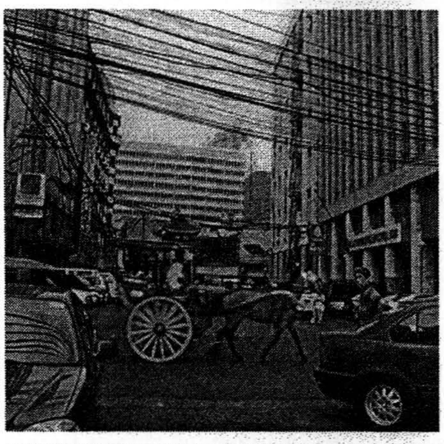
LEONARDO Q. LIONGSON, Ph.D.
Professor, Department of
Civil Engineering, UP Diliman
Director, National Hydraulic
Research Center, UP Diliman





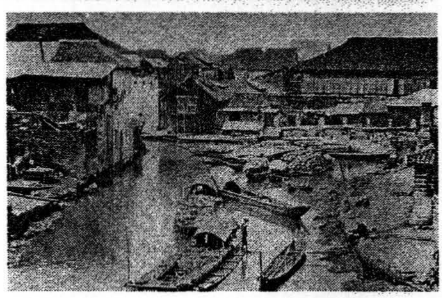
DORACIE B. ZOLETA-NANTES, Ph.D.
Associate Professor
Department of Geography
College of Social Sciences and
Philosophy, UP Diliman

JOY B. PAGE
Instructor, Department of Sociology
College of Social Sciences and
Philosophy, UP Diliman



ALAN L. PINEDA, Ph.D.
Assistant Weather Services Chief
Philippine Atmospheric,
Geophysical and Astronomical Services
Administration

GUILLERMO Q. TABIOS III, Ph.D.
Associate Professor, Department of
Civil Engineering
Research Fellow, National Hydraulic
Research Center, UP Diliman



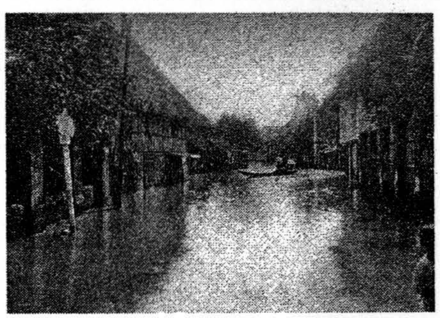


Photo credits:
Reports of the Philippine Commission
for the years 1900-1906, and Ariel Manuel.

It is hoped that this publication will benefit academics, researchers, planners, scientists, engineers, policy and program advocates, decision makers, and the general reader. As many will agree, flooding is one phenomenon which has been progressively dominated by human influence. The human factors are population growth (settlements in flood-prone area), urbanization factors (loss of permeable open space, encroachment

Pressures of Urbanization: Flood Control and Drainage in Metro Manila

of natural waterways, increase of impervious surfaces), and the effects of infrastructure (design criteria and know-how of the technical people, and the realized effects of the constructed structure on the flooding process itself). This about makes everybody a flood-causing agent as well as a potential flood-mitigating person.

[From the Preface]

University of the Philippines
Center for Integrative and Development Studies

ISBN 971-742-040-8